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(54) A TEMPERATURE SENSOR FOR BODY TEMPERATURE MEASUREMENT

TEMPERATURSENSOR ZUR KÖRPERTEMPERATURMESSUNG

CAPTEUR DE TEMPÉRATURE POUR MESURER LA TEMPÉRATURE CORPORELLE

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Description

FIELD OF THE INVENTION

[0001] The present invention is related to a temperature sensor for body temperature measurements, and to a garment comprising the temperature sensor.

BACKGROUND OF THE INVENTION

[0002] In the recent years, there has been some development in developing core body temperature sensors. A heat flux temperature sensor is an example of such a core body temperature sensor, but the measuring is based on so-called zero heat flux principle, but this principle is used in the "low power core body temperature monitoring" for continuous temperature monitoring of patients. According to this principle the core body temperature is measured by placing the sensor on the skin of e.g. the forehead of the patient. An accurate temperature measurement requires that the sensor is flexible so that it follows that skin surface so as to ensure that there are no air gaps between the skin and sensor, which otherwise can have adverse effect on the measurement accuracy.

[0003] Although the prior art heat flux temperature sensors are somewhat flexible, they are suitable for high acuity applications, e.g. during surgery where the sensor monitors the core body temperature during the surgery and where the patient is not moving.

[0004] However, for applications where the skin is actually moving more, e.g. for monitoring temperature of newborns, or more general use (e.g. outside the hospital) their use is somewhat limited due to the lack of flexibility needed to follow the skin surface. Also the prior art sensors are obtrusive, either for newborns requiring an adhesive on the skin, or for non-high acuity applications being visible on the patient's forehead, changing the appearance of the patient.

[0005] US 3,933,045A describes that the temperature within a body is measured by covering an area of the body surface with a layer of thermal insulation, measuring the temperature with two sensors located respectively at the insulation/body surface interface and at the opposite side of the insulating layer to indicate any temperature gradient along a path from within the body through the sensors, and applying heat over the insulating layer/sensor sandwich to annul any such gradient. This effectively exteriorises the desired deep body temperature, which is then indicated by the sensors. It is important that the insulation extend laterally beyond the sensors to guard against peripheral temperature gradients affecting the sensor region and to take account of any inherent thermal irregularities in the body. This last point is particularly relevant to clinical use on human subjects with irregularities caused by vascular channels. Similar considerations lead to use of a thin film or similar uniform heating element over the relevant area.

[0006] Lymberis A and Dittmar A, IEEE Engineering and Biology Magazine, May/June 2007, 29-33, describe advanced wearable health systems and applications with respect to research and development efforts in the European Union. It is concluded that research and development on smart wearable health systems (SWHS) was motivated by the need to respond successfully to the healthcare challenges of reducing healthcare costs while maintaining a high quality of care, providing ubiquitous easy access to care, and shifting the locus of healthcare expenditure from treatment to prevention through wellness programs.

SUMMARY DESCRIPTION OF THE INVENTION

[0007] The object of the present invention is to overcome the above mentioned drawbacks by providing a temperature sensor with enhanced flexibility.

[0008] In a first aspect, there is provided a temperature sensor for body temperature measurements as defined in appended claim 1.

[0009] In second aspect, there is provided a garment as defined in appended claim 17.

[0010] According to a first embodiment the present invention relates to a temperature sensor for body temperature measurements, comprising:

- a first layer having a central heater embedded therein,
- a second layer attached to the first layer having at least one first thermistor embedded therein for measuring a first temperature value,
- at least one third layer having at least one second thermistor embedded therein separated from the first thermistor for measuring at least one second temperature value, the at least one third layer being adapted to be in contact to the skin of the surface of the body for conducting the heat escaping from the body through the layers, the difference between the first and the second temperature values indicating the vertical heat flux from the body, where the heat emitted from central heater is tuned oppositely to the vertical heat flux until a zero heat flux is reached, where the temperature at the at least one second thermistor at zero heat flux indicates the body temperature,

wherein the first, second and at least the third layer are fabric layers.

[0011] Accordingly, a very flexible temperature sensor is provided which follows the skin of the body and that can easily be integrated into garment, such as a cap, baby cap, headband, shirt, diaper and belt, and even into a bed object such as a pillow, blanket or seat which is in contact with the body. Another advantage offered by the flexible body temperature is comfort, while not critical in the high acuity setting, is of great importance in the low acuity setting and use outside of the hospital.

[0012] In one embodiment, the layers are stitched or laminated together, interwoven, or combination thereof.

[0013] In one embodiment, the first and the second layers are made of the same fabric and form a single functional layer having the central heater and the at least one first thermistor embedded therein such that they are separated from each other.

[0014] In one embodiment, the central heater is stitched, or embroidered, or woven, or laminated into the first layer using conductive yarn. The conductive yarn can for example be a metal coated polymer such as Ag-coated polyester, stainless steel (containing) yarn or Cu wire (with or without silver coating).

[0015] In one embodiment, the dimension of the central heater is adapted to the depth of measurement such that the larger the depth is to be measured the larger becomes the dimension of the central heater.

[0016] In one embodiment, the central heater is printed onto the first layer using conductive ink or conductive paste.

[0017] In one embodiment, the central heater is made of a conductive material with a resistance between 5-150 ohm/meter.

[0018] In one embodiment, the thermistors are attached to a woven, stitched or knitted conductive circuit.

[0019] In one embodiment, the conductive circuit is made of conductive material having a resistance lower 20 ohm/meter.

[0020] In one embodiment, the fabric layers are made of woven or non-woven fabrics.

[0021] In one embodiment, the second and the at least the third layers are separated by a flexible heat insulating layer. The flexible heat insulating layer may as an example be selected from: neoprene (polychloroprene), PVDF, EPDM (ethylene propylene diene monomer), and foam type materials polyethylene (PE), polypropylene (PP), methylacrylate (EMA), ethylenevinylacetate (EVA), polyolefin.

[0022] In one embodiment, the temperature sensor further comprises an insulating layer applied on top of the first layer. In that way, heat losses may be prevent and thus a less power is required to run the sensor.

[0023] In one embodiment, the temperature sensor further comprises a transmitter for transmitting the temperature measured at the at least one second thermistor at zero heat flux to an external monitoring device comprising a receiver. Accordingly, the temperature can be continuously monitored via e.g. a wireless communication link. This is of particular advantage when monitoring e.g. newborns where the measured temperature is displayed on the external monitoring device (e.g. babyphone).

[0024] In one embodiment, the temperature sensor is integrated into patch.

[0025] In one embodiment, the patch further comprises a processing unit for converting the output from the at least one second thermistor at zero heat flux into the measured body temperature, a battery, and an indicator means for indicating the measured body temperature. This patch can be made so that it is either re-usable or disposable. Accordingly, this allows unobtrusive temperature monitoring, e.g. for children with fever. In one embodiment, the temperature sensor further comprises a side thermistor arranged at the periphery of the third layer and adapted to measure a third temperature value at the periphery of the third layer, where the difference between the second and the third temperature values indicates the horizontal heat flux within the third layer.

[0026] In one embodiment, the temperature sensor further comprises a side heater arranged at the periphery of the third layer adapted to be tuned oppositely to the heat until a zero horizontal heat flux is reached in the third layer.

[0027] It is thus possible to prevent lateral heat loss, but the biggest source of lateral heat loss is heat that is escaping from the brain that is not going vertically, but diagonally. Using an additional side thermistor along with the thermistor in the third layer makes it possible to detect the lateral heat flux. It is therefore possible to operate the side heater such that the lateral heat flux becomes zero. This makes the temperature profile uniform in the lateral direction, reducing the problem to one dimension.

[0028] According to a second aspect, the present invention relates to a garment comprising said temperature sensor integrated therein such that when the garment is placed onto the body or is being worn by the body the at least one third layer becomes in contact to the skin of the surface of the body. As mentioned previously, such garment may as an example include a cap, baby cap, headband, shirt, diaper and belt, and even into a bed object such as a pillow, blanket or seat which is in contact with the body and the like.

[0029] The aspects of the present invention may each be combined with any of the other aspects. These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] Embodiments of the invention will be described, by way of example only, with reference to the drawings, in which

Fig. 1 shows one embodiment of a temperature sensor for body temperature measurements according to the present invention, and

Fig. 2 shows a system adapted to be integrated into the temperature sensor or a patch or a garment, and

Fig. 3 shows a garment comprising the temperature sensor from Fig. 1 integrated therein.

DESCRIPTION OF EMBODIMENTS

[0031] Fig. 1 shows one embodiment of a temperature sensor 100 for body temperature measurements according to the present invention. The temperature sensor 100 comprises a first layer 104 having a central heater 107 embedded therein, a second layer 103 attached to the first layer 104 having at least one first thermistor (Ttop) 108 embedded therein for measuring a first temperature value t^{first}, a third layer 101 having at least one second thermistor (Tbottom) 109 embedded therein separated from the first thermistor (Ttop) 108 for measuring at least one second temperature value t^{second}. The third layer 101 is adapted to be in contact to the skin of the surface 106 of the body for conducting the heat escaping from the body through the layers. The difference between the first and the second temperature values, i.e. $t^{second} - t^{first}$ indicates the vertical heat flux from the body. The central heater 107 is adapted to be tuned oppositely to the vertical heat flux $t^{second} - t^{first}$ until a zero heat flux is reached, i.e. until $t^{second} = t^{first}$. At this zero vertical heat flux, the temperature at the second thermistor (Tbottom) 109 at zero heat flux indicates the body temperature, or more particularly the core body temperature. The fabric layers may be made of woven or non-woven fabrics. The thickness of each layer is typically in the millimeter range, but may just as well be less than a millimeter.

[0032] The second layer 103 and the third layer 101 further comprise a woven, stitched or knitted conductive circuit, respectively, to which the thermistors in the respective layers are attached to. The thermistor can be attached by soldering, clamping or using conductive epoxy or Anisotropic Conductive Foil/paste (ACF/ACP). The conductive circuit may be made of a (common) ground and a signal line using e.g. conductive yarn that is stitched, woven, knitted or laminated to/into a fabric. In one embodiment, the conductive circuit is made of conductive material having a resistance lower 20 ohm/meter.

[0033] The first, second and at least the third layer are fabric layers 104, 103, 101 may be stitched or laminated together, interwoven, or combination thereof which makes the sensor soft, flexible and thin.

[0034] In one embodiment, the temperature sensor 100 further comprises a top layer 105 made of insulating material, which may be transparent, e.g. so as for illustrative purposes such as to show a nice illustrative shape (a picture).

[0035] In one embodiment, the first and second layers 104, 103 are made of the same fabric and form a part of a single layer 110 containing both the thermistor (Ttop) 108 and the heating element 107 on the same fabric, such that this single layer 110 comprises both the thermistor (Ttop) 108 and the heating element 107. A care must be taken to prevent shorts between the thermistor (Ttop) 108 and the heating element 107.

[0036] In one embodiment, the third layer 101 and the thermistor (Tbottom) 109 along with the first and second layers 104, 103 form a part of a single layer 111 on the same fabric. It is possible with 3D knitting technologies to make spacerfabrics integrated with two (or more) top layers.

[0037] In one embodiment, the second and the at least the third layers are separated by a flexible heat insulating layer 102, made of e.g. neoprene (polychloroprene), ethylene propylene diene monomer (PVDF, EPDM), and foam type materials polyethylene (PE), polypropylene (PP), methylacrylate (EMA), ethylenevinylacetate (EVA), polyolefin.

[0038] Referring to the embodiment shown in Fig. 1, the five layers 101-104 may be stitched or laminated together, or it is also possible to combine several of the layers into one fabric.

[0039] In one embodiment, the central heater 107 has a cross section that is adapted to the depth of measurement such that the larger the depth is to be measured, the larger should the cross section of the heater be. An example of a cross section is a cross section within millimeter up to few centimeters. The central heater can be made by stitching, weaving, knitting or laminating conductive yarns to/into a fabric, where the conductive yarns may be (but not necessarily) surrounded by an insulating polymer layer, or it may be printed onto the first layer using conductive ink or conductive paste. In one embodiment, the resistance of the heater is such that it can deliver around 100 mW. Referring to the setup shown in Fig. 1, this corresponds to resistances between 5 and 50 ohm. This can be achieved by matching the length of the conductive wire with the resistance. As an example, 80 Ohm/m stainless steel wire of 25cm is 20 Ohm. The shape of the central heater should preferably be such that it gives rise to a homogeneous temperature profile in the lower layers. This shape could as an example be a spiral, but other shapes are of course also possible.

[0040] The third layer 101 is a fabric layer that incorporates at least one thermistor, and a conductive circuit to connect the thermistor. The thermistor can be attached by soldering, clamping or using conductive epoxy or ACF/ACP. The conductive circuit consists of a (common) ground and a signal line and can be made using conductive yarn that is stitched, woven, knitted or laminated to/into a fabric. The conductive circuit can be made in or as part of an illustrative design, or for hygienic layer/coating such that it becomes in contact with the skin (106).

[0041] In one embodiment, the temperature sensor 100 further comprises a transmitter (not shown) for transmitting the temperature measured at the at least one second thermistor at zero heat flux to an external monitoring device comprising a receiver. Such a monitoring device may as an example be a babyphone or some external monitoring unit that further comprises a processing unit that monitors that baby temperature continuously during the first days.

[0042] It should be noted that the temperature sensor 100 is not limited to this particular number of layers. The number of layers may just as well include more than four or five layers, also the number of thermistors does not necessarily be limited to the two thermistors 108 and 109, but three or more may just as well be implemented to measure the vertical heat flux.

[0043] Until now, the measured heat flux is a vertical heat flux which is proportional to $t^{second} - t^{first}$.

[0044] In one embodiment, the temperature sensor 100 further comprises a side thermistor (Tside) 112 arranged at the periphery of the third layer 101 and adapted to measure a third temperature value t^{third} at the periphery of the third layer 101. The difference between the second and the third temperature values, i.e. t^{third} - t^{second} indicates the horizontal heat flux within the third layer 101. To compensate the heat loss due to the horizontal heat flux, a side heater 113 is arranged at the periphery of the third layer adapted to be tuned oppositely to the heat flux t^{third} - t^{second} until a zero horizontal heat flux is reached in the third layer. In one embodiment, the side heater 113 has substantially the same geometry as the third layer, e.g. a ring (if the third layer is a ring) made of similar elements as discussed previously in conjunction with the central heater. Accordingly, the side heater 113 is controlled by the horizontal heat flux, whereas the central heater 107 is controlled by the vertical heat flux. One of the reasons of using such a side heater 113 is to prevent lateral heat loss. The biggest source of lateral heat loss is heat that is escaping from the brain that is not going vertically, but diagonally. So the temperature profile in the skull becomes 2-dimensional. The side heater makes the temperature profile uniform in the lateral direction, reducing the problem to 1 dimension. The thermistor 112 at the periphery is used to detect this lateral temperature profile. A minor source of lateral heat loss is heat that is escaping from the center of the sensor to the side of the sensor. But this is minimal, given the flatness of the sensor.

[0045] In one embodiment, the temperature sensor 100 is integrated into a patch (not shown), where the patch further comprises a system 200 (see Fig. 2) comprising a processing unit (P) 201 such as a microprocessor for converting the output from the at least one second thermistor at zero heat flux into the measured body temperature, a battery (B) 203, and an indicator means (I_M) 202 for indicating the measured body temperature. The indicator means (I_M) 202 may as an example be a display such as a color display. The indicator means (I_M) 202 may be replaced by a transmitter (T) 204 for transmitting the measured body temperature to a monitoring device comprising a receiver (e.g. a babyphone). This patch can be made so that it is either re-usable or disposable. Accordingly, this allows unobtrusive temperature monitoring, e.g. for children with fever. Although not depicted here, the system 200 shown in Fig. 2 may also be integrated into the temperature sensor 100.

[0046] Fig. 3 shows a garment 301 comprising the temperature sensor 100 from Fig. 1 integrated therein such that when the garment is placed onto the body or is being worn by the body the at least one third layer 101 becomes in contact to the skin of the surface 106 of the body. An example of such garment is mattress, sleeping bag, pillow, sheet, blanket, belt etc.

Example:

[0047] During the first days, newborns can have difficulties to keep a constant temperature. Therefore, it is recommended to measure the temperature frequently, and adjust clothing and heating accordingly. Too cold is not good, but overheating is even more dangerous. Present babyphones show the temperature of the room, but not of the baby.

[0048] In this example the temperature sensor 100 is integrated into a baby cap 301 such that when the baby cap is worn by the baby the sensor becomes automatically well positioned on the forehead for the measurement. This allows measuring the temperature of the baby continuously during the first days and displayed via e.g. a wireless link on the babyphone 302. However, integration possibilities are not limited to a baby cap; but could be extended to any fabric (mattress, sleeping bag, pillow, sheet, blanket, etc.) surrounding the baby. In this example, the cap 201 further comprises the system shown in Fig. 2, namely a battery (B) 203, a microcontroller (M_C) 205 for signal processing. However, instead of the indicator means (I_M) 202 the system comprises a transmitter (T) 204 to transmit the signal to the babyphone 202. For clinical applications, the signal may be sent to a wireless patient monitoring system or a bedside monitor.

[0049] Certain specific details of the disclosed embodiment are set forth for purposes of explanation rather than limitation, so as to provide a clear and thorough understanding of the present invention. However, it should be understood by those skilled in this art, that the present invention might be practiced in other embodiments that do not conform exactly to the details set forth herein, without departing significantly from the scope of the appended claims. Further, in this context, and for the purposes of brevity and clarity, detailed descriptions of well-known apparatuses, circuits and methodologies have been omitted so as to avoid unnecessary detail and possible confusion.

[0050] Reference signs are included in the claims, however the inclusion of the reference signs is only for clarity reasons and should not be construed as limiting the scope of the claims.

Claims

1. A temperature sensor (100) for body temperature measurements, comprising:

   - a first layer (104) having a central heater (107) embedded therein,
   - a second layer (103) attached to the first layer (104) having at least one first thermistor (108) embedded therein for measuring a first temperature value,
   - at least one third layer (101) having at least one second thermistor (109) embedded therein

separated from the first thermistor (108) for measuring at least one second temperature value, the at least one third layer (101) being adapted to be in contact to the skin of the surface (106) of the body for conducting the heat escaping from the body through the layers, the difference between the first and the second temperature values indicating the heat flux from the body, where the heat emitted from central heater is tuned oppositely to the heat flux until a zero heat flux is reached, where the temperature at the at least one second thermistor at zero heat flux indicates the body temperature, **characterized in that** the first, second and the at least one third layer are fabric layers, and wherein the central heater (107) is made by stitching, weaving, knitting or laminating conductive yarns to/into a fabric, or is printed onto the first layer using conductive ink or conductive paste.

2. A temperature sensor according to claim 1, wherein the layers are stitched or laminated together, interwoven, or combination thereof.

3. A temperature sensor according to claim 1, wherein the first and the second layers (104, 103) are made of the same fabric and form a single functional layer having the central heater (107) and the at least one first thermistor embedded therein such that they are separated from each other.

4. A temperature sensor according to claim 1, wherein the dimension of the central heater (107) is adapted to the depth of measurement such that the larger the depth is to be measured the larger becomes the dimension of the central heater.

5. A temperature sensor according to claim 1, wherein the central heater (107) is made of a conductive material with a resistance between 5-150 ohm/meter.

6. A temperature sensor according to claim 1, wherein the thermistors (108, 109) are attached to a woven, stitched or knitted conductive circuit.

7. A temperature sensor according to claim 6, wherein the conductive circuit is made of conductive material having a resistance lower 20 ohm/meter.

8. A temperature sensor according to claim 1, wherein the fabric layers are made of woven or non-woven fabrics.

9. A temperature sensor according to claim 1, wherein the second and the at least the third layers (103, 101) are separated by a flexible heat insulating layer (102).

10. A temperature sensor according to claim 1, further comprising an insulating layer (105) applied on top of the first layer (104).

11. A temperature sensor according to claim 1, further comprising a transmitter (204) for transmitting the temperature measured at the at least one second thermistor at zero heat flux to an external monitoring device comprising a receiver.

12. A temperature sensor according to claim 1, wherein the temperature sensor (100) is integrated into patch (301).

13. A temperature sensor according to claim 1, wherein the patch (301) further comprises a processing unit (201) for converting the output from the at least one second thermistor (108, 109) at zero heat flux into the measured body temperature, a battery (203), and an indicator means (202) for indicating the measured body temperature.

14. A temperature sensor according to claim 1, further comprising a side thermistor (Tside) (112) arranged at the periphery of the third layer (101) and adapted to measure a third temperature value at the periphery of the third layer (101), where the difference between the second and the third temperature values indicates the horizontal heat flux within the third layer (101).

15. A temperature sensor according to claim 14, further comprising a side heater (113) is arranged at the periphery of the third layer (101)adapted to be tuned oppositely to the heat flux until a zero horizontal heat flux is reached in the third layer.

16. A temperature sensor according to claim 15, wherein the side heater (113) is adapted to the geometrical shape of the third layer (101).

17. A garment (301) comprising the temperature sensor as claimed in claim 1 integrated therein such that when the garment is placed onto the body or is being worn by the body the at least one third layer becomes in contact to the skin of the surface of the body.

Patentansprüche

1. Temperatursensor (100) für Körpertemperaturmessungen, umfassend:

- eine erste Schicht (104) mit einem darin eingebetteten zentralen Heizelement (107),
- eine an der ersten Schicht (104) angebrachte zweite Schicht (103) mit mindestens einem darin eingebetteten Thermistor (108) zum Messen

eines ersten Temperaturwerts,

- mindestens eine dritte Schicht (101) mit mindestens einem zweiten darin eingebetteten Thermistor (109), der von dem ersten Thermistor (108) getrennt ist, zum Messen von mindestens einem zweiten Temperaturwert, wobei die mindestens eine dritte Schicht (101) dafür ausgelegt ist, die Hautoberfläche (106) des Körpers zu kontaktieren, um die aus dem Körper austretende Wärme durch die Schichten zu leiten, wobei der Unterschied zwischen den ersten und den zweiten Temperaturwerten den Wärmefluss aus dem Körper angibt, wobei die Wärme, die von dem zentralen Heizelement emittiert wird, entgegengesetzt zum Wärmefluss abgestimmt wird, bis ein Wärmefluss von null erreicht ist, wobei die Temperatur bei dem mindestens einen zweiten Thermistor bei einem Wärmefluss von null die Körpertemperatur angibt,

dadurch gekennzeichnet, dass die erste, die zweite und die mindestens eine dritte Schicht Stoffschichten sind, und wobei das zentrale Heizelement (107) durch Sticken, Weben, Stricken oder Laminieren von leitfähigen Garnen an/in einen Stoff hergestellt wird oder mittels leitfähiger Druckfarbe oder leitfähiger Paste auf die erste Schicht aufgedruckt wird.

2. Temperatursensor nach Anspruch 1, wobei die Schichten miteinander versteppt oder laminiert, verwoben oder eine Kombination hiervon sind.

3. Temperatursensor nach Anspruch 1, wobei die ersten und die zweiten Schichten (104, 103) aus dem gleichen Stoff hergestellt sind und eine einzelne funktionale Schicht bilden, in die das zentrale Heizelement (107) und der mindestens eine erste Thermistor derartig eingebettet sind, dass sie voneinander getrennt sind.

4. Temperatursensor nach Anspruch 1, wobei die Abmessung des zentralen Heizelements (107) derartig an die Messtiefe angepasst wird, so dass die Abmessung des zentralen Heizelements mit zunehmender zu messender Tiefe größer wird.

5. Temperatursensor nach Anspruch 1, wobei das zentrale Heizelement (107) aus einem leitfähigen Material mit einem Widerstand zwischen 5-150 Ohm/Meter besteht.

6. Temperatursensor nach Anspruch 1, wobei die Thermistoren (108, 109) an einer gewebten, gestickten oder gestrickten leitfähigen Schaltung angebracht sind.

7. Temperatursensor nach Anspruch 6, wobei die leitfähige Schaltung aus leitfähigem Material mit einem Widerstand von weniger als 20 Ohm/Meter besteht.

8. Temperatursensor nach Anspruch 1, wobei die Stoffschichten aus gewebten oder nicht-gewebten Stoffen bestehen.

9. Temperatursensor nach Anspruch 1, wobei die zweiten und die mindestens dritten Schichten (103, 101) durch eine flexible wärmeisolierende Schicht (102) getrennt sind.

10. Temperatursensor nach Anspruch 1, weiterhin umfassend eine Isolierschicht (105), die auf die erste Schicht (104) aufgebracht ist.

11. Temperatursensor nach Anspruch 1, weiterhin umfassend einen Sender (204) zum Senden der bei dem mindestens einen zweiten Thermistor bei einem Wärmefluss von null gemessenen Temperatur an eine einen Empfänger umfassende externe Überwachungsvorrichtung.

12. Temperatursensor nach Anspruch 1, wobei der Temperatursensor (100) in Pflaster (301) integriert ist.

13. Temperatursensor nach Anspruch 1, wobei das Pflaster (301) weiterhin eine Verarbeitungseinheit (201) zum Umwandeln der Ausgabe von dem mindestens einen zweiten Thermistor (108, 109) bei einem Wärmefluss von null in die gemessene Körpertemperatur, eine Batterie (203) und ein Anzeigemittel (202) zum Angeben der gemessenen Körpertemperatur umfasst.

14. Temperatursensor nach Anspruch 1, weiterhin umfassend einen Seitenthermistor (Tside) (112), der am Umfang der dritten Schicht (101) angeordnet ist und dafür ausgelegt ist, einen dritten Temperaturwert am Umfang der dritten Schicht (101) zu messen, wobei der Unterschied zwischen den zweiten und den dritten Temperaturwerten den horizontalen Wärmefluss innerhalb der dritten Schicht (101) angibt.

15. Temperatursensor nach Anspruch 14, weiterhin umfassend ein Seitenheizelement (113), das am Umfang der dritten Schicht (101) angeordnet ist und dafür ausgelegt ist, entgegengesetzt zum Wärmefluss abgestimmt zu werden, bis ein horizontaler Wärmefluss von null in der dritten Schicht erreicht ist.

16. Temperatursensor nach Anspruch 15, wobei das Seitenheizelement (113) an die geometrische Form der dritten Schicht (101) angepasst ist.

17. Kleidungsstück (301) umfassend den Temperatursensor nach Anspruch 1, der derartig darin integriert ist, dass die mindestens eine dritte Schicht in Kontakt mit der Hautoberfläche des Körpers kommt, wenn das Kleidungsstück auf den Körper aufgelegt oder durch den Körper getragen wird.

Revendications

1. Capteur de température (100) destiné à des mesures de température corporelle, comprenant :

- une première couche (104) ayant un réchauffeur central (107) incorporé à l'intérieur,
- une deuxième couche (103) fixée à la première couche (104) ayant au moins une première thermistance (108) incorporée à l'intérieur pour mesurer une première valeur de température,
- au moins une troisième couche (101) ayant au moins une seconde thermistance (109) incorporée à l'intérieur séparée de la première thermistance (108) pour mesurer au moins une seconde valeur de température, l'au moins une troisième couche (101) étant adaptée pour être en contact avec la peau de la surface (106) du corps pour conduire la chaleur s'échappant du corps par le biais des couches, la différence entre les première et seconde valeurs de température indiquant le flux de chaleur provenant du corps, où la chaleur émise à partir du réchauffeur central est réglée de manière opposée au flux de chaleur jusqu'à ce qu'un flux de chaleur nul soit atteint, où la température au niveau de l'au moins une seconde thermistance au flux de chaleur nul indique la température du corps,

caractérisé en ce que la première, la deuxième et l'au moins une troisième couche sont des couches de tissu, et
dans lequel le réchauffeur central (107) est fabriqué en cousant, en tissant,
en tricotant ou en stratifiant des fils conducteurs à/dans un tissu, ou est imprimé sur la première couche en utilisant de l'encre conductrice ou une pâte conductrice.

2. Capteur de température selon la revendication 1, dans lequel les couches sont cousues ou stratifiées ensemble, entrelacées, ou une combinaison de cela.

3. Capteur de température selon la revendication 1, dans lequel la première et la deuxième couche (104, 103) sont fabriquées dans le même tissu et forment une unique couche fonctionnelle ayant le réchauffeur central (107) et l'au moins une première thermistance incorporés à l'intérieur de telle sorte qu'ils soient séparés l'un de l'autre.

4. Capteur de température selon la revendication 1, dans lequel la dimension du réchauffeur central (107) est adaptée à la profondeur de mesure de telle sorte que, plus la profondeur à mesurer est grande, plus la dimension du réchauffeur central devient grande.

5. Capteur de température selon la revendication 1, dans lequel le réchauffeur central (107) est fabriqué dans une matière conductrice avec une résistance entre 5 et
150 ohms/mètre.

6. Capteur de température selon la revendication 1, dans lequel les thermistances (108, 109) sont fixées à un circuit conducteur tissé, cousu ou tricoté.

7. Capteur de température selon la revendication 6, dans lequel le circuit conducteur est fabriqué dans une matière conductrice ayant une résistance inférieure à 20 ohms/mètre.

8. Capteur de température selon la revendication 1, dans lequel les couches de tissu sont fabriquées dans des tissus ou des non-tissés.

9. Capteur de température selon la revendication 1, dans lequel la deuxième et les au moins les troisièmes couches (103, 101) sont séparées par une couche d'isolation thermique flexible (102).

10. Capteur de température selon la revendication 1, comprenant en outre une couche isolante (105) appliquée sur le dessus de la première couche (104).

11. Capteur de température selon la revendication 1, comprenant en outre un émetteur (204) pour transmettre la température mesurée au niveau de l'au moins une seconde thermistance à un flux de chaleur nul à un dispositif de surveillance externe comprenant un récepteur.

12. Capteur de température selon la revendication 1, dans lequel le capteur de température (100) est intégré dans un patch (301).

13. Capteur de température selon la revendication 1, dans lequel le patch (301) comprend en outre une unité de traitement (201) pour convertir la sortie en provenance de l'au moins une seconde thermistance (108, 109) à un flux de chaleur nul en la température corporelle mesurée, une batterie (203) et un moyen indicateur (202) pour indiquer la température corporelle mesurée.

14. Capteur de température selon la revendication 1, comprenant en outre une thermistance latérale (Tside) (112) agencée à la périphérie de la troisième couche (101) et adaptée pour mesurer une troisième valeur de température à la périphérie de la troisième couche (101), où la différence entre la deuxième et la troisième valeur de température indique le flux de chaleur horizontal dans la troisième couche (101).

15. Capteur de température selon la revendication 14, comprenant en outre un réchauffeur latéral (113) est agencé à la périphérie de la troisième couche (101) adapté pour être réglé de manière opposée au flux de chaleur jusqu'à ce qu'un flux de chaleur horizontal nul soit atteint dans la troisième couche.

16. Capteur de température selon la revendication 15, dans lequel le réchauffeur latéral (113) est adapté à la forme géométrique de la troisième couche (101).

17. Vêtement (301) comprenant le capteur de température selon la revendication 1 intégré à l'intérieur de telle sorte que, lorsque le vêtement est placé sur le corps ou est porté par le corps, l'au moins une troisième couche vient en contact avec la peau de la surface du corps.

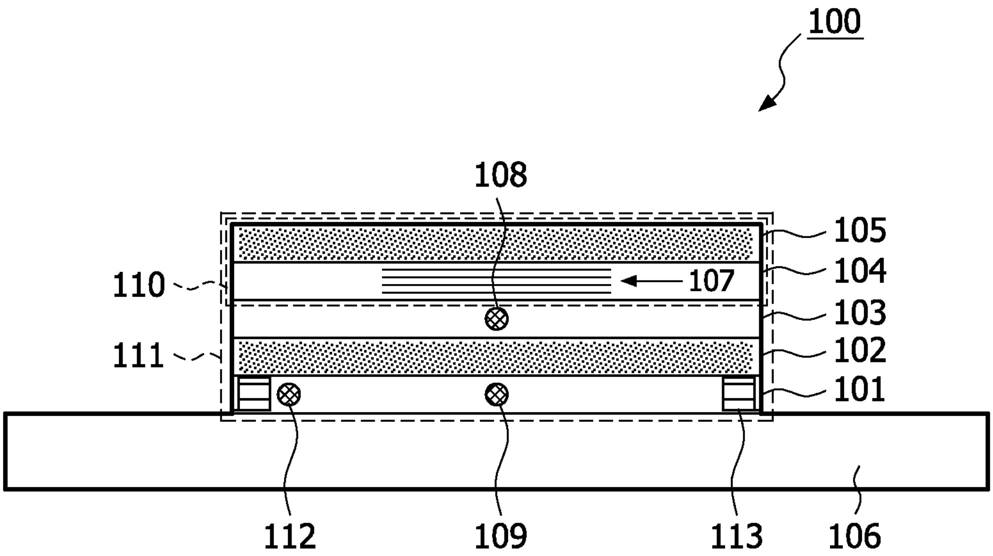
100
108
105
110
104
107
103
111
102
101
112
109
113
106

FIG. 1

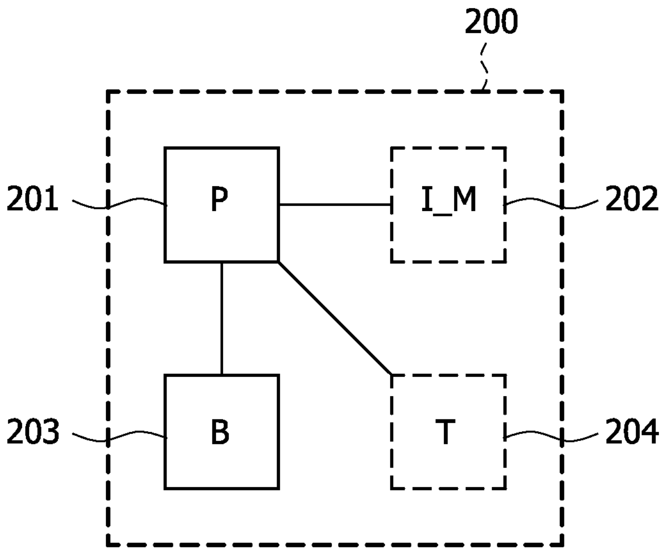
200
201
P
I_M
202
203
B
T
204

FIG. 2

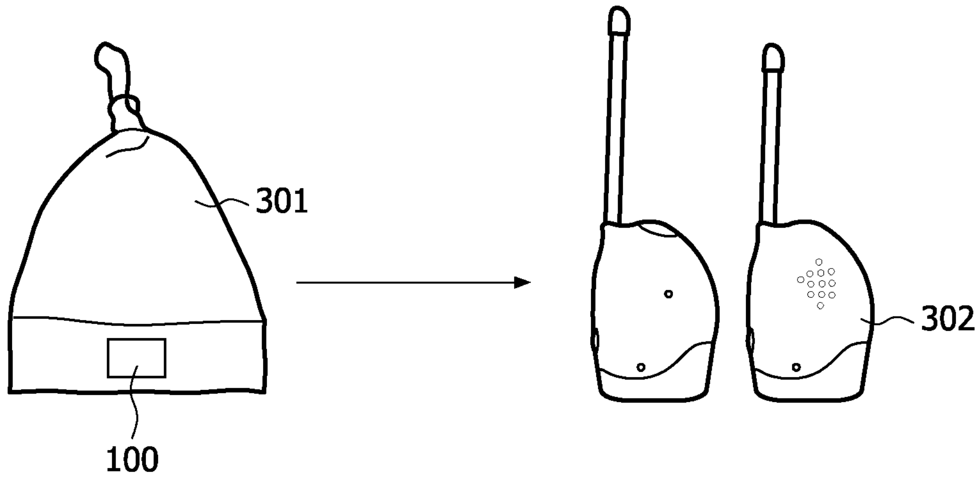

FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 3933045 A **[0005]**

Non-patent literature cited in the description

- **LYMBERIS A ; DITTMAR A.** *IEEE Engineering and Biology Magazine,* May 2007 **[0006]**

专利名称(译)	用于体温测量的温度传感器		
公开(公告)号	EP2417430B1	公开(公告)日	2017-06-14
申请号	EP2010714081	申请日	2010-04-01
[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
申请(专利权)人(译)	皇家飞利浦电子N.V.		
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优先权	2009157392 2009-04-06 EP		
其他公开文献	EP2417430A1		
外部链接	Espacenet		

摘要(译)

本发明涉及一种用于体温测量的温度传感器。温度传感器由若干层制成，其中第一层具有嵌入其中的中央加热器，附接到第一层的第二层具有嵌入其中的至少一个第一热敏电阻，用于测量第一温度值，第三层具有嵌入其中的一个或多个第二热敏电阻与第一热敏电阻分开，用于测量至少一个第二温度值，但该第三层适于与身体表面的皮肤接触，以传导从身体通过层逸出的热量。 。第一和第二温度值之间的差异表示来自身体的热通量。从中央加热器发出的热量与热通量相反地调节，直到达到零热通量，其中至少一个第二热敏电阻在零热通量处的温度表示体温。这些层是织物层。

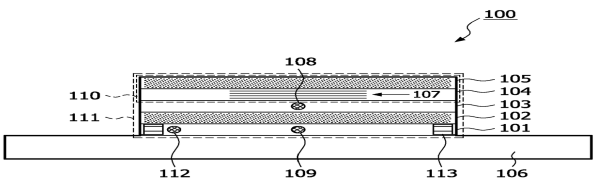

FIG. 1

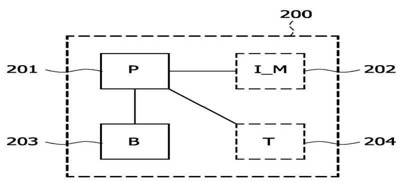

FIG. 2