

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
14 July 2011 (14.07.2011)

(10) International Publication Number
WO 2011/083441 A1

(51) International Patent Classification:

A61B 5/0408 (2006.01) A61B 5/04 (2006.01)
A61B 5/0416 (2006.01) A61B 5/11 (2006.01)

(21) International Application Number:

PCT/IB2011/050078

(22) International Filing Date:

10 January 2011 (10.01.2011)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

10100226.4 8 January 2010 (08.01.2010) HK

(72) Inventor; and

(71) Applicant : YUEN, Paul Anthony [CN/CN]; 2-12 Kwai Fat Road, 11-A Kwai Chung, New Territories, Hong Kong (CN).

(74) Agent: ONC Lawyers; Unit 1510, No. 9 Queen's Road, Central, Hong Kong (CN).

(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, 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, IS, JP, KE, KG, KM, KN, KP,

KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, 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.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, 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, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- 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))

(54) Title: PHYSIOLOGICAL SIGNAL COLLECTION APPARATUS AND PERFORMANCE MONITORING APPARATUS INCORPORATING SAME

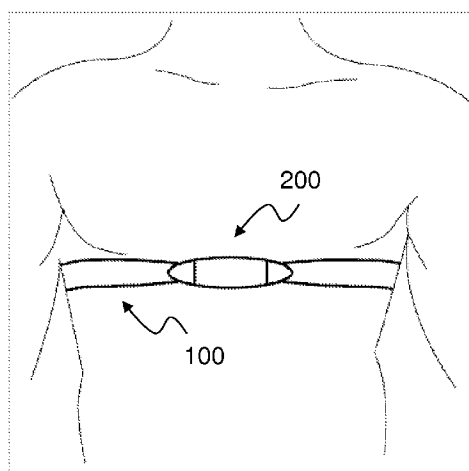


Figure 5

(57) Abstract: A physiological signal collection electrode comprises a signal collection pad having a skin contact portion, a signal output pad and an elongate bridging portion interconnecting the signal collection pad and the signal output pad. The signal collection pad, the signal output portion and the bridging portion are integrally moulded of a flexible, conductive and resilient material. The width of the bridging portion is substantially smaller than that of the skin contact portion. A narrowed bridging portion operates to concentrate collected physiological signals collected by the skin contact portion before the signals are output to the signal output pad. An elongate bridging portion reduces skin covering area for better wearer comfort as well as providing better resiliency to the electrode when the bridging portion is extended.

WO 2011/083441 A1

PHYSIOLOGICAL SIGNAL COLLECTION APPARATUS AND PERFORMANCE MONITORING APPARATUS INCORPORATING SAME

Field of the Invention

The present invention relates to physiological signal collection apparatus,
5 and more particularly to chest-worn physiological signal collection apparatus. This
invention also relates to performance monitoring apparatus comprising a
physiological signal collector and a signal processing device for processing
collected physiological signals. More specifically, although not solely limited
thereto, the present invention also relates to chest-worn swim monitors.

10 Background of the Invention

Physiological signal collectors are useful for collecting physiological data of
a person during physical exercises, during medical examination or during
everyday life. Typical physiological signals which are commonly collected for
processing and analyzing include ECG, heart rate, blood pressure, blood oxygen
15 content, body temperature. The collected signals are typically processed and
converted into data which provide information on the state of health, physical
fitness, or physical performance of a person.

A chest strap is a known type of physiological signal collectors adapted to
be chest-worn by a person for collecting physiological signals during physical

exercises or activities. Physiological signals commonly collected by a chest strap include, for example, heart-rate, ECG pulses, skin conductivity, infra-red absorption or other electrical or opto-electrical signals measureable from the skin of a person.

- 5 A typical chest strap usually includes a plurality of electrodes or sensors which is mounted on a flexible plastic chest strap in a spaced apart manner to collect weak physiological signals in electrical or optical form from a human body for differential signal processing. Each electrode typically comprises a signal reception pad having a signal reception surface with a surface area large enough
- 10 to collect signals which are strong enough for processing by a signal processing device, such as a heart rate signal processor.

- The flexible plastic strap is usually a pre-assembled strap loop which comprises a length adjustment or tension adjustment arrangement to tighten the strap against the body of a person, usually the chest, during use to provide
- 15 electrical contact between the electrodes and the skin of a user. The strap is usually made of soft plastics to provide flexibility for body wearing and electrical insulation between the electrodes. The tensions adjustment arrangement typically comprises a length of soft plastic strap portion which runs around buckle or clasp arrangements.

However, such chest-type physiological data collectors are uncomfortable and difficult to wear and adjust. Also, it is noted that known chest straps do not operate well enough for wet applications, for example swimming or water sports.

Therefore, it would be advantageous to provide improvement chest straps to
5 mitigate shortcoming aspects of conventional chest straps.

Summary of the Invention

According to the present invention, there is provided a physiological signal collection electrode comprising a signal collection pad having a skin contact portion, a signal output pad, and an elongate bridging portion interconnecting the
10 signal collection pad and the signal output pad, wherein the signal collection pad, the signal output portion and the bridging portion are integrally moulded of a flexible, conductive and resilient material; characterized in that the width of the bridging portion is smaller than that of the skin contact portion.

A narrowed bridging portion operates to concentrate collected physiological
15 signals collected by the skin contact portion before the signals are output to the signal output pad. An elongate bridging portion reduces skin covering area for better wearer comfort as well as providing better resiliency to the electrode when the bridging portion is extended. The signal collection pad coupled with the narrowed bridging portion makes the electrode more flexible and is therefore

particularly suitable for collecting human ECG signals, for example, from rib cage regions of a person.

To mitigate spurious signals reception of the bridging portion, the bridging portion may be covered by a flexible, resilient and waterproof insulating material such as rubber, silicone rubber or soft plastics. The insulating material is preferably over-moulded on the electrode for better shielding against spurious signals.

The skin contact portion may elevate from the signal collection pad and may be surrounded by an insulating material. The surface of the insulating material is preferably flush with the surface of the skin contact portion, thereby making a continuous flush surface for better wear comfort while maintaining a well defined signal collection area.

The signal output pad may include a signal output terminal to output the collected physiological signal for external processing.

The effective resistance of the electrode measured between the skin contact portion and the signal output terminal is less than 1 k Ω , preferably less than 500 Ω , and more preferably less than 400 Ω . It has been found that such a low resistance is beneficial for in or under water applications. Accordingly, the electrode may be configured as an ECG signal collector for collecting ECG signals

during swimming.

The skin contact surface may be flexible and elongate with an effective skin contact surface of between 7.5 cm² to 20cm².

The skin contact portion may be between 1.5-2.5 cm wide and 5-8 cm long.

5 The narrowed bridging portion may be between 6 and 10 cm long and about half or less than half of the width of the skin contact portion.

The flexible, conductive and resilient material may be selected from carbonized rubber, carbonized fabrics, Nickel copper plated polyester, silver nylon mesh, cotton silver bamboo fiber, or other conductive fabrics such as metalized
10 fabrics or the like.

According to another aspect of the present invention, there is provided an ECG signal collection strap comprising first and second ECG signal collection electrodes which are respectively mounted at first and second free longitudinal ends of an insulating strap, wherein each signal collection electrode comprises a
15 signal output terminal and a signal collection pad having a skin contact surface which is adapted for collecting ECG signals from the skin of a user, characterized in that, the ECG signal collection electrode is an electrode of the present invention.

According to yet another aspect of the present invention, there is provided an ECG signal collection strap comprising first and second ECG signal collection electrodes which are respectively mounted at first and second free longitudinal ends of an insulating strap, wherein each signal collection electrode comprises a signal output terminal and a signal collection pad having a skin contact surface which is adapted for collecting ECG signals from the skin of a user, characterized in that, first and second mechanical fastening parts are provided respectively at the first and second longitudinal ends of the strap for converting the longitudinal strap into a strap loop for wearing on the body of a user, and the first and second mechanical fastening parts are arranged such that the strap will urge the skin contact surfaces of the first and second electrodes to abut skin of the user to make electrical contacts and to collect physiological signals when the strap loop is worn on the body of the user with the fastening parts engaged.

Such an arrangement facilitates front wearing of the strap as a user could engage the fastening parts at the front of the chest.

The signal output terminal comprises a mechanical mating portion of a conductive mechanical fastening part which is adapted for engagement with a complementary mechanical mating portion of a counterpart mechanical fastening part. A signal output terminal which is also a mechanical portion of a conductive

mechanical fastening part means added user convenience because a user only needs to make a single connection step to achieve both electrical and mechanical connection.

The first and second mechanical fastening parts of the signal collection
5 strap may be adapted for mechanical engagement with a portable ECG signal processing device, and to form a complete strap loop upon engagement with the portable ECG signal processing device, and wherein the strap is arranged such that ECG signals collected by the electrodes are delivered to the portable ECG
10 signal processing device via the mechanical fastening parts. The portable ECG signal processing device is useful for ECG signal processing as well as serves as a latching bridging for converting the strap into a strap loop.

The signal output terminal may also a conductive mating portion of a snap fastener part. This facilitates snap fastening for making both electrical and mechanical connections for added convenience.

15 The insulating strap may be elastic and its length may be adjustable. The insulating strap may be made of air and/or moisture permeable elastomeric fabric such as elastomeric polyamide or swimwear fabric such as Nylon, Lycra®, polyester, or the like. Anti-slid texture may be formed on portions of the insulating strap which are in contact with user skin during use.

The bridging portion of each of the electrodes may be embedded within the insulated strap. The signal collection pad of each of the electrodes may be bonded on the insulated strap.

5 The mechanical fastening components may be arranged to convert the longitudinal tensioning strap into a tensioning strap loop. The conductive parts of the mechanical fastening components may form part of the signal output terminals and/or vice versa.

The swim motion detector and the ECG signal processing device may be formed as a module and may be housed within a common housing, and the ECG
10 signal processing device has first and second signal input terminals. The ECG signal processing device may be arranged to obtain ECG signals from the strap via the signal output terminals of the strap.

The swim motion detector may comprise a 3-axis accelerometer which is arranged to collect swim motion data.

15 The effective signal path resistance between the skin contact portion of the electrode and a corresponding output terminal may be less than that of the swim water signal path between the skin in contact with the electrode and the corresponding output terminal.

The monitor is adapted for use in sea water, chlorinated water or other ionized water, and the effective signal path resistance of each of the electrodes is below 800 ohms, preferably below 500 ohms.

Each of the first and second terminals of the ECG processing device may
5 be formed as a mating portion of a mechanical fastener part, and each of the output terminals of the strap is formed into a complementary mating portion of a counterpart mechanical fastener part.

The physiological signal processing module may connect with the signal collection strap to form a complete strap loop when they are mechanically
10 engaged.

The strap loop is a body strap such as a chest strap, head strap, arm strap, thigh strap, or the like.

Brief Description of the Drawings

Embodiments of the present invention will be explained below by way of example
15 and with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of a chest strap illustrating a first embodiment of the present invention,

Figures 2 and 3 respectively show the front and rear views of the chest strap of

Figure 1,

Figure 4 shows the strap of Figures 1-3 when fastened with an ECG processing apparatus,

Figure 4A shows the strap of Figure 4 when the ECG processing apparatus partly
5 detached from the chest strap,

Figure 5 is a schematic view illustrating the chest strap of Figure 1 in use,

Figure 5A is an enlarged view showing the chest strap of Figure 1 in combination with an ECG signal processor,

Figure 6 is a plan view of a first embodiment of an ECG electrode covered with an
10 insulator,

Figures 6A & 6B are respectively plan and side views of the electrode alone,

Figure 6C is a schematic side view illustrating the electrode of Figure 6 connected with an output terminal,

Figure 7 shows a second embodiment of an ECG electrode, and

15 Figure 7A shows a cross-sectional view of the electrode of Figure 7.

Detailed Description of Exemplary Embodiments

The strap of Figures 1 to 5A is a chest-worn ECG signal collection strap

apparatus (more commonly known to as a 'chest strap') illustrating an exemplary embodiment of a physiological signal collection strap of the present invention. The chest strap 100 comprises first 120 and second 140 ECG signal collection electrodes which are mounted on an elastic strap 180. The elastic strap is made of

5 a breathable and insulating material, such as a fabric comprising a mixture of polyamide and an elastomer. Each of the signal collection electrodes 120, 140 comprises a signal collection pad and a signal output portion. Each signal collection pad comprises a flexible signal collection surface which is arranged to contact the skin and collect ECG signals from a user during use.

10 A carbonized rubber pad as an example of a flexible signal collection pad is used to collect ECG signals from the chest of a user. The flexible signal collection pad is arranged such that it is urged and pressed against the skin of a user by the tension, more particularly the body-bound tension, of the elastic strap during use when the elastic strap is tightened on the body of the user to minimize contact

15 resistance between the skin and the signal collection pad. The flexible collection surface are arranged to transmit collected ECG signals to a signal output portion which is terminated at a conductive fastening component located at a longitudinal end of the strap. The conductive fastening components of the two ECG signal collection electrodes are located at opposite longitudinal ends of the strap and are

arranged to convert the longitudinal strap into a strap loop when the fastening components are respectively anchored onto corresponding or counterpart fastening components. Each conductive fastening component comprises a mechanical mating portion which is adapted for making counterpart engagement
5 with another compatible mechanical mating portion of a compatible fastener. Example of suitable fasteners includes a snap fit fastener or a magnetic clasp.

Each of the signal collection electrodes is mounted on the insulating fabric strap with the signal output portion located at or proximal to a free longitudinal end of the strap such that the two signal output portions are located at the two extreme
10 or free longitudinal ends before the chest strap is converted into a chest strap loop. In this condition, the two signal collection pads are located intermediate the two conductive fasteners which are located at the free longitudinal ends of the strap. To provide good mechanical fastening and good electrical contact, the signal output portion of the signal collection electrode is riveted onto the chest strap by a
15 rigid conductive fastener, which conductive fastener also operates as a signal output terminal to deliver ECG signals from the chest strap for further processing.

In order that ECG signals can be effectively collected from the chest of a user, the signal collection pads of the two ECG signal collection electrodes are disposed on the strap such that when the fastening components are mechanically

connected with the respective counterpart or corresponding fastening means to form a tensioned strap loop and duly worn and aligned on the chest of a user, the signal collection surfaces will be attached respectively to the left and right portions of the rib cage of the user. To adapt for this application, the distance between the two signal collection surfaces is equal to or approximately equal to the distance between the portions of the rib cage left and right of the sternum when the chest strap loop is duly worn. In order to provide adequate separation between the two signal collection surfaces during use, the signal collection pad of a signal collection electrode is connected to its corresponding signal output portion via a bridging portion which is adapted to provide spatial separation between the signal collection surface and the signal output portion. For good signal continuity, the signal collection pad, the bridging portion and the output portion are integrally moulded of carbonized rubber as an example of a flexible and conductive substance. It will be noted that the moulded flexible electrode is substantially planar for wearing comfort. The chest strap also comprises a strap length adjustment mechanism for adjusting the effective or usable length of the chest strap to cater for users of different chest widths.

Construction of an exemplary chest strap will be described in more detail below. The elastic strap comprises first and second elongate fabric layer strips

which are glued together to form a double-layered strap. Each of the fabric layers are made of an insulating and elastic fabric, such as a mixture of polyamide and elastomer. A breathable fabric which is moisture permeable is preferred for comfort wearing. The planar electrode is sandwiched or embedded between the two fabric layers, while leaving the signal collection surface and the signal output portion exposed for external electrical contact. The regions of the unexposed planar electrode are also glued to the elastic strap for durability. A bonding agent is applied to the periphery of the exposed signal collection surface to further bond the signal collection pad to the strap and to provide a smooth edge. As an optional feature, the back surface of the elastic strap, which is the surface adapted to be in contact with the skin of a user, is formed with a woven anti-slid texture. As a further option, the material composition of the two strap layers could be different. For example, the textured layer may be made of 37% elastomer while the non-textured layer comprises less than 20% elastomer.

15 In an exemplary use of the chest strap as shown in Figures 4, 4A & 5, the chest strap is illustrated when used in combination with a mobile ECG signal processor 200. The ECG signal processor includes a rigid housing and a pair of signal input terminals. Each signal input terminal is a fastening component having a rigid mechanical mating portion which is configured to engage with a

corresponding fastening component of the chest strap. The distance between the two signal collection surfaces in this application configuration therefore includes the longitudinal separation between the two fastening components on the mobile ECG signal processor. The ECG signal processor includes means for capturing
5 and processing the detected ECG signals, as well as optional features for transmitting the relevant data to an external device for further processing or storage.

Referring to Figures 6 to 6C, there is shown an embodiment of a signal collection electrode 300 comprising a flexible contact pad 310, a signal output
10 portion 320 and a bridging portion 330 interconnecting the flexible contact pad and the signal output portion. The signal collection electrode is integrally moulded of carbonized rubber and is substantially planar and elongate. As is better seen in Figures 6B and 6C, the flexible contact portion 310 protrudes above the bridging portion to form an elevated signal collection surface. The entire electrode, except
15 for the signal collection surface and the signal output portion, is covered by an insulator, which is for example a moulded rubber sleeve 340. The rubber sleeve 340 comprises optionally perforations to improve permeability. A mechanical fastening component, for example a snap fastener part, is formed through the signal output portion to form the signal output terminal 350.

The electrode 400 of Figures 7 & 7A also comprises a flexible contact pad 410, a signal output portion 420 and a bridging portion 430 and is integrally moulded of a flexible and resilient conductive substance. The bridging portions of the electrodes of Figures 6 & 7 are narrower than the width of the signal collection surface. Such a narrowed bridging portion of a resilient material provides additional elasticity to strength the chest strap. In addition, the narrowed bridging portion also eliminates the need of extra breathing perforations.

As an alternative, the bridging portions of the electrodes could be of a same or comparable width to that of the signal collection surface, and perforations may be optionally formed outside the signal collection surfaces to improve breathability.

Regardless of the specific electrode designs, each of the signal collection pad is configured so that the effective area of the distributed signal collection surface could collect reasonable ECG signals for meaningful processing. The effective area here refers to the surface which exposes through the fabric strap and which has a typical width of about 1.5 to 2.5 cm and a typical length of about 5-8 cm. The resistance of the electrode, measured between the signal collection pad and the signal output portion, is typically below 1k Ω for good signal processing and operation.

In an exemplary use of the chest strap for swim applications, the electrode

resistance is typically below 1,000 Ω , preferably below 700 Ω , and more preferably below 500 Ω and even 400 Ω . It is noted that such a low resistance provides a useful solution to enable ECG signal collection in both sea and chlorinated water.

When using as a swim chest strap, the bridging portion is insulated by a moulded
5 collar which is mould over the electrode, leaving only the signal collection surface and the signal output portion exposed. The insulated bridging portion mitigates signal leakage or interference when the chest is used in a highly conductive medium such as sea or chlorinated water.

While the present invention has been explained with reference to the
10 embodiments above, it should be appreciated that the embodiments are only described to illustrate the invention and are not meant for restricting the scope of invention. For example while a swim monitor strap has been illustrated as an example, a strap of the present invention could be used for running or other activities without loss of generality.

Table of Numerals

100		Chest strap
	120	First ECG signal collection electrode
	140	Second ECG signal collection electrode
	180	Strap
200		Mobile ECG signal processor
300		Signal collection electrode
	310	Contact pad
	320	Signal output portion
	330	Bridging portion
	340	Sleeve
	350	Signal output terminal
400		Electrode
	410	Contact pad
	420	Output portion
	430	Bridging portion

CLAIMS:

1. A physiological signal collection electrode comprising a signal collection pad having a skin contact portion, a signal output pad and an elongate bridging portion interconnecting the signal collection pad and the signal
5 output pad, wherein the signal collection pad, the signal output portion and the bridging portion are integrally moulded of a flexible, conductive and resilient material; characterized in that the width of the bridging portion is substantially smaller than that of the skin contact portion.
2. An electrode according to Claim 1, wherein the signal output pad defines a
10 signal output aperture, and the width of the bridging portion is smaller than that of the signal output pad but comparable to that of the signal output aperture.
3. An electrode according to Claims 1 or 2, wherein the bridging portion is
15 covered by a flexible, resilient and waterproof insulating material such as rubber, silicone rubber or soft plastics.
4. An electrode according to any of the preceding Claims, wherein the skin contact portion is elevated from the signal collection pad and surrounded by an insulating material.

5. An electrode according to Claims 3 or 4, wherein the insulating material is over-moulded onto the electrode.
6. An electrode according to any of the preceding Claims, wherein the signal output pad includes a signal output terminal, and wherein the effective resistance of the electrode measured between the skin contact portion and the signal output terminal is less than 1 k Ω , preferably less than 500 Ω , and more preferably less than 400 Ω .
7. An electrode according to any of the preceding Claims, wherein the skin contact surface is flexible and elongate with an effective skin contact surface of between 7.5 cm² to 20cm².
8. An electrode according to any of the preceding Claims, wherein the skin contact portion is between 1.5 -2.5 cm wide and 5-8 cm long.
9. An electrode according to any of the preceding Claims, wherein the narrowed bridging portion is between 6 and 10 cm long and about half or less than half of the width of the skin contact portion.
10. An electrode according to any of the preceding Claims, wherein the flexible, conductive and resilient material is selected from carbonized rubber, carbonized fabrics, Nickel copper plated polyester, silver nylon mesh,

cotton silver bamboo fiber, or other conductive fabrics such as metalized fabrics or the like.

11. An ECG signal collection strap comprising first and second ECG signal collection electrodes which are respectively mounted at first and second free longitudinal ends of an insulating strap, wherein each signal collection electrode comprises a signal output terminal and a signal collection pad having a skin contact surface which is adapted for collecting ECG signals from the skin of a user, characterized in that, the ECG signal collection electrode is an electrode according to any of Claims 1 to 10.
12. An ECG signal collection strap comprising first and second ECG signal collection electrodes which are respectively mounted at first and second free longitudinal ends of an insulating strap, wherein each signal collection electrode comprises a signal output terminal and a signal collection pad having a skin contact surface which is adapted for collecting ECG signals from the skin of a user, characterized in that, first and second mechanical fastening parts are provided respectively at the first and second longitudinal ends of the strap for converting the longitudinal strap into a strap loop for wearing on the body of a user, and the first and second mechanical fastening parts are arranged such that the strap will urge the skin contact

surfaces of the first and second electrodes to abut skin of the user to make electrical contacts and to collect physiological signals when the strap loop is worn on the body of the user with the fastening parts engaged.

13. An ECG signal collection strap according to Claims 12, wherein the signal
5 output terminal comprises a mechanical mating portion of a conductive mechanical fastening part which is adapted for engagement with a complementary mechanical mating portion of a counterpart mechanical fastening part.
14. An ECG signal collection strap according to Claims 12 or 13, wherein each
10 signal collection electrode comprises a signal output pad on which there is formed the signal output terminal and an elongate bridging portion interconnecting the signal collection pad and the signal output pad; wherein the signal collection pad, the signal output portion and the bridging portion are integrally moulded of a flexible, conductive and resilient material; and
15 wherein the signal output terminal is mechanically mounted on the signal output pad and formed as a mechanical mating portion of a conductive mechanical fastening part.
15. An ECG signal collection strap according to any of Claims 12 to 14, wherein the first and second mechanical fastening parts of the signal

- collection strap are adapted for mechanical engagement with a portable ECG signal processing device, and to form a complete strap loop upon engagement with the portable ECG signal processing device, and wherein the strap is arranged such that ECG signals collected by the electrodes are delivered to the portable ECG signal processing device via the mechanical fastening parts.
- 5
16. An ECG signal collection strap according to any of Claims 12-15, wherein the signal output terminal is also a conductive mating portion of a snap fastener part.
- 10 17. An ECG signal collection strap according to any of Claims 12 to 16, wherein the signal output terminal and the signal collection pad of an electrode are exposed on opposite surfaces of the insulating strap.
- 15 18. An ECG signal collection strap according to any of Claims 12-17, wherein the signal output terminal and the signal collection pad of the signal collection electrode are respectively proximal and distal from the free longitudinal end of the signal collection strap on which the electrode is mounted, and the skin contact surfaces of the first and second signal collection electrodes are arranged to respectively abut the left and right rib cage portions of a user when the strap is worn with the first and second

mechanical fastening parts engaged.

19. An ECG signal collection strap according to any of Claims 12-18, wherein the insulating strap is elastic and its length is adjustable.
20. An ECG signal collection strap according to any of Claims 12-19, wherein
5 the insulating strap is made of air and/or moisture permeable elastomeric fabric such as elastomeric polyamide or swimwear fabric such as Nylon, Lycra®, polyester, or the like.
21. An ECG signal collection strap according to any of Claims 12 to 20, wherein anti-slid texture is formed on portions of the insulating strap which
10 are in contact with user skin during use.
22. An ECG signal collection strap according to any of Claim 12 to 21, wherein the signal collection electrode is an electrode according to any of Claims 1 to 10.
23. An ECG signal collection strap according to any of Claims 12-22, wherein
15 the bridging portion of each of the electrodes is embedded within the insulated strap.
24. An ECG signal collection strap according to any of Claims 12-23, wherein the signal collection pad of each of the electrodes is bonded on the

insulated strap.

25. An ECG signal collection strap according to any of Claims 12-24, wherein the insulating strap is an elastic tensioning strap, and the signal output terminals of the first and second signal collection electrodes are the end terminals of the tensioning strap.
- 5
26. An ECG signal collection strap according to any of Claims 12-25, wherein the tensioning strap comprises mechanical fastening components located at longitudinal ends of the tensioning strap, and wherein the mechanical fastening components are arranged to convert the longitudinal tensioning strap into a tensioning strap loop; and wherein the conductive parts of the mechanical fastening components form part of the signal output terminals and/or vice versa.
- 10
27. A swim performance monitor comprising a swim motion detector arranged to detect swim motion data, an ECG signal processing device arranged to process physiological data of a user, and an ECG signal collection strap according to any of Claims 12 to 24; wherein the swim motion detector and the ECG signal processing device are formed as a module and are housed within a common housing, and the ECG signal processing device has first and second signal input terminals; and wherein the ECG signal processing
- 15

device is arranged to obtain ECG signals from the strap via the signal output terminals of the strap.

28. A swim performance monitor according to Claim 27, wherein the swim motion detector comprises a 3-axis accelerometer which is arranged to collect swim motion data.
29. A swim performance monitor according to Claims 27 or 28, wherein resistance of the electrode is such that the effective signal path resistance between the skin contact portion of the electrode and a corresponding output terminal is less than that of the swim water signal path between the skin in contact with the electrode and the corresponding output terminal.
30. A swim performance monitor according to Claim 29, wherein the monitor is adapted for use in sea water, chlorinated water or other ionized water, and the effective signal path resistance of each of the electrodes is below 800 ohms, preferably below 500 ohms.
31. A swim performance monitor according to any of Claims 26-30, wherein each of the first and second terminals of the ECG processing device is formed as a mating portion of a mechanical fastener part, and each of the output terminals of the strap is formed into a complementary mating portion of a counterpart mechanical fastener part.

32. A physiological signal monitoring apparatus comprising a signal collection strap according to any of the preceding Claims and a physiological signal processing module, the physiological signal processing module comprising a physiological signal processor arranged to process data collected by the signal collection strap; wherein the first electrode and the second electrode are arranged for collecting physiological signals from the human body for processing by the physiological signal processor.
- 5
33. A physiological signal monitoring apparatus according to Claim 32, wherein the physiological signal processor is for processing ECG or heart rate signals and the first and second electrodes are arranged for collecting ECG or heart rate signals.
- 10
34. A physiological signal monitoring apparatus according to Claims 32 or 33, wherein the physiological signal processing module comprises conductive mechanical fasteners for mechanical engagement with the mechanical fastener components of the first and the second electrodes.
- 15
35. A physiological signal monitoring apparatus according to any of Claims 32 to 34, wherein the physiological signal processing module connects with the signal collection strap to form a complete strap loop when they are mechanically engaged.

36. A physiological signal monitoring apparatus according to Claim 35, wherein the strap loop is a body strap such as a chest strap, head strap, arm strap, thigh strap, or the like.

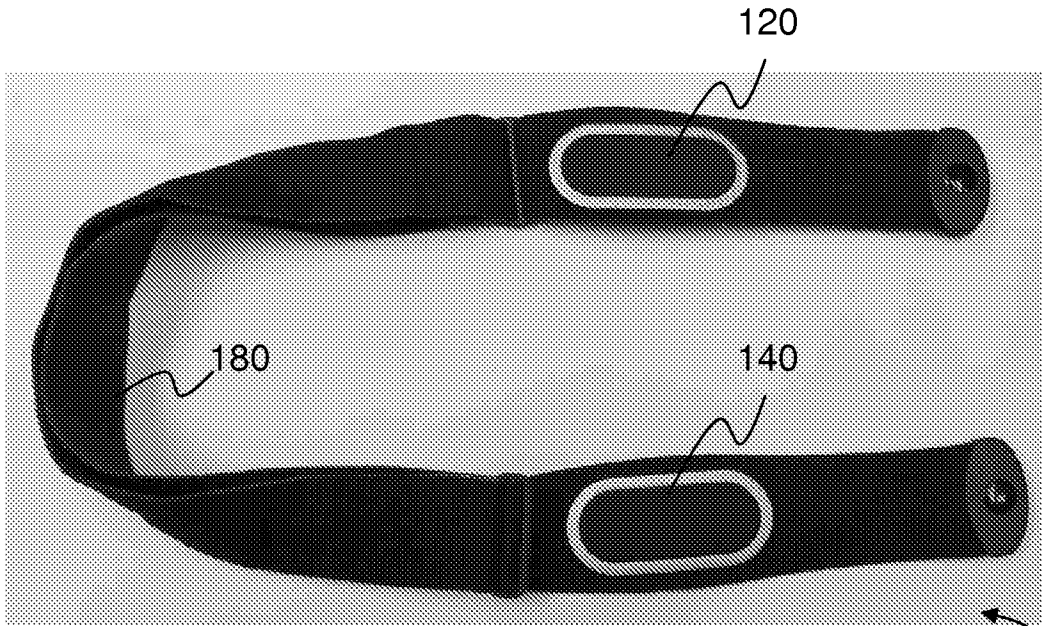


Figure 1

100

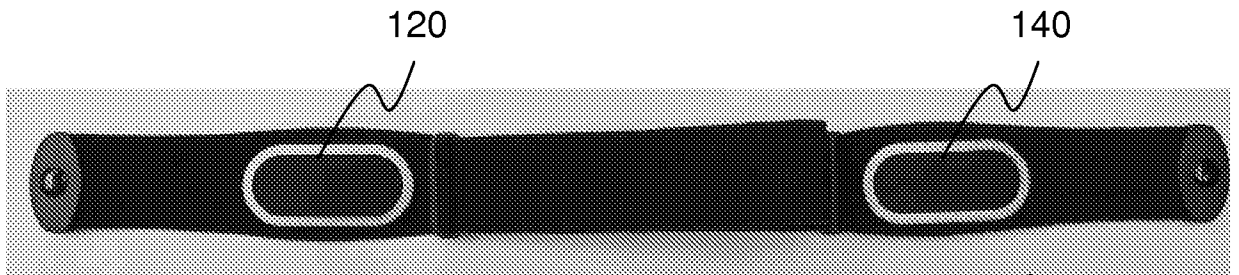


Figure 2

100

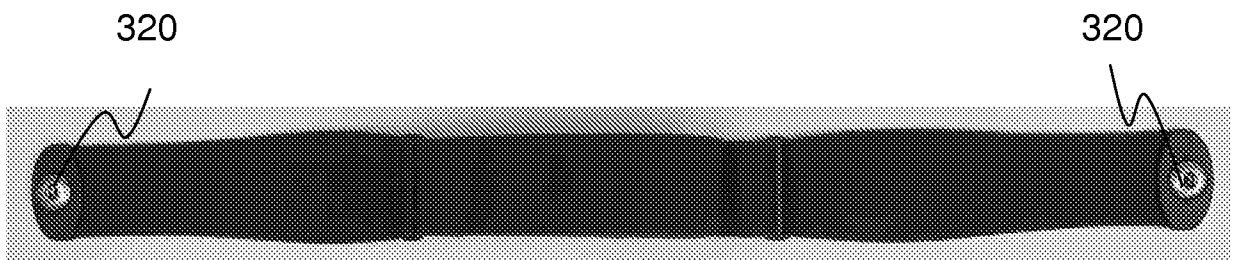


Figure 3

100

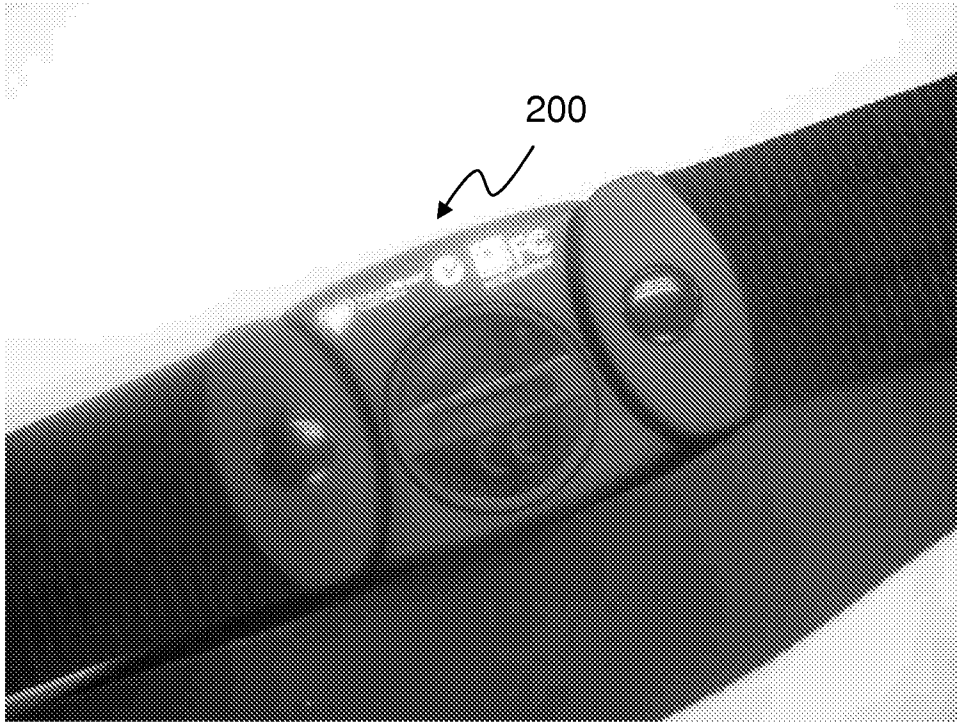


Figure 4

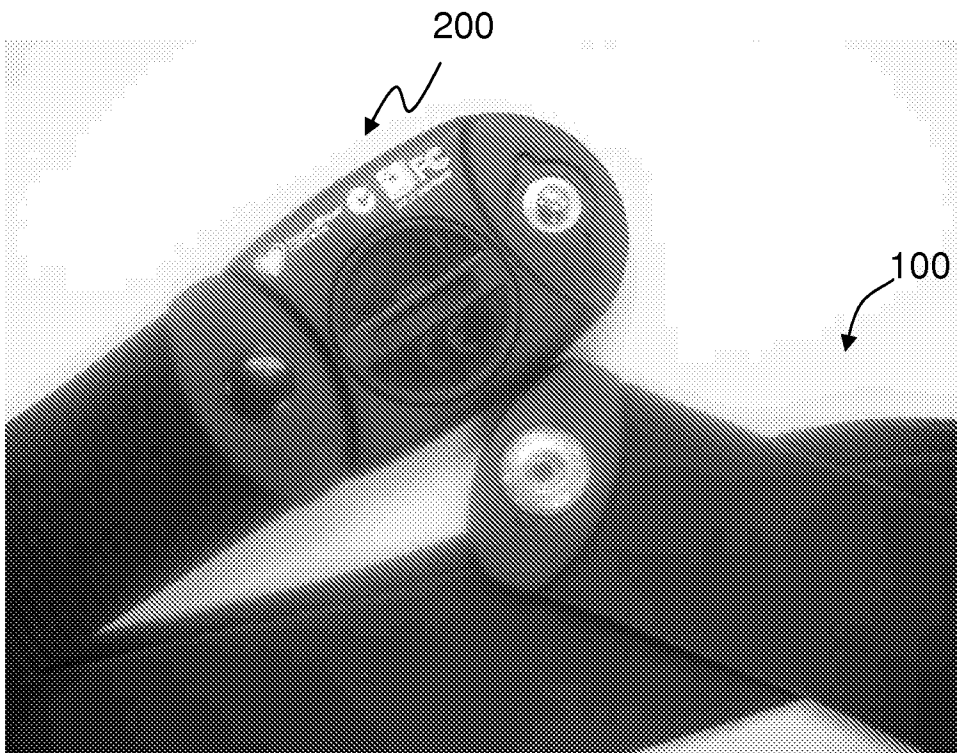


Figure 4A

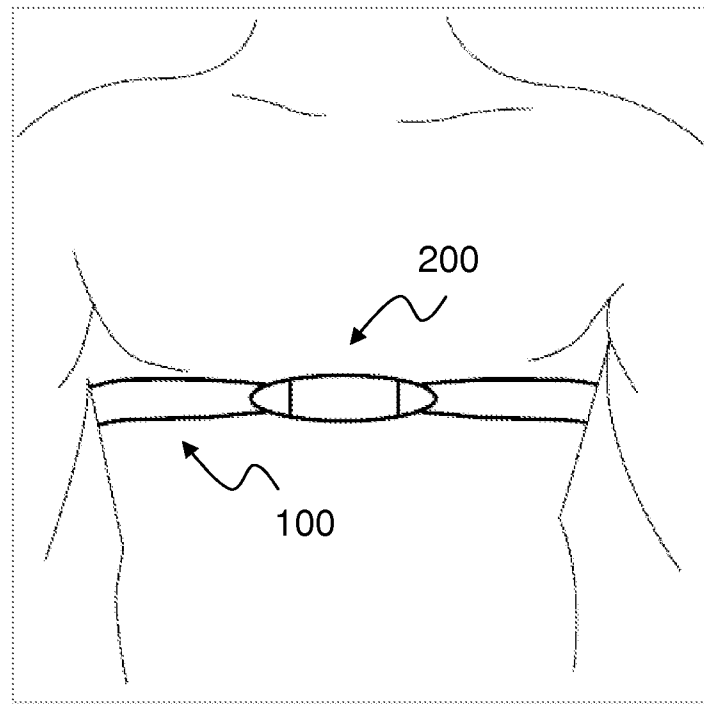


Figure 5

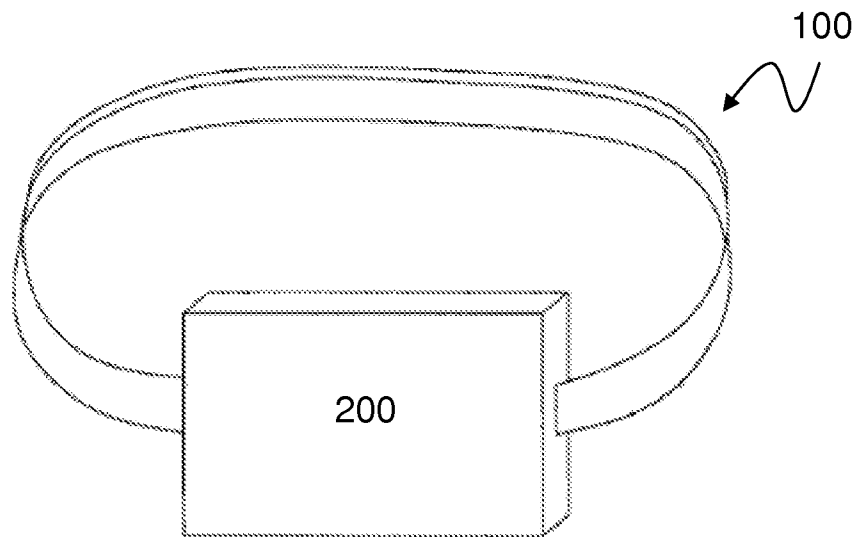


Figure 5A

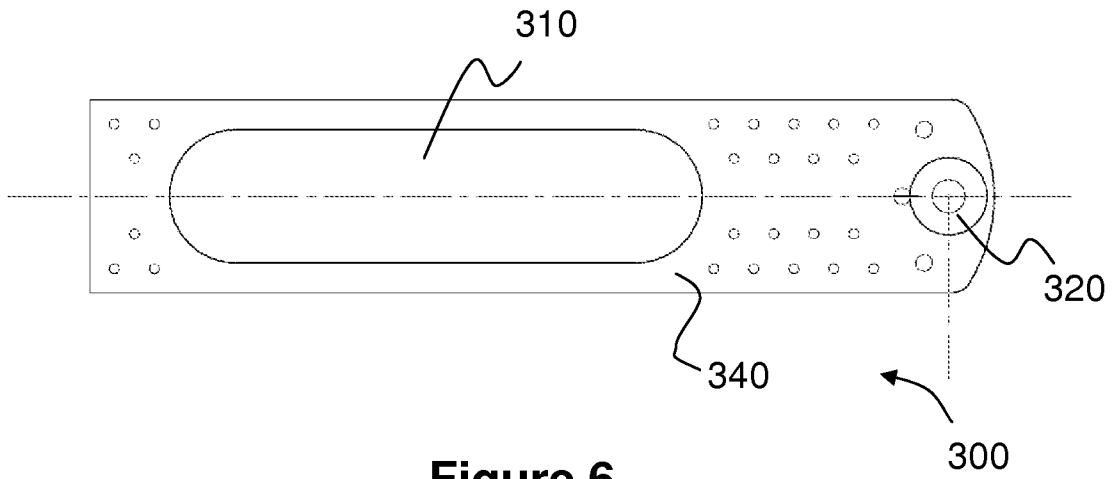


Figure 6

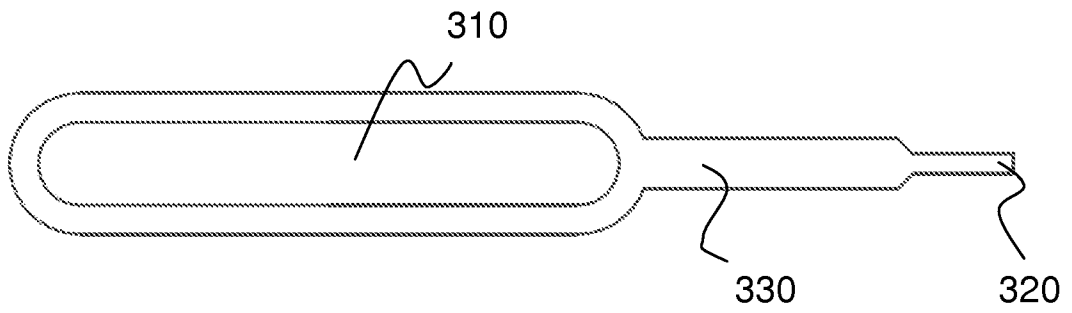


Figure 6A

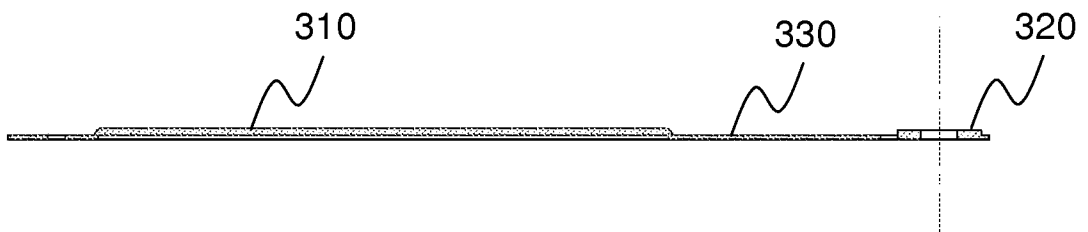


Figure 6B

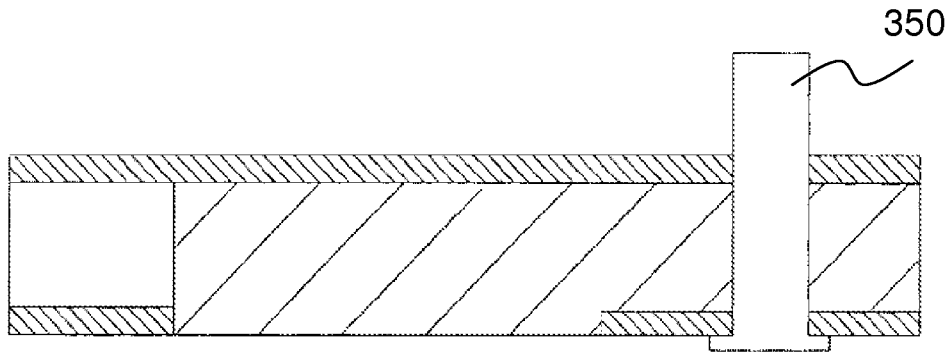


Figure 6C

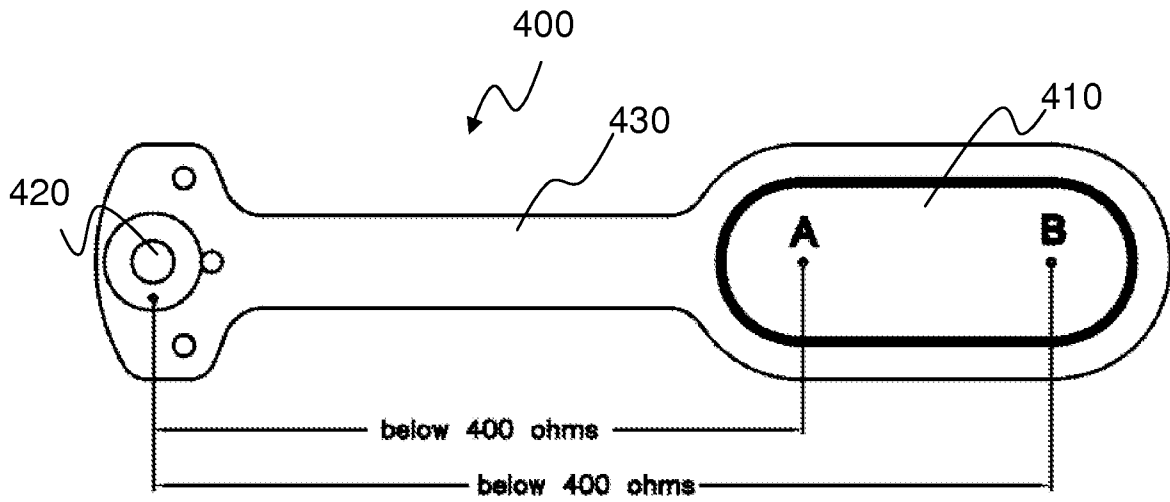


Figure 7

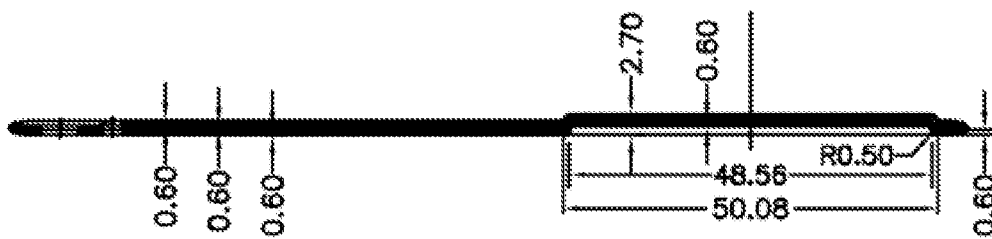


Figure 7A

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2011/050078

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: A61B5/-

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)

WPI, EPODOC, CNPAT, CNKI: ELECTRODE?, SENSOR+, BELT+, STRAP+, CONTACT+, OUTPUT+, BRIDG+, MOLD+, MOULD+, INTEGRAL+, INTEGRAT+, PAD?, SHEET+, SWIM+, SPORT+, MOTION+, MOVEMENT?, ECG, ELECTROCARD+, CARDIO+, CARDIAC+, HEART, ACCELEROMETER+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US2007/0093707A1(NOGUCHI, Eriko) 26 Apr. 2007(26.04.2007) paragraphs 24-26 in the specification, figures 1-4	1-11, 14, 22, 27-36
Y	JP2002143110A(NIPPON SEIMITSU SOKKI KK) 21 May 2002(21.05.2002) paragraph 12 in the specification, figure 4	1-11, 22, 27-36
X	US2005/0096556A1(HSIEH CHEN, Yi Mei) 05 May 2005(05.05.2005) paragraphs 26-27, 42-43 in the specification, figures 15-17	12-13, 15-21, 23-26

Further documents are listed in the continuation of Box C.

See patent family annex.

<p>* Special categories of cited documents:</p> <p>“A” document defining the general state of the art which is not considered to be of particular relevance</p> <p>“E” earlier application or patent but published on or after the international filing date</p> <p>“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)</p> <p>“O” document referring to an oral disclosure, use, exhibition or other means</p> <p>“P” document published prior to the international filing date but later than the priority date claimed</p>	<p>“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</p> <p>“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</p> <p>“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</p> <p>“&”document member of the same patent family</p>
--	--

Date of the actual completion of the international search 22 Apr. 2011(22.04.2011)	Date of mailing of the international search report 19 May 2011 (19.05.2011)
---	---

<p>Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451</p>	<p>Authorized officer WANG Rui Telephone No. (86-10)82245033</p>
---	---

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2011/050078

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US2005/0096556A1(HSIEH CHEN, Yi Mei) 05 May 2005(05.05.2005) paragraphs 26-27, 42-43 in the specification, figures 15-17	11, 14, 22, 27-36
Y	US2008/0284650A1(MNT INNOVATIONS PTY LTD.) 20 Nov. 2008(20.11.2008) paragraphs 11-25 in the specification	27-31
X	US2009/0069724A1(OTTO, Chris A. et al.) 12 Mar. 2009(12.03.2009) paragraphs 28-63 in the specification, figures 1-3	12-13, 15-21, 23-26

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2011/050078

Continuation of: second sheet: A. CLASSIFICATION OF SUBJECT MATTER

A61B5/0408 (2006.01) i

A61B5/0416 (2006.01) i

A61B5/04 (2006.01) i

A61B5/11 (2006.01) i

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2011/050078

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US2007/0093707A1	26.04.2007	GB2431586A	02.05.2007
		GB2431586B	27.10.2010
		DE102006047090A1	16.05.2007
		JP2007117157A	17.05.2007
JP2002143110A	21.05.2002	NONE	
US2005/0096556A1	05.05.2005	NONE	
US2008/0284650A1	20.11.2008	EP1992389A1	19.11.2008
		AU2008202170A1	04.12.2008
US2009/0069724A1	12.03.2009	US2009/0048540A1	19.02.2009

专利名称(译)	生理信号收集装置和包含其的性能监测装置		
公开(公告)号	EP2521485A4	公开(公告)日	2015-05-20
申请号	EP2011731723	申请日	2011-01-10
申请(专利权)人(译)	DAYTON TECHNOLOGIES LIMITED		
当前申请(专利权)人(译)	DAYTON TECHNOLOGIES LIMITED		
[标]发明人	YUEN PAUL ANTHONY		
发明人	YUEN, PAUL ANTHONY		
IPC分类号	A61B5/0408 A61B5/0416 A61B5/04 A61B5/11 A61B5/00		
CPC分类号	A61B5/04085 A61B5/04 A61B5/04012 A61B5/11 A61B5/6814 A61B5/6823 A61B5/6824 A61B5/6828 A61B5/6831 A61B2560/0412 A61B2562/0219		
优先权	10100226 2010-01-08 HK		
其他公开文献	EP2521485A1		
外部链接	Espacenet		

摘要(译)

生理信号收集电极包括信号收集垫，该信号收集垫具有皮肤接触部分，信号输出垫和将信号收集垫和信号输出垫互连的细长桥接部分。信号收集垫，信号输出部分和桥接部分由柔性，导电和弹性材料整体模制而成。桥接部分的宽度基本上小于皮肤接触部分的宽度。在信号输出到信号输出垫之前，变窄的桥接部分用于集中由皮肤接触部分收集的收集的生理信号。细长的桥接部分减小了皮肤覆盖区域，以便更好地佩戴者舒适，并且当桥接部分延伸时为电极提供更好的弹性。