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**(54) GARMENT COMPRISING MEDICAL SENSORS**

KLEIDUNGSTÜCK MIT EINGEARBEITETEN MEDIZINISCHEN SENSOREN

CAPTEURS MEDICAUX A PORTER, APPLIQUES SELECTIVEMENT

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(56) References cited:  
**US-A- 4 827 943                      US-A- 6 047 203**

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**EP 1 455 640 B1**

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## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

[0001] This invention relates to sensors used in the electrical treatment and monitoring of human and animal bodies. More specifically, the invention relates to wearable garments that allow sensor devices to be pressed selectively against the skin of the wearer when it is desired to obtain medical information or to apply treatment by contact with the surface of the skin.

#### 2. Description of the Invention

[0002] Sensing and treatment devices for contacting the surface of the skin are well-known in the art. It is also well-known that such devices require tight-fitting, e.g. elevated unit pressure, contact with the skin. However, the incorporation of such sensors into wearable garments that provide for applying sensors to the skin of a wearer with selective and/or variable pressure, is not well-known.

[0003] US 4827943 discloses a portable sensor unit, which is worn by a patient to be monitored, and includes a number of sensors which continuously gather physiological data from the patient and generate corresponding electrical signals. A hybrid circuit pack receives two respiration signals from two conventional respiration transducers which are mounted around the patient's chest and abdomen, respectively. Each of the chest and abdominal respiration transducers is formed as part of a body strap, respectively, which fits around the patient's torso to position the transducer at the desired location.

[0004] In the prior art, sensors are either adhered directly to the skin of the wearer using well-known types of adhesive materials or, they are tightly strapped to the user's body using suitable straps or bands having buckles or other clasp mechanisms adapted to the purpose. Such prior art apparatus for affixing sensors to the skin of a user do not take the user's comfort into consideration by allowing the pressure of the sensor against the skin to be increased easily only when the sensor is in use. Document US 6 047 203 discloses a physiologic signs feedback system. Document US-A-5 454 376 discloses an article of wearing apparel comprising a chest encircling garment and a belt associated with said garment.

[0005] The present invention overcomes these problems and limitations of the prior art by allowing sensors to be pressed against the skin of a wearer selectively, only when needed or desired. The sensors are mounted on the inside of a wearable garment, and the garment incorporates circumscribing bands that can be reduced in diameter, selectively, to press the sensors against the skin of one wearing the garment.

### SUMMARY OF THE INVENTION

[0006] The present invention discloses a wearable garment that incorporates one or more skin-contacting sensor devices positioned to contact the skin surface of a user wearing the garment. The wearable garment of this invention incorporates one or more bands of flexible material that circumscribe portions of the wearer's body with at least one sensor device positioned between the band and the wearer. The circumference of the band can be shortened from a first dimension, which loosely circumscribes the desired portion of the wearer's body, to a second, lesser dimension, which securely presses the sensor into contact with the wearer's skin.

[0007] In accordance with this invention, the band may be tightened about the wearer's body either by drawing the ends of a loop about the body in the nature of a drawstring or by shrinking the overall length of the material of a continuous loop as by passing an electrical current through a continuous loop made of shape Memory Alloy Wire. In this regard, the band may be loosely incorporated into the body of the garment in the well-known manner of a drawstring or, the band may be integrated into the body of the garment as by forming a desired portion of the fabric material from different fibers such as fibers comprising Shape Memory alloy. To utilize the electrically responsive shrinkage characteristics of shape-memory alloy material in a convenient manner, the garment may be provided with means for supporting or otherwise carrying with it, a portable electrical power supply such as a battery.

[0008] Further in accordance with this invention, it may be noted that any treatment or monitoring equipment that relies upon the sensors carried by the wearable garment, may incorporate internal features such as a programmable microprocessor to activate a band formed of shape memory alloy, at a predetermined rate or in accordance with a predetermined schedule.

[0009] These and other aspects of the present invention appear in the appended claims, to which the reader is now referred and which are incorporated herein by reference.

[0010] These and other and further features and advantages of this invention will be made more apparent to those having skill in this art, by reference to the following specification considered in conjunction with the accompanying drawings, in which:

Figure 1 is a front plan view of a wearable garment in accordance with this invention, incorporating two separate drawstrings positioned to apply two separate sensors to the skin of a wearer;

Figure 2 is a pictorial representation of an alternative embodiment of an electrically activatable band usable in accordance with this invention in lieu of the drawstring of Figure 1; and,

Figure 3 is a front plan view of an alternative embodiment of a wearable garment in accordance with this

invention, incorporating constriction bands formed of a shape-memory material that is constrictable in response to the flow of electricity therethrough.

**[0011]** In the following description, for purposes of explanation rather than limitation, specific details are set forth such as the particular architecture, interfaces, techniques, etc., in order to provide a thorough understanding of the present invention. For purposes of simplicity and clarity, detailed descriptions of well-known devices, circuits, and methods are omitted so as not to obscure the description of the present invention with unnecessary detail.

**[0012]** Referring now to Figure 1 of the drawings, a wearable shirt garment 10 in accordance with this invention may be seen to comprise a wearable body structure 12 having a first constriction band 14 coupled to the body 12 in the form of a drawstring circumscribing the chest area of a wearer, and a second constricting drawstring 16 circumscribing a wrist area. Shown in dotted lines representing a position on the interior (invisible) surface of garment 10, a first sensor device 18 is positioned so that it will lie between the band 14 and the chest skin of one wearing the garment 10. A second sensor 20 is similarly positioned to lie between band 16 and the wrist skin of a wearer.

**[0013]** It should be understood readily by those having skill in this art, that the number and positioning of the bands 14, 16 and the sensors 18, 20 is illustrative only, and other or different sensors, or different number of sensors, in other or different locations may be incorporated into this or any differently shaped garment without departing from the spirit and scope of this invention. For example, in the absence of any desire for a sensor in a wrist area, the garment may be made essentially sleeveless in form, if desired. Similarly, the garment may assume other forms, such as, for example, trousers rather than a shirt or vest, or even, perhaps, a simple wrist or arm band.

**[0014]** Bands 14, 16 define loops positioned so as to substantially circumscribe desired portions of the anatomy of the wearer of the garment 10 in a loose-fitting loop, and they are configured to have a first circumferential loop dimension that circumscribes the wearer's body in a loose, non-confining fit. In the embodiment illustrated in Figure 1, bands 14, 16 are coupled to the body structure 12 in the manner of a drawstring that is looped around the anatomy of a wearer when the body structure is being worn. Further, the bands are provided with free ends 22, 24, that can be drawn in opposite directions to reduce the circumferential dimension of the loop from a first value to a second value that is less than the first. When the circumferential dimension of the loop is reduced in this way, the corresponding band constricts the body of the wearer of garment 10, and presses the corresponding sensor device 18, 20 against the wearer's skin.

**[0015]** As mentioned earlier herein, Figure 2 illustrates an alternative form of constriction band 26, having the

form of a continuous, or closed, loop formed of shape memory alloy fibers having a first loose-fitting circumferential dimension. In the well-known manner of shape memory alloy materials, the first circumferential dimension of loop 26 may be reduced to a lesser second dimension so as to constrict an interposed sensor device 18' into contact with a wearer's body in accordance with this invention, by passing an electrical current, from a battery [not shown] for example, through the material of the loop. If desired, this embodiment of the invention may incorporate a suitable microprocessor [not shown] coupled with a source of electrical power such as a battery, to control the application of electrical current to the band. In this manner, constriction of the band 26 may be made to take place periodically or in association with any desired external activity, such as the activation of an apparatus associated with use of sensors such as sensor 18', shown in Figure 3.

**[0016]** The fabric of the garment body structure 12 may be any suitable material usable for garments, consistent with the requirements of the embodiments of the invention described herein. Similarly, the material of the bands 14, 16 may be any suitable flexible material consistent with this disclosure.

**[0017]** In summary, in one embodiment of the invention, the circumscribing band has the form and function of a drawstring loop, with ends adapted to be drawn in opposite directions so as to tighten the loop about the circumscribed portion of the user's body. In another embodiment, the band is a continuous loop of material, incorporated into the structure of the garment, and formed of material such as Shape Memory Alloy wire, or any similar material, that has the characteristic of shortening in axial length in response to the application of electrical current. Such materials are well-known in various fields, such as robotics, for example, where they are identified as "muscle wires" or "Nitinol".

**[0018]** While the preferred embodiments of the present invention have been illustrated and described, it will be understood by those skilled in the art that various changes and modifications may be made, and equivalents may be substituted for elements thereof without departing from the true scope of the present invention. In addition, many modifications may be made to adapt to a particular situation and the teaching of the present invention without departing from the central scope. Therefore, it is intended that the present invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out the present invention, but that the present invention include all embodiments falling within the scope of the appended claims.

## Claims

1. A garment for selectively applying a medical sensor against the skin of a wearer, said garment comprising:

a wearable body structure (12);  
 a medical sensor (18, 18', 20) mounted to said body structure in position to contact a desired portion of the anatomy of a wearer of said body structure;  
 a band (14, 16, 26) of flexible material incorporated into said body structure (12) in position to circumscribe a desired portion of the wearer's anatomy with said sensor (18, 18', 20) being positioned to lie between said band and the wearer's anatomy;  
 said band (14, 16, 26) of flexible material defining a loop having a first circumferential dimension, and having means associated therewith for reducing said first circumferential dimension to a second circumferential condition less than said first circumferential dimension so as to constrict the anatomy of a wearer of said garment and press said sensor against said anatomy **characterized in that** said band (26) is a continuous loop and at least a portion of said loop is formed of shape memory alloy material that reduces in axial length in response to the passage of electrical current therethrough.

2. The garment of claim 1, wherein said flexible material of said band (14, 16, 26) is axially elastic.
3. The garment of claim 1, wherein said shape memory alloy material is Nitinol.
4. The garment of claim 1, wherein said wearable body structure (12) has the shape of a shirt.
5. The garment of claim 4, wherein said medical sensor (16, 18, 18') is positioned to contact the chest of a wearer.
6. A method of selectively applying a medical sensor (18, 18', 20) against the anatomy of a subject, said method comprising the steps of:

loosely positioning said sensor (18, 18', 20) adjacent a desired portion of the anatomy of said subject;  
 loosely surrounding said sensor and said subject with a constrictable band (14, 16) of flexible material, the method being **characterized in the** step of  
 selectively constricting said band to press said sensor into contact with the anatomy of said subject by passing electric current through a shape memory alloy material which is comprised in said constrictable band.

## Patentansprüche

1. Kleidungsstück für selektives Anlegen eines medizinischen Sensors gegen die Haut eines Trägers, wobei das genannte Kleidungsstück Folgendes umfasst:

eine tragbare Körperstruktur (12);  
 einen medizinischen Sensor (18, 18', 20), der auf der genannte Körperstruktur in Position montiert ist, um einen gewünschten Teil der Anatomie eines Trägers der genannten Körperstruktur zu kontaktieren;  
 ein Band (14, 16, 26) aus flexiblen Material, das in die genannte Körperstruktur (12) in Position eingearbeitet ist, um einen gewünschten Teil der Anatomie des Trägers zu umgeben, wobei der genannte Sensor (18, 18', 20) so positioniert ist, dass er zwischen dem genannten Band und der Anatomie des Trägers liegt;  
 wobei das genannte Band (14, 16, 26) aus flexiblen Material eine Schleife mit einer ersten Umfangsabmessung definiert und damit verbundene Mittel hat, die genannte erste Umfangsabmessung auf eine zweite Umfangsbedingung zu reduzieren, die kleiner ist als die genannte erste Umfangsabmessung, um so die Anatomie eines Trägers des genannten Kleidungsstücks einzuengen und den genannten Sensor gegen die genannte Anatomie zu pressen, **dadurch gekennzeichnet, dass** das genannte Band (26) eine kontinuierliche Schleife ist und mindestens ein Teil der genannten Schleife aus Formspeicher-Legierungsmaterial gebildet ist, das sich als Reaktion auf das Durchleiten von elektrischem Strom durch dieses in axialer Länge reduziert.

2. Kleidungsstück nach Anspruch 1, in dem das genannte flexible Material des genannten Bands (14, 16, 26) axial elastisch ist.
3. Kleidungsstück nach Anspruch 1, in dem das genannte Formspeicher-Legierungsmaterial Nitinol ist.
4. Kleidungsstück nach Anspruch 1, in dem die genannte Körperstruktur (12) die Form eines Hemds hat.
5. Kleidungsstück nach Anspruch 4, in dem der genannte medizinische Sensor (16, 18, 18') positioniert ist, den Brustkorb eines Trägers zu kontaktieren.
6. Verfahren zum selektiven Anlegen eines medizinischen Sensors (18, 18', 20) gegen die Anatomie eines Objekts, wobei das genannte Verfahren folgende Schritte umfasst:

lockeres Positionieren des genannten Sensors (18, 18', 20) anliegend an einen gewünschten Teil der Anatomie des genannten Objekts;  
lockeres Umlegen des genannten Sensors und des genannten Objekts mit einem einengbaren Band (14, 16) aus flexiblen Material, wobei das Verfahren **gekennzeichnet ist durch** den Schritt des selektiven Einengens des genannten Bandes, um den genannten Sensor **durch** Durchleiten von elektrischem Strom **durch** ein Formspeicher-Legierungsmaterial, das in dem genannten Einengungsband enthalten ist, in Kontakt mit der Anatomie des genannten Objekts zu pressen.

### Revendications

1. Vêtement pour appliquer de façon sélective un capteur médical contre la peau d'un porteur, ledit vêtement comprenant :
  - une structure de vêtement portable (12);
  - un capteur médical (18, 18', 20) monté sur ladite structure de corps en position pour venir en contact d'une partie souhaitée de l'anatomie d'un porteur de ladite structure de corps;
  - une bande (14, 16, 26) en matériau flexible incorporée dans ladite structure de corps (12) en position pour entourer une partie souhaitée de l'anatomie d'un porteur, avec ledit capteur (18, 18', 20) positionné pour se trouver entre ladite bande et l'anatomie du porteur;
  - ladite bande (14, 16, 26) en matériau flexible définissant une boucle qui a une première dimension circonférentielle, et ayant des moyens qui y sont associés pour réduire ladite première dimension circonférentielle à une deuxième dimension circonférentielle inférieure à ladite première dimension circonférentielle, de façon à entourer l'anatomie d'un porteur dudit vêtement et presser ledit capteur contre ladite anatomie, **caractérisé en ce que** ladite bande (26) est une boucle continue et au moins une partie de ladite boucle est formée en matériau en alliage à mémoire de forme qui diminue de longueur axiale en réponse à un passage d'un courant électrique au travers de celui-ci.
2. Vêtement selon la revendication 1, dans lequel ledit matériau flexible de ladite bande (14, 16, 26) est axialement élastique.
3. Vêtement selon la revendication 1, dans lequel ledit matériau en alliage à mémoire de forme est le Nitinol.
4. Vêtement selon la revendication 1, dans lequel ladite

structure de corps portable (12) a la forme d'une chemise.

5. Vêtement selon la revendication 4, dans lequel ledit capteur médical (16, 18, 18') est positionné pour venir en contact avec la poitrine d'un porteur.
6. Procédé d'application sélective d'un capteur médical (18, 18', 20) contre l'anatomie d'un sujet, ledit procédé comprenant les étapes de :

de façon lâche, positionner ledit capteur (18, 18', 20) adjacent à une partie souhaitée de l'anatomie dudit sujet;

de façon lâche, entourer ledit capteur et ledit sujet avec une bande qui peut être serrée (14, 16) en matériau flexible, le procédé étant **caractérisé par** l'étape de serrer ladite bande de façon sélective pour presser ledit capteur en contact avec l'anatomie dudit sujet, en faisant passer un courant électrique au travers d'un matériau en alliage à mémoire de forme qui est compris dans ladite bande qui peut être serrée.

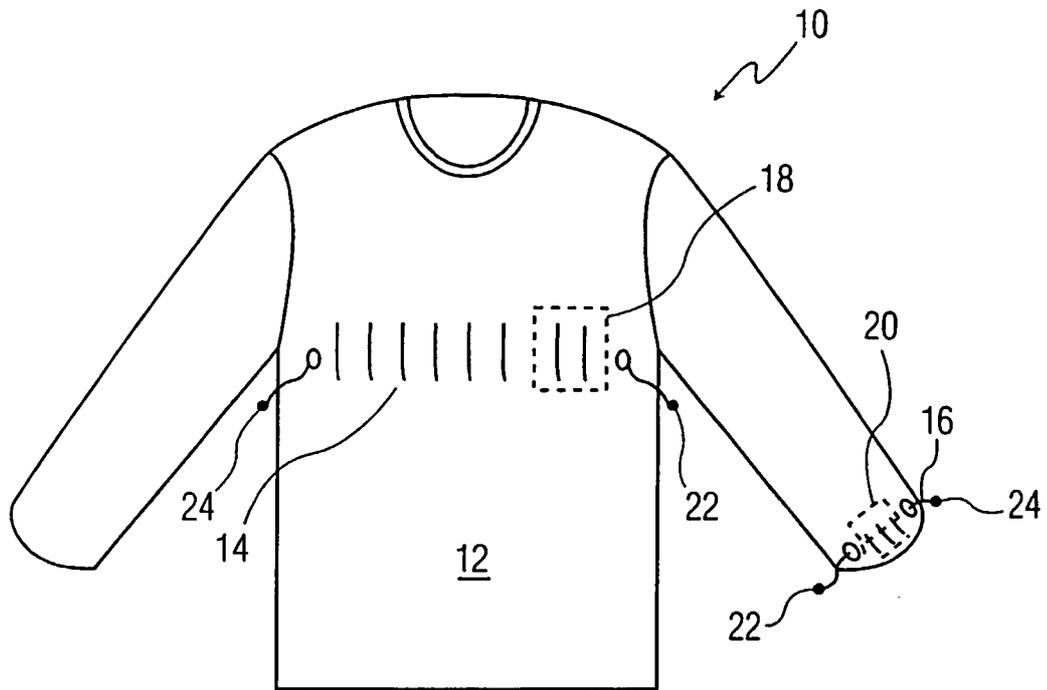


FIG. 1

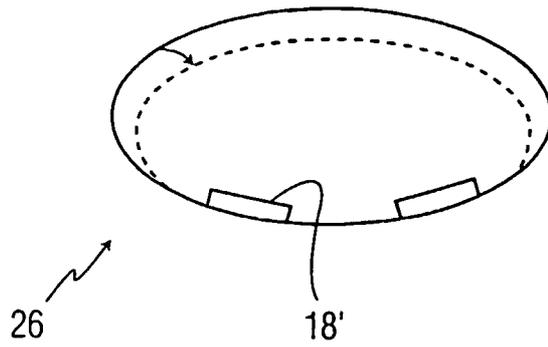


FIG. 2

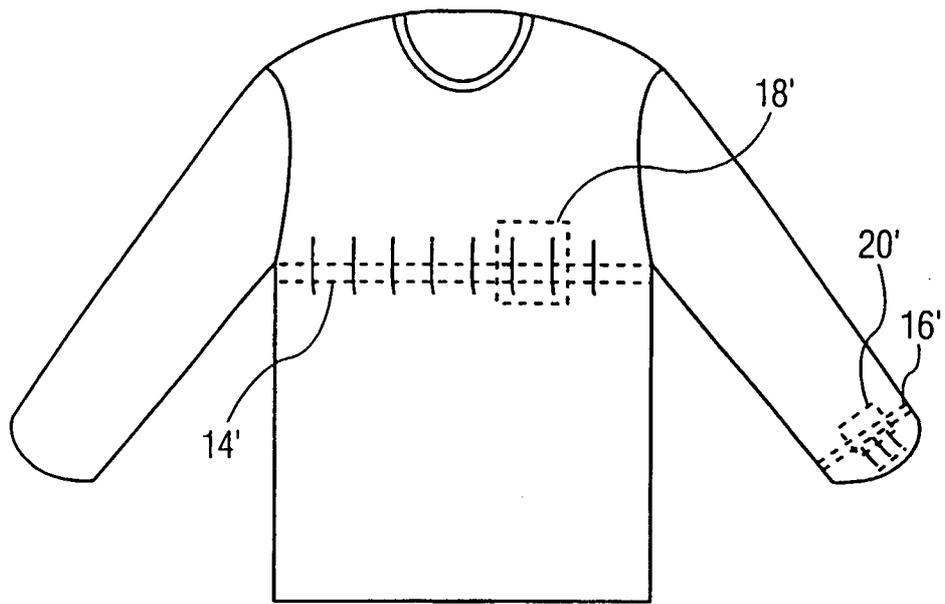


FIG. 3

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- US 4827943 A [0003]
- US 6047203 A [0004]
- US 5454376 A [0004]

专利名称(译)	服装包括医疗传感器		
公开(公告)号	<a href="#">EP1455640B1</a>	公开(公告)日	2008-01-16
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[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
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CPC分类号	A61B5/6804 A61B5/02055 A61B5/02438		
代理机构(译)	DAMEN , DANIEL马亨		
其他公开文献	EP1455640A2		
外部链接	<a href="#">Espacenet</a>		

摘要(译)

可穿着服装 ( 10 ) 包括众所周知设计的医疗传感器装置 ( 18,20 ) , 当希望获得诸如心率或温度的医学读数或者应用治疗时, 所述医疗传感器装置选择性地压靠在穿着者的皮肤上。例如用于除颤目的的电脉冲。该服装包括一个或多个柔性材料带 ( 14,16 ) , 其围绕穿着者身体的一部分, 其中至少一个传感器装置 ( 18,20 ) 定位在该带和穿着者身体之间的衣服上。为了确保穿着者的舒适性, 可以从第一尺寸选择性地缩短带的周长, 第一尺寸松散地围绕穿着者身体的期望部分, 到第二较小尺寸, 其更紧密地围绕穿着者的身体并且按压传感器牢固地与佩戴者的皮肤接触。

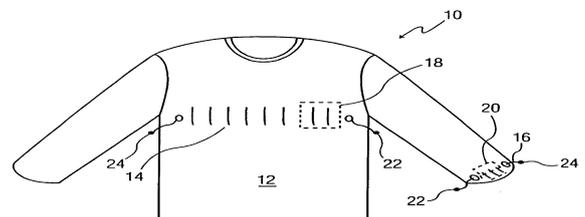


FIG. 1

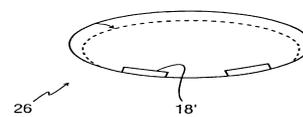


FIG. 2