



(51) International Patent Classification:

A61B 5/00 (2006.01)	A41D 1/00 (2006.01)
A61B 5/04 (2006.01)	H01B 7/04 (2006.01)
A61B 5/0476 (2006.01)	H01B 7/40 (2006.01)
A61B 5/0402 (2006.01)	D02G 3/32 (2006.01)
A61B 5/0408 (2006.01)	D02G 3/36 (2006.01)

(74) Agent: KATZ, Itzhak; 7 Haim Gilad Street, 4937754 Petach Tikva (IL).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(21) International Application Number:

PCT/IL2015/050239

(22) International Filing Date:

5 March 2015 (05.03.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/950,139	9 March 2014 (09.03.2014)	US
62/006,102	31 May 2014 (31.05.2014)	US

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(71) Applicant: HEALTHWATCH LTD. [IL/IL]; 34 Hazeitim Street, 4630734 Herzliya (IL).

(72) Inventors: SHOSHANI, Boaz; 53 Rambam Street, 4360138 Raanana (IL). AMIR, Uri; 6 Almog Street, 60405 Or Yehuda (IL).

[Continued on next page]

(54) Title: ELASTIC CONDUCTIVE STRIPE AND METHODS OF UTILIZING THEREOF

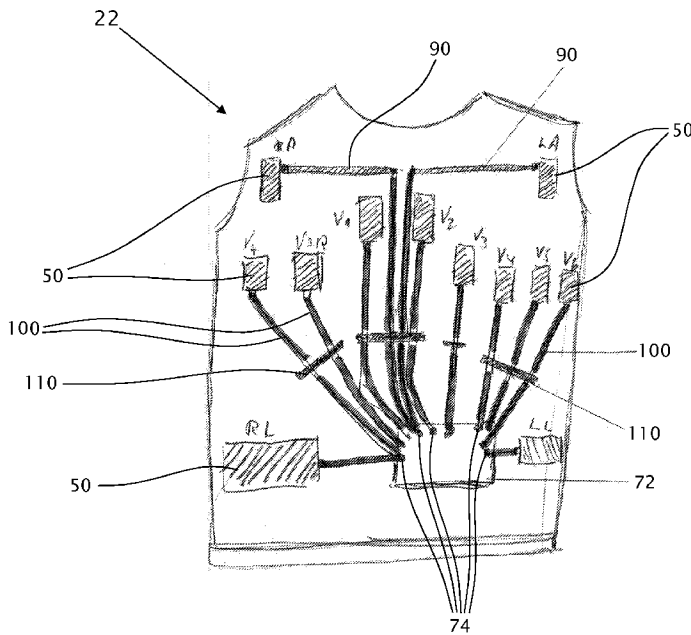


Fig. 4

(57) Abstract: According to the teachings of the present invention there is provided a knitted smart garment. The garment includes a tubular form having variable elasticity and at least one conductive textile electrode for sensing an electrical vital signal, such as a clinical-level ECG signal. The garment further includes at least one elastic and loose conductive stripe, having a first end and a second end. The first end of the at least one conductive stripe is securely attached to a respective conductive textile electrode, and the second end of the at least one conductive stripe is operatively connected with a processor. The elasticity and looseness of the at least one conductive stripe is configured to prevent a pulling force from being applied to the respective conductive textile electrode, when the garment is stretched.

WO 2015/136521 A1

**Declarations under Rule 4.17:**

— of inventorship (Rule 4.17(iv))

**Published:**

— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

## ELASTIC CONDUCTIVE STRIPE AND METHODS OF UTILIZING THEREOF

## CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under 35 USC 119(e) from US provisional  
5 application 61/950,139 filed March 9<sup>th</sup>, 2014, and the benefit under 35 USC 119(e) from  
US provisional application 62/006,102 filed May 31<sup>st</sup>, 2014, the disclosure of which are  
included herein by reference.

This application also relates to the PCT/ IL2013/050963 ('963), the disclosure of  
which is included herein by reference in its entirety.

10

## FIELD OF THE INVENTION

The present invention relates to real-time health monitoring systems and more  
particularly, the present invention relates to a knitted garment having a tubular form at  
preconfigured locations, transferring ECG or other signals from textile electrodes to a  
15 selected area of the garment.

## BACKGROUND OF THE INVENTION AND PRIOR ART

Monitoring systems for monitoring of physiological parameters of a living being  
are well known in prior art. For example, PCT/IL2012/000248, the disclosure of which is  
20 included herein by reference in its entirety, discloses a wearable health monitoring  
system that continuously checks the wellbeing of a person that, typically, is considered  
healthy, covering a significant range of health hazards that may cause a significant life  
style change/limitation, and provides an alert as early as possible – all this, with no  
significant limitation to the normal life style of the person bearing the system.

25 Unlike conventional gel electrodes, which are directly applied to the living being's  
skin, using a conductive gel, textile electrodes are dry contact sensors adapted for use in  
measuring ECG signals and other vital signals such (EEG), electroencephalogram  
(EOG), electrooculogram and other medical measurements on the skin without any skin  
preparation, such as needed with wet electrodes, for example, shaving hairy skin.

30 To improve performance over conventional wet ECG sensors and to be able to  
conduct continuous long term monitoring, a textile substrate is used to develop dry textile  
electrodes for sensing physiological parameters of a living being such as ECG signals.

One such textile electrodes are disclosed in PCT application PCT/IL2013/050964, filed Nov 23<sup>rd</sup>, 2013, titled "*float loop textile electrodes and methods of knitting thereof*", the disclosures of which is included herein by reference for all purposes as if fully set forth herein.

5           There is however a need to transfer the sensed electrical signals from the textile electrodes to a processing unit for collecting and processing the sensed data.

Reference is made to Fig. 1 (prior art) depicting an open smart garment **20**, having multiple textile electrodes **50** integrally knitted therein. Smart garment **20** is configured to receive a processing unit **70**. Fig. 1 demonstrates the need to electrically  
10 connect each of the textile electrodes **50** to processing unit **70**.

One solution is to integrally knit conductive traces form each of the textile electrodes **50** to a docking station configured to receive processing unit **70**. This solution is disclosed in PCT application PCT/IL2013/050963, titled "*vertical conductive textile traces and methods of knitting thereof*", filed Nov 23<sup>rd</sup>, 2013, the disclosures of which is  
15 included herein by reference for all purposes as if fully set forth herein.

Fig. 2a (prior art) schematically illustrates an exemplary garment **20**, having a tubular form, wherein textile electrodes **50** are knitted therein and are individually operatively connected to a processing unit **70**. Fig.2b (prior art) depicts a front view of an exemplary garment, wherein the textile electrodes **50** are designed to measure a 15-lead  
20 ECG signal, and are connected to a processing unit (not shown) by respective conductive traces **60**.

The conductive traces **60** are knitted therein as part of the fabrication of the garment, wherein the conductivity, in particular between adjacent knitting courses in the vertical direction, can support the transfer of clinical level ECG signals from a textile  
25 electrode, along the fabric, to a selected area in the garment preconfigured to host the processing unit. Since the normal knitting direction of a tubular form is substantially horizontal, conductive traces **90** that are knitted therein in a horizontal direction maintain a stable conductivity.

The good conductivity should prevail when the fabric is stretched to different  
30 directions during wearing, which typically requires that the conductive physical means for transferring the sensed electrical signals from textile electrodes **50** to processing unit **70**. This may entail that the conductive physical means is made of materials having high elasticity. This may entail that good conductive should prevail when the fabric is stretching, in particular between adjacent knitting courses in the vertical direction.

The good conductivity of the conductive physical means should prevail when using any type of basic fabric yarns (cotton, manmade yarns, synthetic yarns, metallic yarns, etc.).

5 The good conductivity should prevail after a preconfigured number of washes, including in a washing machine.

The good conductivity should prevail in any knitting design, location and shape in the fabric.

10 More so, signals detecting is the motion artifact occurring during movement of the person **10**, wearing garment **20**. The motion artifact problem may increase as a result of the large area of the textile electrodes **50** and/or the conductive traces **60**, moving with respect to the skin of user **10**. It should be noted that the larger the area of the textile electrodes **50** and/or the conductive traces **60** is, the higher the capacitance between the skin and textile electrode **50** and conductive traces **60** is.

15 There is therefore a need and it would be advantageous to provide conductive physical means for transferring the sensed electrical signals from textile electrodes to a target receiving unit that provides high conductivity and low sensitivity to motion artifacts.

## DEFINITIONS

20 The term “seamless monitoring”, as used herein with conjunction with wearable monitoring devices, refers to a device that when worn by an average person, wherein the device puts no significant limitation to the normal life style of that person and preferably not seen by anybody when used and not disturbingly felt by the user while wearing it. Furthermore, no activity is required from the monitored person in order for the system to  
25 provide a personal-alert when needed. It should be noted that people that pursue non-common life style, such as soldiers in combat zone or in combat training zone, or firefighters in training and action, or athletes in training or competition may utilize non-seamless monitoring devices. As the "seamless monitoring" characteristics refers also to the user's behavior, the wearable component is preferably an item that is normally worn  
30 (e.g., underwear) and not some additional item to be worn just for getting the alert. It should be noted that the term “seamless monitoring” differ from the notion of commonly known notion of a seamless clothing item that refers to tubular form clothing having no seams for forming the tubular form.

The terms "underwear" or "garment", as used herein with conjunction with wearable clothing items, refers to wearable clothing items with seamless monitoring capabilities that preferably, can be tightly worn adjacently to the body of a monitored living being, typically adjacently to the skin, including undershirts, sport shirts, brassiere, 5 underpants, special hospital shirt, socks and the like. Typically, the terms "underwear" or "garment" refer to a clothing item that is worn adjacently to the external surface of the user's body, under external clothing or as the only clothing, in such way that the fact that there are sensors embedded therein, is not seen by any other person in regular daily behavior. An underwear item may also include a clothing item that is not underwear per se, but still is in direct and preferably tight contact with the skin, such as a T-shirt, 10 sleeveless or sleeved shirts, sport-bra, tights, dancing-wear, and pants. The sensors, in such a case, can be embedded in such a way that are still unseen by external people to comply with the "seamless monitoring" requirement.

The terms "course" and "line segment", are used herein as related terms. The 15 tubular form of the garment is knitted on a knitting machine, such as a Santoni knitting machine, where the tubular form is knitted in a spiral having substantially horizontal lines. A single spiral loop/circle is referred to herein as a course and a portion of a course is referred to as line segment.

The term "vertical conductive trace", is used herein, refers to knitting a lead wire, 20 made of conductive yarns, and capable of transferring electrical signals across knitted line segment.

The phrase "clinical level ECG", as used herein with conjunction with ECG measurements, refers to the professionally acceptable number of leads, sensitivity and specificity needed for a definite conclusion by most cardiology physicians to suspect a 25 risky cardiac problem (for example, arrhythmia, myocardial ischemia, heart failure) that require immediate further investigation or intervention. Currently, it is at least a 12-leads ECG and preferably 15-lead ECG, coupled with a motion/posture compensation element, and a real-time processor with adequate algorithms.

### 30 BRIEF SUMMARY OF THE INVENTION

A principle intention of the present invention is to provide conductive physical means for transferring the sensed electrical signals from textile electrodes to a target receiving unit. Typically, the conductive physical means is composed of elastic

conductive yarns, herein referred to as a "conductive stripe". The conductive stripe is made of yarns selected from a group of yarns including manmade yarns, synthetic yarns and metallic yarns. The conductive stripe provides high conductivity, elasticity and low sensitivity to motion artifacts.

5 Another principle intention of the present invention is to connect textile electrodes to a signal receiving unit by a flexible and loose conductive stripe, such that the conductive stripe does not apply pulling forces or applies minimal pulling forces on the textile electrode securely connected thereto. Thereby, during motion, the textile electrode remains stably in position with respect to the skin of the user, while the signals,  
10 such as ECG signals, transfer to a receiving unit such as a docking station.

It should be noted that the signals can be any sensed electric signals (e.g. respiration) and it is not restricted to ECG signals. It should also be noted that any non-horizontal angle can be knitted using this invention by a continuous sequence of vertical lines.

15 It should be further noted that with respect to the embodiments provided by PCT application PCT/IL2013/050963, the embodiments of the present invention show significant reduction of motion artifact when the user is in motion, due to the fact that the new conductive elastic stripes are attached to the basic garment only in a few points such as to prevent the pulling the respective electrodes, which pulling may create unnecessary  
20 friction of the textile electrode with the skin. Furthermore, the present invention provides embodiment that substantially reduce the quantity and cost of materials and labor.

According to the teachings of the present invention there is provided a knitted smart garment. The garment includes a tubular form having a preconfigured elasticity, typically varied elasticity, and at least one conductive textile electrode for sensing an  
25 electrical vital signal, such as a clinical-level ECG signal. The garment further includes at least one elastic conductive stripe, having a first end and a second end.

The first end of the at least one conductive stripe is securely and conductively attached to a respective conductive textile electrode, and the second end of the at least one conductive stripe is operatively connected with a processor.

30 The elasticity of the at least one conductive stripe is configured to prevent a pulling force from being applied to the respective conductive textile electrode, when the garment is stretched.

The at least one conductive stripe is insulated by insulation means, wherein the insulation means are selected from the group including at least one insulating adhered stripe (110), sleeves (170), non-conductive coating and non-conductive textile material that is knitted, weaved, braided or covered on the respective at least one conductive stripe.

The insulation means are designed not reduce the conductivity of the respective the at least one conductive stripe. The insulation means are further designed not reduce the elasticity of the respective the at least one conductive stripe.

Typically, the at least one conductive stripe is at least partially loose inside the respective insulation means.

The at least one conductive stripe is made of yarns selected form a group of yarns including manmade yarns, synthetic yarns and metallic yarns, or a combination thereof.

The second end of the at least one conductive stripe may be securely attached to a connector, such as, with no limitations, a HDMI connector. Alternatively, the second end of the second end of the at least one conductive stripe is securely attached to a docking station.

The garment may include a zipper, wherein said zipper is situated between the at least one textile electrode and a docking station, wherein the at least one conductive stripe passes through the continuous section of the garment, without crossing the zipper, and wherein the second end of said respective at least one conductive stripe or knitted line-trace is securely attached to the docking station.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become fully understood from the detailed description given herein below and the accompanying drawings, which are given by way of illustration and example only and thus not limitative of the present invention, and wherein:

Fig. 1 (prior art) depicts an open smart garment, having multiple textile electrodes integrally knitted therein, wherein the smart garment is configured to receive a processing unit.

Fig. 2a (prior art) is a schematic illustration of an exemplary garment, having a tubular form, wherein textile electrodes are knitted therein.

Fig. 2b (prior art) depicts a front view of an exemplary garment, wherein the textile electrodes are designed to measure a 15-lead ECG signal.

Fig. 3a depicts segments of a number of conductive stripes, according to embodiments of the present invention, wherein the conductive stripes are covered by an insulating tube, showing an open end of the conductive stripes.

Fig. 3b depicts segments of a number of conductive stripes, as in Fig. 3a, showing the other end of the conductive stripes, which, in the shown example, are connected to an HDMI connector.

Fig. 4 illustrates an example smart garment, having multiple textile electrodes integrally knitted therein, wherein the conductive stripes are configured to transfer the sensed electrical signals from the textile electrodes to a processing unit configured to collect the sensed data, according to some embodiments of the present invention.

Fig. 5 illustrates an example method of securely connecting a conductive stripe to a respective textile electrode, according to some embodiments of the present invention.

Figs. 6a and 6b illustrate example smart garments, having multiple textile electrodes connected to conductive stripes, wherein insulating sleeves are used to insulate the conductive stripes from being electrically shortened by an adjacent conductive stripe and/or the user's skin, according to some embodiments of the present invention.

Figs. 6c and 6d depict another example garment, according to the methods shown in Figs. 6a and 6b. Fig. 6c, illustrating the internal side of garment the garment, having multiple textile electrodes connected to respective conductive stripes.

Fig. 7 illustrates an example smart garment, having multiple textile electrodes connected to conductive stripes, wherein a lining is used to insulate the conductive stripes from being electrically shortened by the user's skin, according to some embodiments of the present invention.

Fig. 8 is a schematic illustration of an exemplary garment having a tubular form and being an undershirt having a zipper in the front side, wherein textile electrodes are knitted therein.

Fig. 9 is a schematic illustration the exemplary garment shown in Fig. 8, wherein the zipper is unzipped and the garment in a spread, unfolded form.

## DETAILED DESCRIPTION OF THE INVENTION

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should  
5 not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided, so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

An embodiment is an example or implementation of the inventions. The various appearances of "one embodiment," "an embodiment" or "some embodiments" do not  
10 necessarily all refer to the same embodiments. Although various features of the invention may be described in the context of a single embodiment, the features may also be provided separately or in any suitable combination. Conversely, although the invention may be described herein in the context of separate embodiments for clarity, the invention may also be implemented in a single embodiment.

Reference in the specification to "one embodiment", "an embodiment", "some  
15 embodiments", "another embodiment" or "other embodiments" means that a particular feature, structure, or characteristic described in connection with the embodiments is included in at least one embodiments, but not necessarily all embodiments, of the inventions. It is understood that the phraseology and terminology employed herein is not  
20 to be construed as limiting and are for descriptive purpose only.

Methods of the present invention may be implemented by performing or  
completing manually, automatically, or a combination thereof, selected steps or tasks. The term "method" refers to manners, means, techniques and procedures for  
accomplishing a given task including, but not limited to, those manners, means,  
25 techniques and procedures either known to, or readily developed from known manners, means, techniques and procedures by practitioners of the art to which the invention belongs. The descriptions, examples, methods and materials presented in the claims and the specification are not to be construed as limiting but rather as illustrative only.

It should be noted that orientation related descriptions such as "bottom", "up",  
30 "horizontal", "vertical", "lower", "top" and the like, assumes that the is worn by a person being in a standing position.

Meanings of technical and scientific terms used herein are to be commonly understood as to which the invention belongs, unless otherwise defined. The present

invention can be implemented in the testing or practice with methods and materials equivalent or similar to those described herein.

A principle intention of the present invention is to connect textile electrodes to a signal receiving unit by an elastic and loose conductive stripe, such that the conductive stripe does not apply pulling forces or applies minimal pulling forces on the textile electrode securely connected thereto. Thereby, during motion, the textile electrode remains stably in position with respect to the skin of the user, while the signals, such as ECG signals, transfer to a receiving unit such as a docking station.

Fig. 3a depicts segments of a number of conductive stripes **100** that are covered by an insulating tube **102**, showing an open end of conductive stripes **100**. Fig. 3b depicts segments of a number of conductive stripes **100**, showing the other end of conductive stripes **100**, which in the shown example, with no limitation, are connected to an HDMI connector **80**. Insulating tube **102** is elastic and does not limit the elasticity of conductive stripe **100**.

Conductive stripes **100** can be made by knitting, weaving, braiding, or any other textile method which can combine both conductivity and elasticity. The good conductivity of conductive stripes **100** should prevail when using any type of basic fabric yarns to make the smart garment (such as manmade yarns, synthetic yarns, metallic yarns, etc.).

Conductive stripes **100** must be insulated to prevent electrical shorting among the stripes, while wearing and moving and to prevent conductive stripes **100** from being electrically shortened by the user's skin, by neighboring conductive stripes **100** or neighboring textile electrode **50**.

The insulation can be done by knitting, weaving, braiding, and covering, using any non-conductive textile material, natural or synthetic yarns.

The insulation should not reduce the conductivity and the elasticity properties of conductive stripes **100**.

Conductive stripes **100** are positioned in a preconfigured configuration along the shirt to facilitate the stripes to stretch while wearing.

In one embodiment of the present invention, the insulation of conductive stripes **100** is done after the braiding process, using Spandex yarn covered with Nylon yarn.

In one embodiment of the present invention, conductive stripes **100** are made of braided conductive yarns (for example, with no limitations, conductive yarns that are

manufactured by XSTATIC) together with spandex yarns, in order to reach the right level of elasticity. However, conductive stripes **100** may be made using any other conductive materials such as stainless steel yarns, cooper yarns and any other combination of conductive yarns), provided that the of conductive stripes **100** is similar  
5 to the local elasticity of the smart garment.

The basic yarns to knit the smart garment and the type of Spandex yarn used should be in line with the machine gauge and type of fabric requested.

The quantity of conductive yarn ends (threads), elastic yarn ends, and the thickness (Den or Dtex) of the yarns in the braided stripe are determined by the level of  
10 conductivity and elasticity required for a particular smart garment.

Reference is made to the drawings. Fig. 4 illustrates an example smart garment **22**, having multiple textile electrodes **50** integrally knitted therein, wherein conductive stripes **100** are securely connected to respective textile electrodes **50**, according to some embodiments of the present invention, facilitating the transfer of the sensed electrical  
15 signals from textile electrodes **50** to a target receiving unit such as a processing unit or a docking station **72**. Fig. 5 illustrates an example method of securely connecting a conductive stripe **100** to a respective textile electrode **50**, according to some embodiments of the present invention.

Smart garment **22**, as shown by way of example only, with no limitations, as a  
20 knitted ECG shirt having 13 knitted electrodes (to all shown) at preconfigured locations on the shirt. Each of the knitted electrodes detects an ECG signal that is transferred to the receiving unit.

Each elastic conductive stripe **100** of smart garment **22** is attached to smart garment **22** at least three at points: securely attached to textile electrode **50**, securely  
25 attached or passed through individual loops formed by a respective insulating adhered stripe **110**, generally at middle area of smart garment **22**, and securely connected to the receiving unit the a respective location, being, in the example shown in fig. 2, a respective snap **74** of docking station **72**.

Elastic conductive stripes **100** are attached to smart garment **22** leaving enough  
30 free length hanging loosely between points to allow the garment fabric to stretch during wear without pulling the respective textile electrode **50**.

The mechanical attachment of elastic conductive stripe **100** to textile electrode **50** must ensure the smooth and efficient transfer of the clinical level ECG signal from the textile electrode **50** to the respective conductive stripe **100**. For example, as shown in Fig.

5, conductive stripe **100** is sawn (**140**) to the respective textile electrode **50** at lingula **150**. Conductive stripe **100** may also be attached to the respective textile electrode **50** by lamination (adhesion) or by heat press. The attachment means does not reduce the conductivity of either the textile electrode **50** or the respective conductive stripe **100**.

5 It should be noted that conductive stripes **100** may be attached to the shirt at the inner or the outer sides of smart garment **22**.

In some other embodiments of the present invention, each individual insulated conductive stripe **100** is inserted into a respective elastic sleeve which is securely attached to the fabric of the smart garment, for example by lamination. Reference is made to Figs. 6a and 6b, depicting example methods of securely connecting a conductive stripe **100** to a respective textile electrode **50**, according to other embodiments shown in Fig. 5. Fig. 6b, illustrates an example smart garments **26** and **27** (which garment **27** includes a zipper), having multiple textile electrodes **50** connected to conductive stripes **100**, wherein insulating sleeves **170** are used to insulate conductive stripes **100** from being electrically shortened by an adjacent conductive stripe and/or the user's skin.

All conductive stripes **100** are inserted into respective sleeves **170**, wherein one end of the elastic conductive stripe **100** is securely connected, for example by sewing, to a textile electrodes **50** and the other end of conductive stripe **100** is securely connected to a receiving unit, such as a docking station **72**.

20 The usage of a laminated sleeve **170** for each of the conductive stripes **100**, eliminates the usage of lining **160** to cover all conductive stripes **100**, and keeps each conductive stripe **100** in a preconfigured path along the fabric of the smart garment (**26** and **27**).

Figs. 6c and 6d depict another example garment **28**, according to the methods shown in Figs. 6a and 6b. Fig. 6c, illustrates the internal side (i.e., the skin side) of garment **28** (which garment **28** is a ladies garment that includes a zipper), having multiple textile electrodes **50** connected to respective conductive stripes **100**, wherein insulating sleeves **170** are used to insulate conductive stripes **100** from being electrically shortened by an adjacent conductive stripe and/or the user's skin. Fig. 6d illustrates the external side of garment **28** showing the protrusions **100'** formed by the sawn-in (on the internal side of garment **28**) conductive stripes **100**.

Reference is now also made to Fig. 7, showing an example smart garment **24**, having multiple textile electrodes **50** connected to conductive stripes **100**, wherein a

lining **160** at the inner side of smart garment **24**, wherein lining **160** is used to insulate conductive stripes **100** from being electrically shortened by the user's skin, according to some embodiments of the present invention. Lining **160** facilitates each conductive stripe **100** to reach the right location **74** (see Fig. 4) at docking station **72**.

5 Reference is now made to Fig. 8, a schematic illustration of an exemplary garment **220** having a tubular form, the garment being an undershirt having a zipper **290** in the front side, wherein textile electrodes **50** are knitted therein and are individually operatively connected to processing unit **70**. However, some electrodes, such as textile electrodes **50R**, may require crossing zipper **290**. To overcome the problem conductive stripes **100** or line-traces (not shown) are knitted into or attached to smart garment **220** in a path that is traced around, via the back side of the garment, such as to bypass zipper **290**. Fig. 9 is a schematic illustration of an exemplary garment **220**, as shown in Fig. 8, wherein zipper **290** is unzipped and the garment is in a spread, unfolded form.

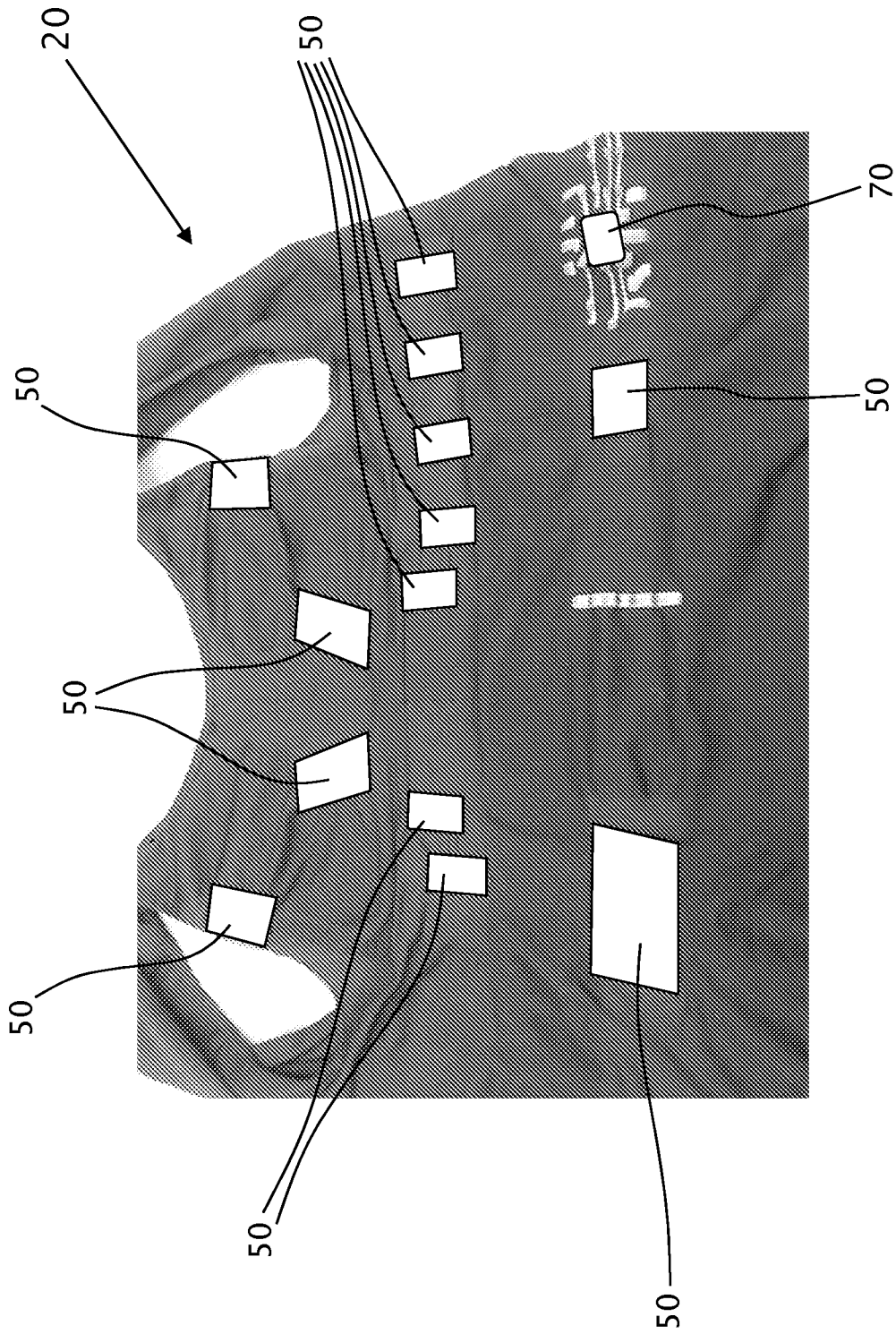
10 The bypassing technique is also valid to any location of a generally vertical zipper, whereas conductive stripes **100** or knitted line-traces (not shown) are knitted into or attached to smart garment **220** in a path that is set to continuously pass through the continuous section of the garment between the **290L** and **290R** parts of zipper **290**.

20 The invention being thus described in terms of embodiments and examples, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the claims.

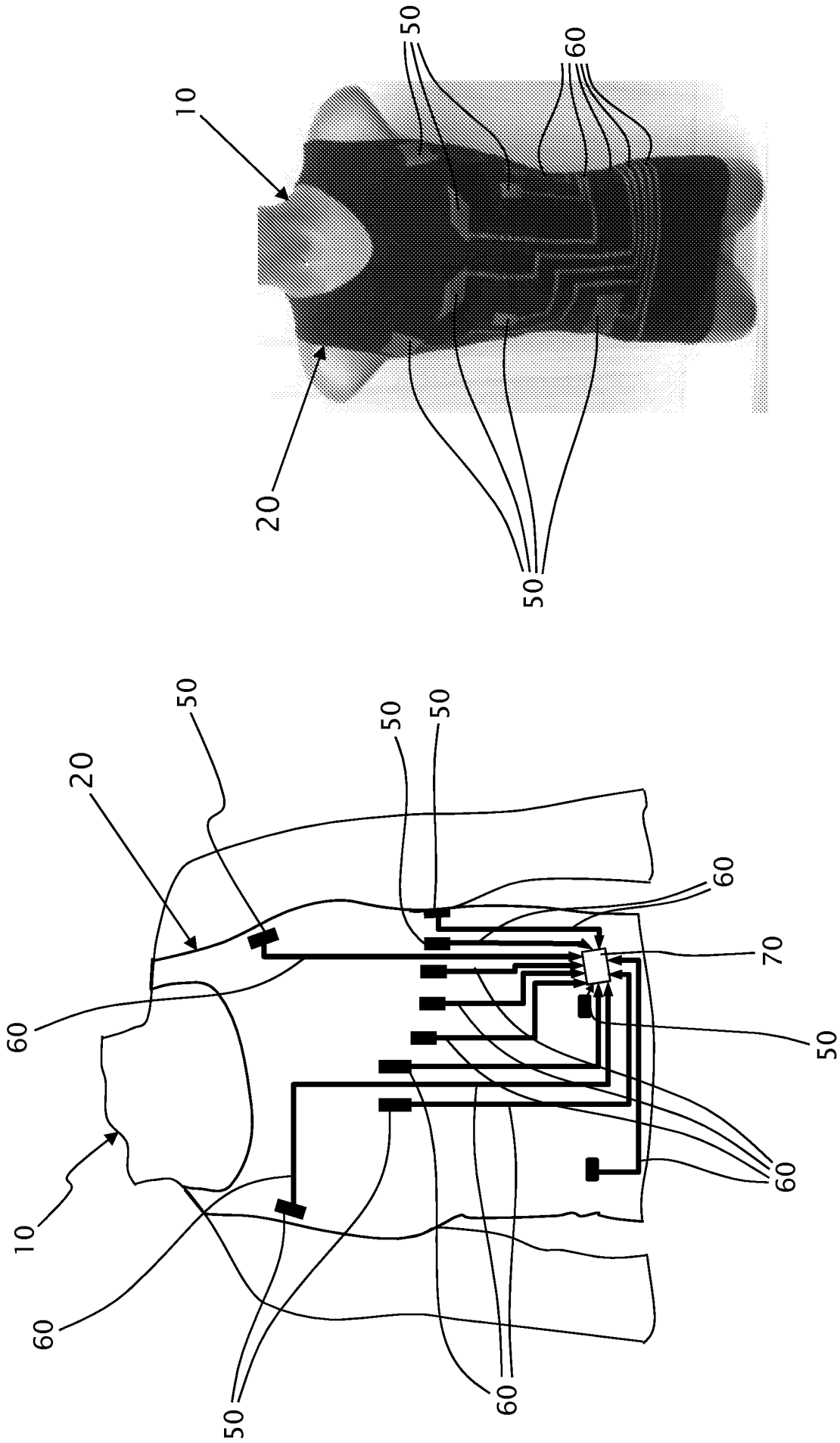
## WHAT IS CLAIMED IS:

1. A knitted smart garment, the garment comprising:
  - a) a tubular form having a preconfigured elasticity;
  - b) at least one conductive textile electrode for sensing an electrical vital signal; and
  - c) at least one elastic conductive stripe, having a first end and a second end,wherein said first end of said at least one conductive stripe is securely and conductively attached to a respective said at least one conductive textile electrode, and said second end of said at least one conductive stripe is operatively connected with a processor; and wherein said elasticity of said at least one conductive stripe is configured to prevent a pulling force from being applied to said respective at least one conductive textile electrode, when said garment is stretched.
2. The garment of claim 1, wherein said electrical vital signal is a clinical-level ECG signal.
3. The garment of claim 1, wherein said at least one conductive stripe is insulated by insulation means.
4. The garment of claim 1, wherein said at least one conductive stripe movements are restricted by motion restriction means, and wherein said motion restriction means are securely attached to said garment.
5. The garment of claim 4, wherein said motion restriction means are securely attached to the external side of said garment.
6. The garment of claim 1, wherein said insulation means are selected from the group including at least one insulating adhered stripe (110), sleeves (170), non-conductive coating and non-conductive textile material that is knitted, weaved, braided or covered on the respective at least one conductive stripe.
7. The garment of claim 1, wherein said insulation means are designed not reduce the conductivity of the respective said at least one conductive stripe.

8. The garment of claim 1, wherein said insulation means are designed not reduce the elasticity of the respective said at least one conductive stripe.
9. The garment of claim 1, wherein said at least one conductive stripe is at least partially loose inside said insulation means.
10. The garment of claim 1, wherein said at least one conductive stripe is made of yarns selected from a group of yarns including manmade yarns, synthetic yarns and metallic yarns, or a combination thereof.
11. The garment of claim 1, wherein said second end of said at least one conductive stripe is securely attached to a connector.
12. The garment of claim 1, wherein said second end of said at least one conductive stripe is securely attached to a docking station.
13. The garment of claim 1 further comprising a zipper, wherein said zipper is situated between said at least one textile electrode and a docking station, wherein said at least one conductive stripe passes through the continuous section of the garment, without crossing said zipper, and wherein said second end of said respective at least one conductive stripe or knitted line-trace is securely attached to said docking station.



**Fig. 1**  
PRIOR ART



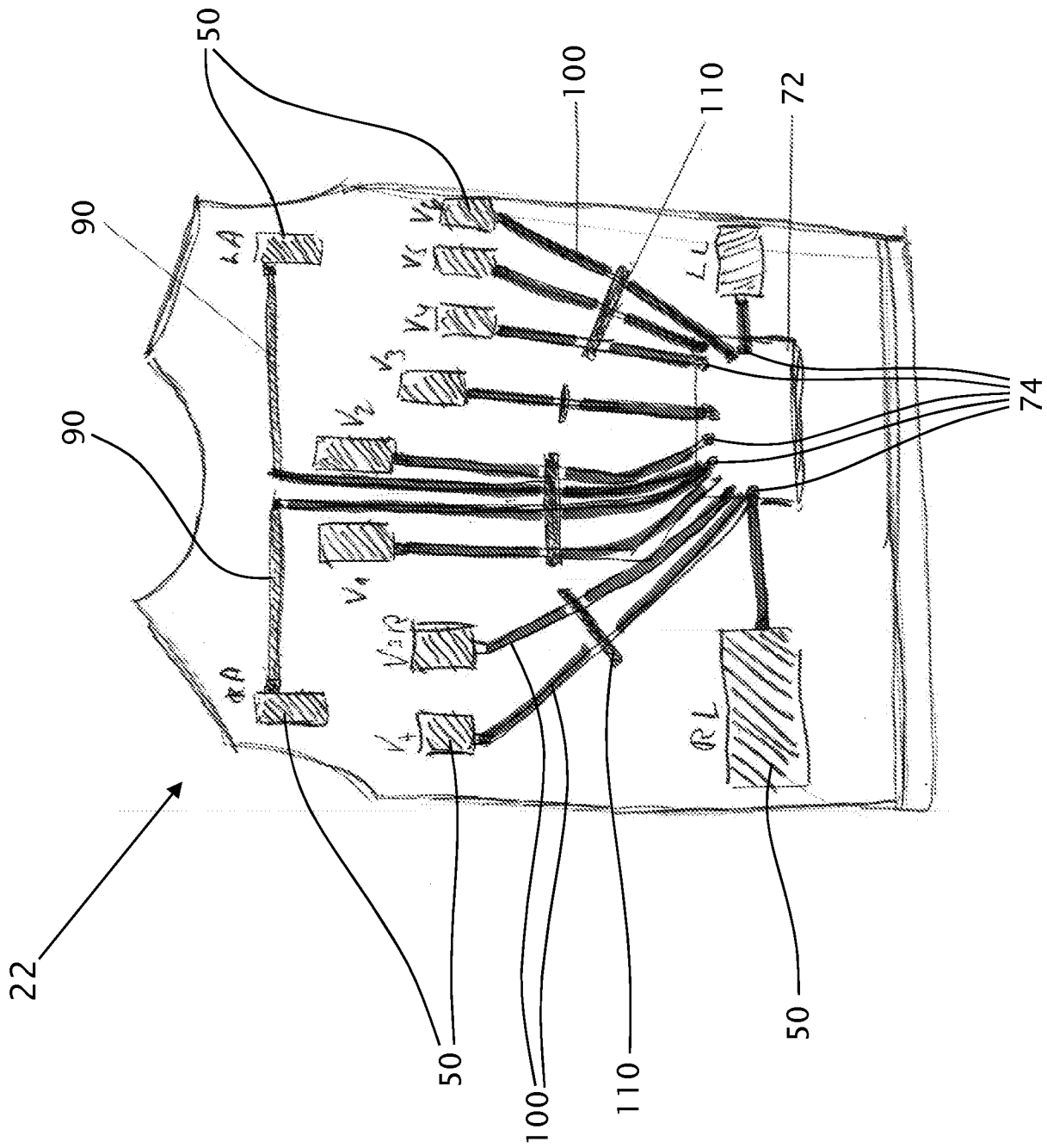


Fig. 4

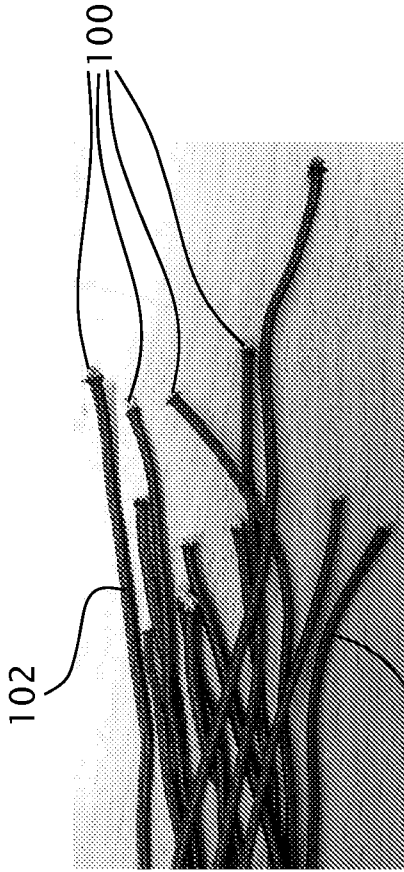


Fig. 3a

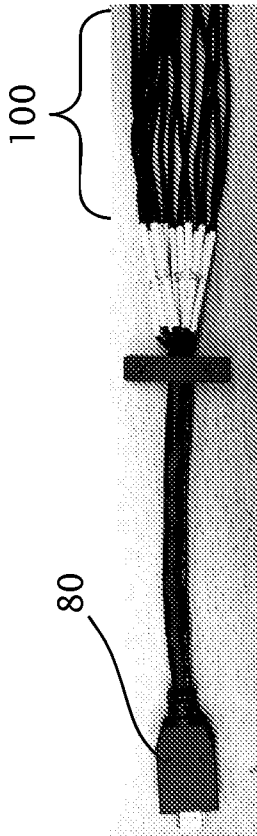


Fig. 3b

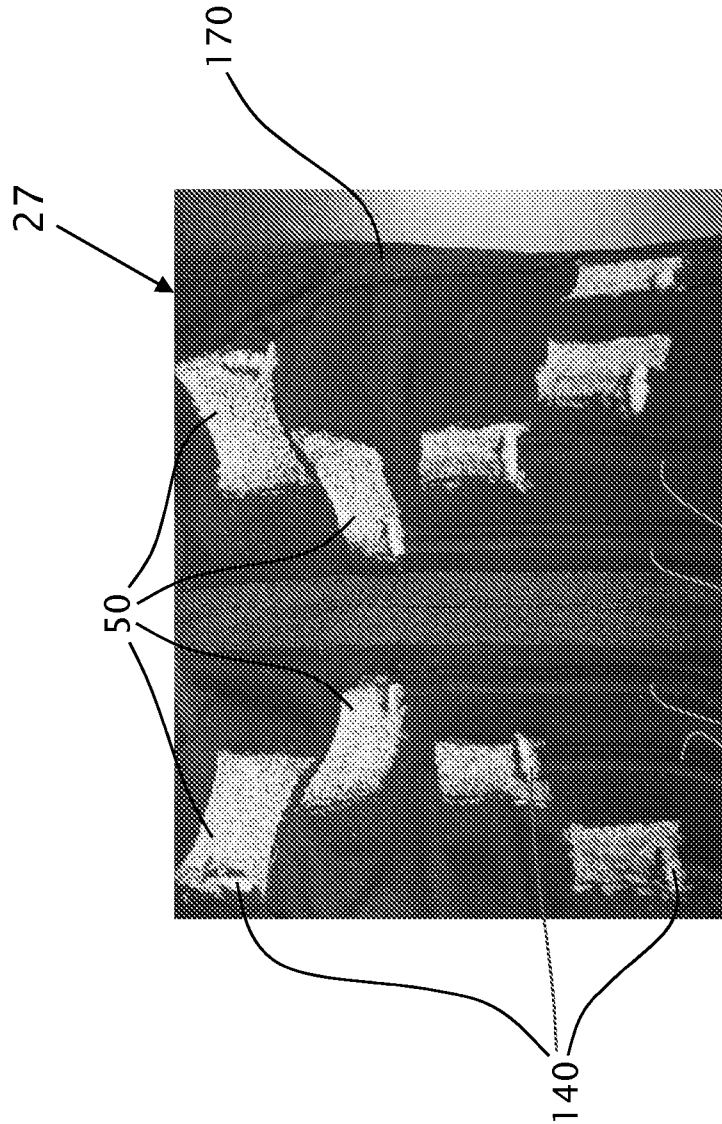


Fig. 6a

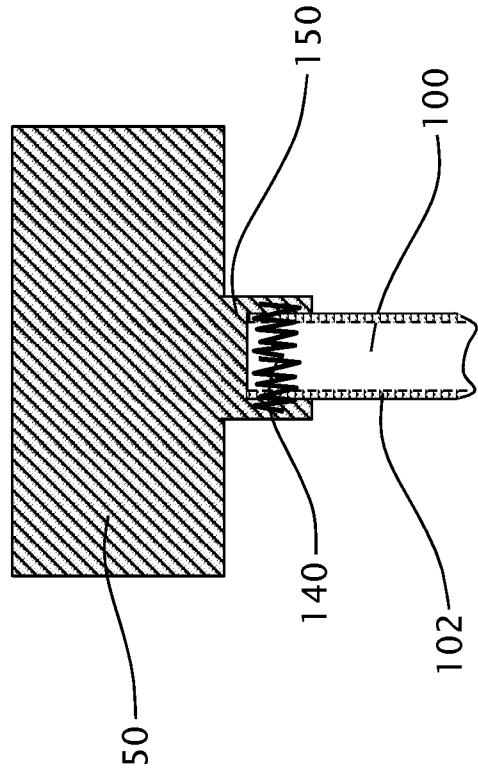


Fig. 5

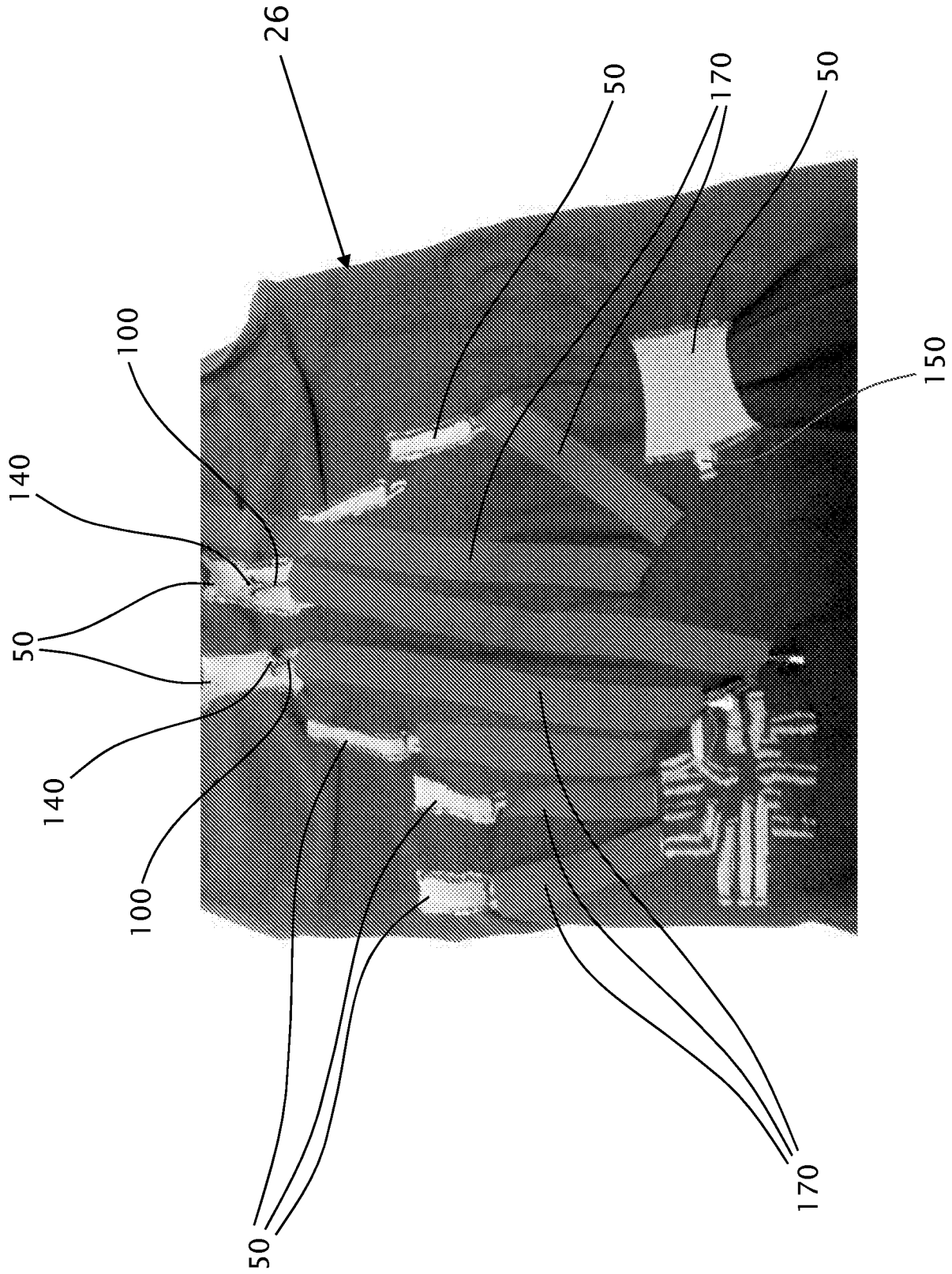


Fig. 6b

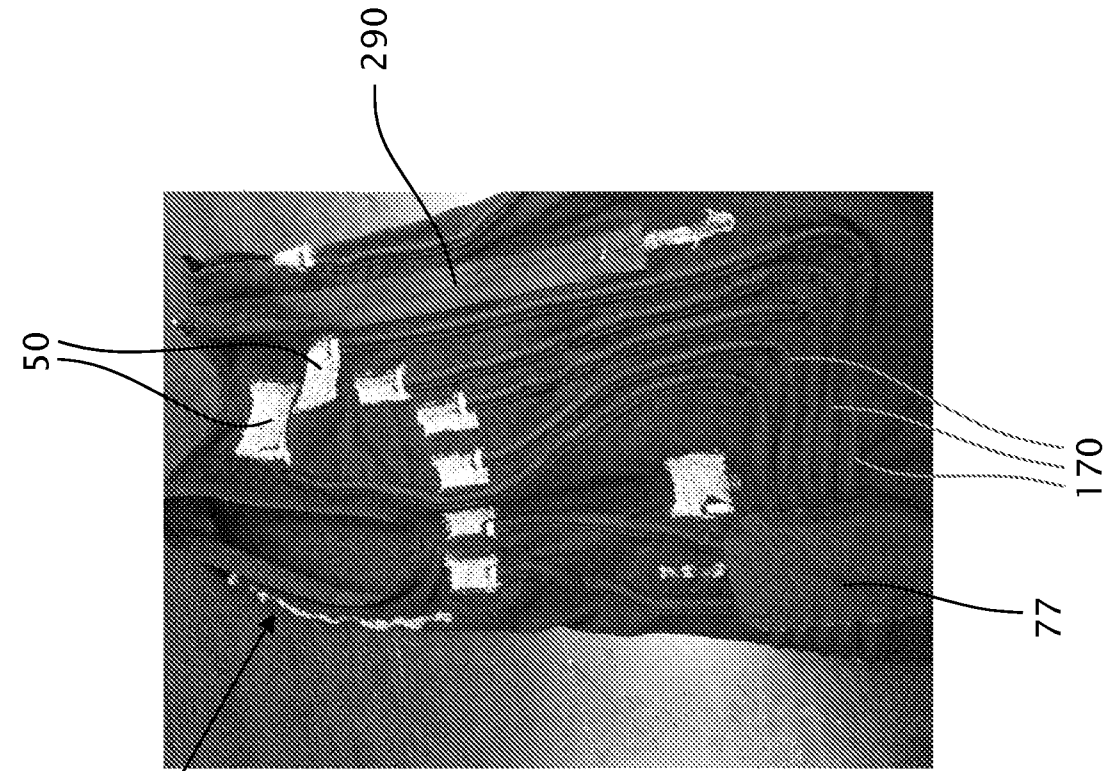


Fig. 6c

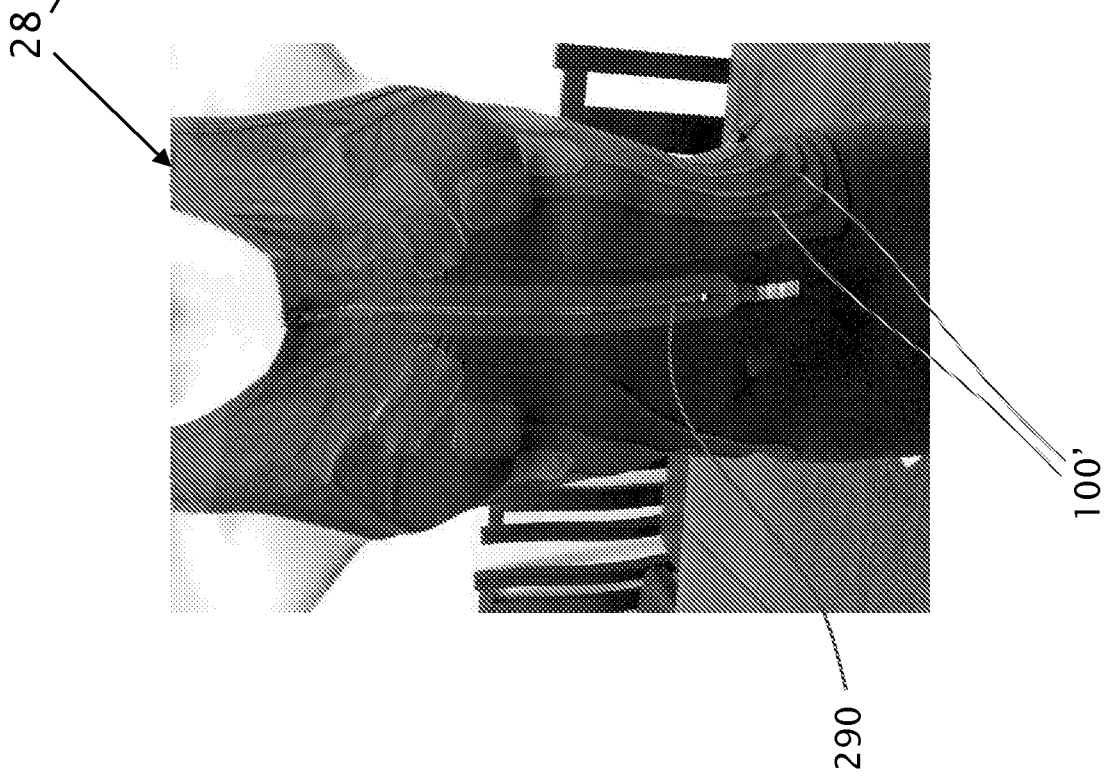


Fig. 6d

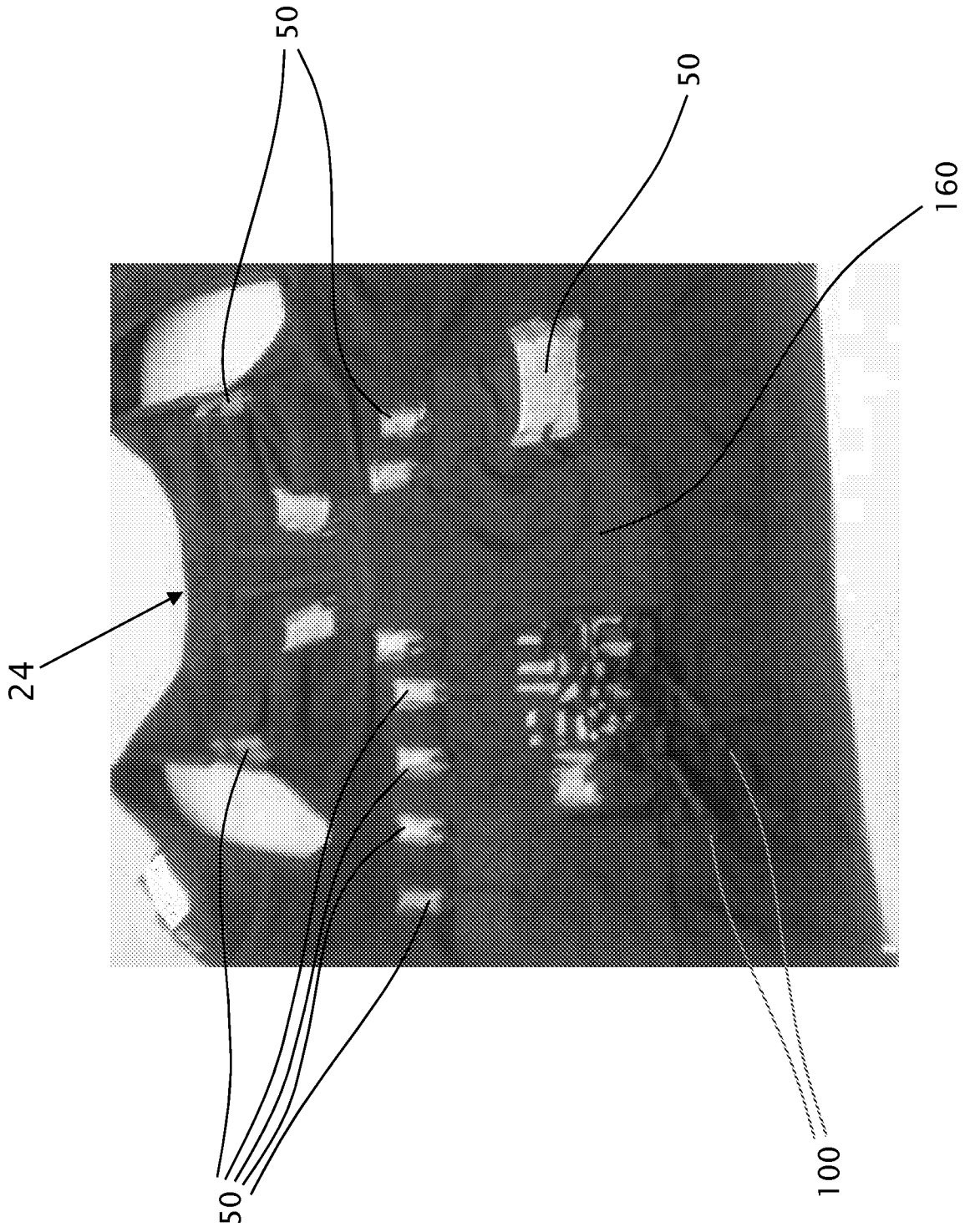


Fig. 7

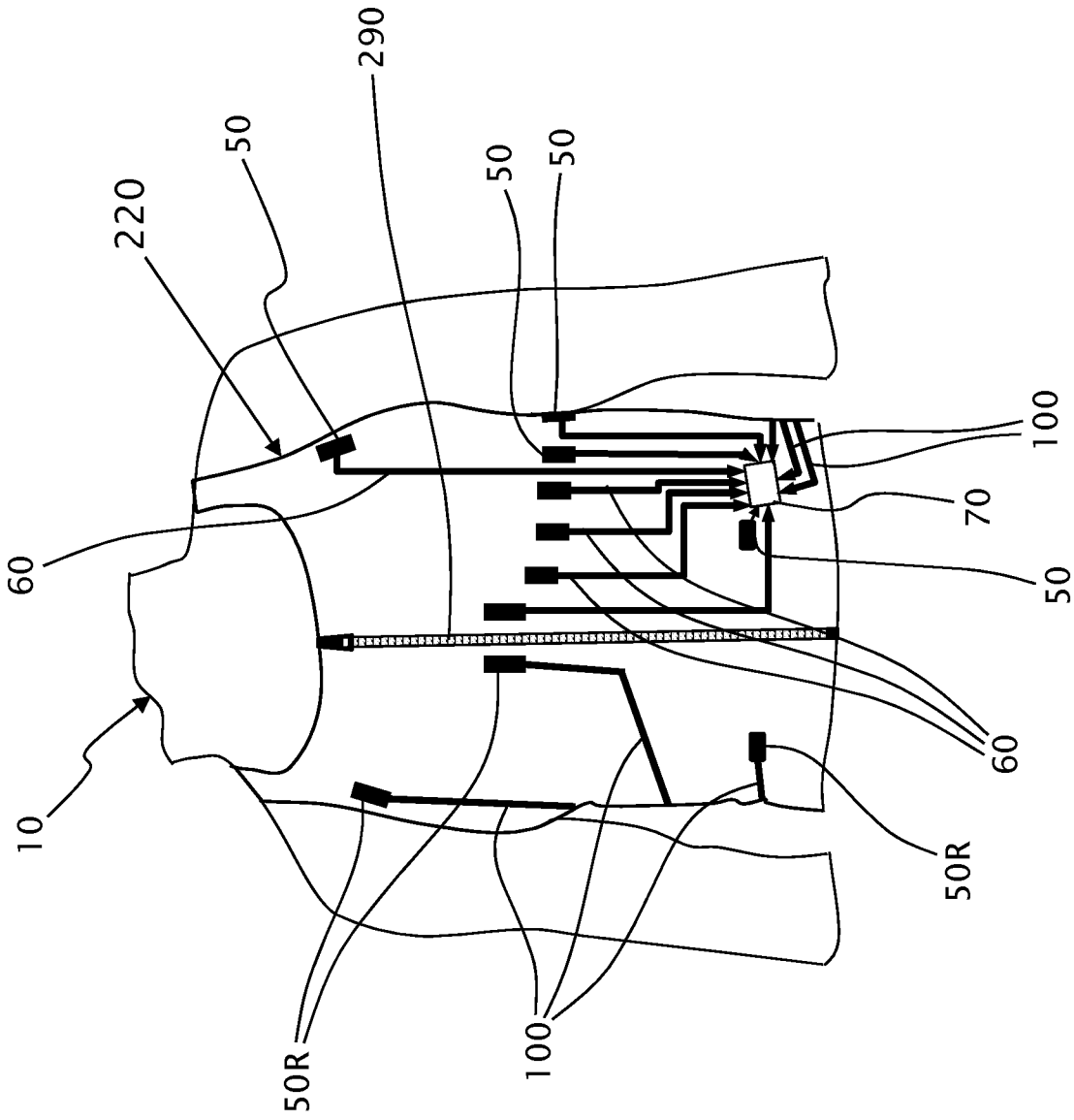


Fig. 8

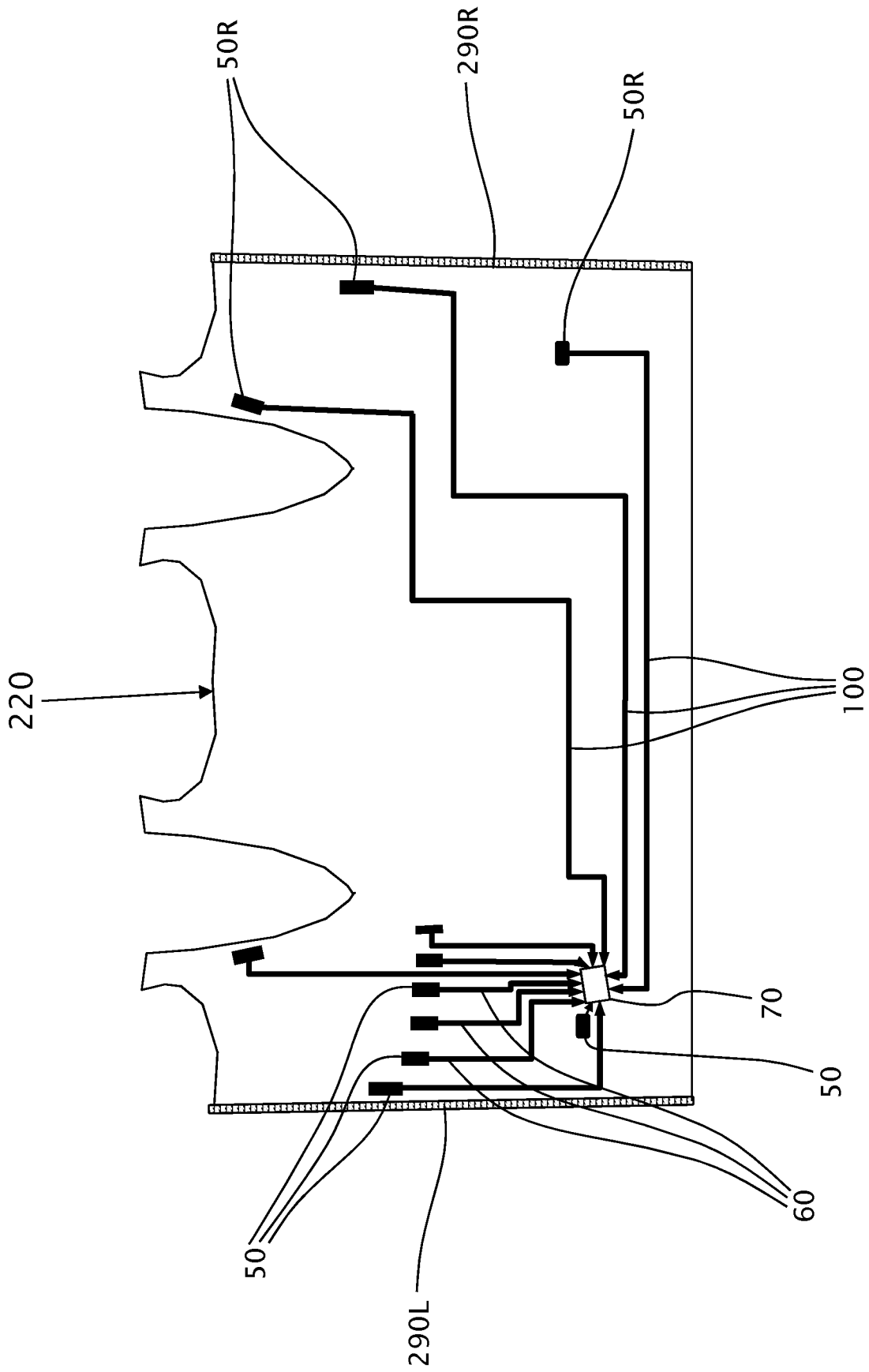


Fig. 9

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2015/050239

A. CLASSIFICATION OF SUBJECT MATTER See extra sheet.  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 (2015.01) A61B 5/00, A61B 5/04, A61B 5/0476, A61B 5/0402, A61B 5/0408, A41D 1/00, H01B 7/04, H01B 7/40, D02G 3/32, D02G 3/36		
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) Databases consulted: PATENTSCOPE, Esp@cenet, Google Patents, PatBase Search terms used: Garment and elastic* and textile and electrode and (insulat* OR coat* OR sleeve* OR sheath)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2012176193 A1 CARDIO HEALTHWATCH INNOVATIVE SOLUTIONS LTD 27 Dec 2012 (2012/12/27) Fig. 1, page 1 lines 18-27, page 7 line 32-page 8 line 3	1-13
Y	US 2012246795 A1 Adidas Ag 04 Oct 2012 (2012/10/04) paragraphs [0082],[0106],[0111],[0115]-[0117]	1,3-10,13
Y	US 7319895 B2 Tam-Telesante 15 Jan 2008 (2008/01/15) column 4 lines 48-51	11,12
A	WO 2008071843 A1 Corusfit Oy et al. 19 Jun 2008 (2008/06/19) All document	1-13
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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) "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 "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 "&" document member of the same patent family		
Date of the actual completion of the international search 24 Jun 2015		Date of mailing of the international search report 25 Jun 2015 <i>CV - 28 July 2015</i>
Name and mailing address of the ISA: Israel Patent Office Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel Facsimile No. 972-2-5651616		Authorized officer JOCHNOWITZ Gershon Telephone No. 972-5651775

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No. PCT/IL2015/050239
--

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
WO 2012176193 A1	27 Dec 2012	WO 2012176193 A1	27 Dec 2012
		AU 2012274931 A1	30 Jan 2014
		CA 2839954 A1	27 Dec 2012
		CN 103781404 A	07 May 2014
		EP 2720606 A1	23 Apr 2014
		EP 2720606 A4	15 Oct 2014
		JP 2014519944 A	21 Aug 2014
		KR 20140058502 A	14 May 2014
		US 2014206948 A1	24 Jul 2014
US 2012246795 A1	04 Oct 2012	US 2012246795 A1	04 Oct 2012
		US 8818478 B2	26 Aug 2014
		CN 102727182 A	17 Oct 2012
		EP 2505090 A2	03 Oct 2012
		EP 2505090 A3	12 Dec 2012
		JP 2012214968 A	08 Nov 2012
		US 2015067943 A1	12 Mar 2015
		US 7319895 B2	15 Jan 2008
US 7319895 B2	15 Jan 2008		
AT 430515 T	15 May 2009		
DE 602004020950 D1	18 Jun 2009		
EP 1506738 A1	16 Feb 2005		
EP 1506738 B1	06 May 2009		
FR 2858758 A1	18 Feb 2005		
FR 2858758 B1	07 Apr 2006		
WO 2008071843 A1	19 Jun 2008		
		FI 20065787 A	12 Jun 2008

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2015/050239

A. CLASSIFICATION OF SUBJECT MATTER:

IPC (2015.01) A61B 5/00, A61B 5/04, A61B 5/0476 , A61B 5/0402 , A61B 5/0408 , A41D 1/00, H01B 7/04, H01B 7/40, D02G 3/32, D02G 3/36

专利名称(译)	弹性导电条及其使用方法		
公开(公告)号	<a href="#">EP3116380A1</a>	公开(公告)日	2017-01-18
申请号	EP2015762244	申请日	2015-03-05
[标]申请(专利权)人(译)	株式会社自动网络技术研究所		
申请(专利权)人(译)	HEALTHWATCH LTD.		
当前申请(专利权)人(译)	HEALTHWATCH LTD.		
[标]发明人	SHOSHANI BOAZ AMIR URI		
发明人	SHOSHANI, BOAZ AMIR, URI		
IPC分类号	A61B5/00 A61B5/04 A61B5/0476 A61B5/0402 A61B5/0408 A41D1/00 H01B7/04 H01B7/40 D02G3/32 D02G3/36		
CPC分类号	A41D13/1281 A61B5/02438 A61B5/0402 A61B5/0408 A61B5/04085 A61B5/6805 A61B5/6823 A61B5/ /6831 A61B2560/0468 A41D1/005 A41D1/04 A41D27/10 A41D2300/322 A41D2500/10 A61B5/04286 A61B2560/0456		
代理机构(译)	沃尔夫FELIX		
优先权	61/950139 2014-03-09 US 62/006102 2014-05-31 US		
其他公开文献	EP3116380A4		
外部链接	<a href="#">Espacenet</a>		

#### 摘要(译)

根据本发明的教导，提供了一种针织智能服装。该服装包括具有可变弹性的管状形式和至少一个导电纺织电极，用于感测电生命信号，例如临床级ECG信号。该服装还包括至少一个弹性且松散的导电条，具有第一端和第二端。所述至少一个导电条的第一端牢固地连接到相应的导电织物电极，并且所述至少一个导电条的第二端与处理器可操作地连接。至少一个导电条的弹性和松散性被配置成在衣服被拉伸时防止拉力施加到相应的导电纺织电极。