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(54) WATCH STRAP FOR A MECHANICAL WATCH

UHRENARMBAND FÜR EINE MECHANISCHE UHR

BRACELET DE MONTRE POUR MONTRE MÉCANIQUE

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(73) Proprietor: **Tishurova, Olga**
65812 Bad Soden am Taunus (DE)

(72) Inventor: **Tishurova, Olga**
65812 Bad Soden am Taunus (DE)

(74) Representative: **Richardt Patentanwälte PartG mbB**
Wilhelmstraße 7
65185 Wiesbaden (DE)

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Description

Field of the invention

[0001] The invention relates to mechanical watches, in particular to watch straps for mechanical watches.

Background and related art

[0002] Mechanical watches are known for their durability and longevity. For example, mechanical watches may be used reliably in variety of extreme climates and environmental conditions, including humidity, pressure and radiation. The watch strap is an important part of a mechanical wrist watch.

[0003] Several watch strap designs are known from the prior art: Unites States patent application publication US 2014/00533602 A1 discloses the use of a flexible metallic blade imbedded within a watch strap for mechanical reinforcement. United States patent 8,870,448 B2 discloses a comfort pad that enables an automatic adjustment of the watch strap to a variety of wrist sizes.

[0004] International patent application WO 2016/125034 A1 discloses a smart watchband with integrated electronics designed to be attachable to a standard mechanical or digital timepiece. The watchband has a flexible circuit board sandwiched between layers of watchband material, allowing for the flexibility of a normal watchband with the electronics capability of a mobile computer and fitness tracker. The watchband has an embedded heart rate sensor, body temperature sensor, ambient temperature sensor, vibration generator, inertial sensors, and wireless communication device.

[0005] International patent application WO 2015/107523 A1 discloses a band configured for being used with a wristwatch and comprising an electronic unit configured for a wireless communication with a variety of portable devices, such as a mobile phone, the band being further configured to be attached to a wristwatch so as corresponding engagement portions of the band and the wristwatch provide secure and tight engagement of the band to the wristwatch.

[0006] European patent publication EP 3 040 792 A1 discloses a mechanical wristwatch comprising a housing and a wristband. The wristband is connected to the housing for wearing the mechanical wristwatch on a wrist of a user. The housing comprises a mechanical watch movement that has at least one of an input/output module and a data processor that is internally located within the wristband such that the wristband is able to: receiving data through the at least one input/output module, processing data by the at least one data processor, and transmitting processed data through the at least one input/output module. The wristband is functionally independent from the housing.

[0007] Numerous smart watches and fitness trackers are available on the market. However the pure electronic devices are known for short durability and lifespan, and furthermore, do not fulfill the aesthetic requirements for many people.

Summary

[0008] The invention relates to a watch strap according to claim 1, a mechanical watch according to claim 11 and a method of using the watch strap according to claim 13. Embodiments are given in the dependent claims.

[0009] A watch strap as used herein is a flexible band which may be wrapped around the wrist of a subject to secure or attach a mechanical watch to the wrist. A watch strap may in some examples be formed by two watch strap parts that are joined by a buckle, clasp, or other closure.

[0010] A mechanical watch as used herein is a watch that comprises a mechanically powered movement, also known as a mechanical watch movement, and is devoid of any electrical or electronic component. A mechanical watch is a purely mechanical watch with a spring powered movement which make them durable and able to be worn lifelong. To maintain this durability and longevity it has not been desirable to incorporate features such as sensors or electronic components into the watch itself. Furthermore, the durability and lifetime of the mechanical parts and electronical parts is different and represents a value conflict.

[0011] Embodiments may provide a means of enhancing the functionality of a mechanical watch. Embodiments of the invention are particularly advantageous as the electronic is placed exclusively in the watch strap so that the mechanically powered movement may not interfere with the operation of sensitive electronics. Likewise, it is ensured that electronic components do not interfere with the operation of a mechanical watch movement.

[0012] Despite a desire to not include electronics into a mechanical watch, embodiments may provide for a means of augmenting traditional mechanical watches with modern electronic functionality by encapsulating an electronics module within a watch strap in an unobtrusive way. This may provide the wearer the comfort feeling of two innovative technologies, mechanical and electronical.

[0013] By encapsulating an electronics module within the flexible material of a watch strap, the electronics module and the mechanical watch movement may be isolated from each other. This may enable mechanical watch users to keep using the mechanical watch while changing the watch strap and may enable the mechanical watch to be augmented with exciting new features such as the monitoring of physiological features or other features associated with smart watches and smart phones. Incorporating the electronics module in a watch strap therefore enables the user of a mechanical watch to enhance the mechanical watch and enjoy the latest electronic innovations.

[0014] As well as amenities such as monitoring the physiological state of a subject wearing the watch, some

examples may also provide interconnectivity with other electronic devices such as a smartphone or other telecommunications device.

[0015] Embodiments may accomplish this by providing for a watch strap formed from a flexible material and encapsulating the electronics module within the flexible material. As part of a watch strap, the watch strap is configured for attaching the mechanical watch to the wrist of the subject. Encapsulating the electronics module within the flexible material protects the electronics module. Integrating the electronics into the watch strap enables the electronics to be easily replaced if the electronics fail or need to be updated.

[0016] In another embodiment the electronics module is located in an area of the watch strap configured for covering the radius bone when worn by the subject. Surprisingly, regardless of the hand that the watch strap is worn on, if the electronics module is above or covering the radius bone then the electronics module is less likely to be damaged. When a subject swings his or her arms or rests them on a table the ulna bone tends to contact the table or other surfaces. The radius bone is typically pointing towards the subject. For example, placing the electronics module over the radius bone provides mechanical protection of the electronics module because it is less subject to mechanical impact when a hand is placed or rested on a desk. Another advantage may be that the watch strap hangs or is pressed onto the radius bone so that a mechanical watch may provide weight which brings the sensor into better contact with the skin of the subject.

[0017] If a watch strap is provided as two watch strap parts (also known as portions or sides) it may be possible to update or replace only one of the two watch strap parts. It may not be necessary to replace the entire watch strap or both watch strap parts.

[0018] In one aspect the invention provides for a watch strap that is configured for attaching a mechanical watch to a wrist of a subject. The watch strap is formed from a flexible material. The watch strap comprises an electronics module encapsulated by the flexible material. The electronics module comprises a sensor configured for acquiring sensor data descriptive of at least one physiological parameter of the subject. This embodiment may be advantageous because encasing the electronics module or encapsulating it within the flexible material may provide for a means of protecting the electronics module from mechanical damage.

[0019] In another embodiment the watch strap comprises a 6 o'clock watch strap part with a 6 o'clock strap attaching portion. The 6 o'clock strap attaching portion is configured for attaching the 6 o'clock watch strap part to a mechanical watch head. Typically, watch straps are attached to mechanical watches using lugs. There is a set of lugs located at 12 o'clock and at 6 o'clock on the mechanical watch head. The watch strap may be divided into two watch strap parts or two sides. In other examples the watch strap is formed from a single band or structure that has two sides: the side which mounts at the 12 o'clock lugs and at the 6 o'clock lugs. The 6 o'clock watch strap part is the portion which mounts to the 6 o'clock lugs of the watch. The electronics module is encapsulated within the 6 o'clock watch strap part and is at least partially adjacent to the 6 o'clock strap attaching portion. Being at least partially adjacent to the 6 o'clock strap attaching portion means that at least one edge or portion of the electronics module is adjacent to the 6 o'clock strap attaching portion. A potential benefit of incorporating the electronics module into the 6 o'clock watch strap part is that this may position the electronics module above the radius bone.

[0020] In another embodiment the watch strap comprises a 12 o'clock watch strap part with a 12 o'clock strap attaching portion. The 12 o'clock strap attaching portion is configured for attaching the 12 o'clock watch strap part to a mechanical watch head. The 12 o'clock watch strap part is the portion which mounts to the 12 o'clock lugs of the mechanical watch head. The electronics module is encapsulated within the 12 o'clock watch strap part and may be at least partially adjacent to the 12 o'clock strap attaching portion. Being at least partially adjacent to the 12 o'clock strap attaching portion means that at least one edge or portion of the electronics module is adjacent to the 12 o'clock strap attaching portion.

[0021] In some examples the 6 o'clock watch strap part may also be referred to as the point side or 6 o'clock side. The 12 o'clock watch strap part of the watch strap may in some examples be referred to as the buckle side or the 12 o'clock side. However, not all examples or embodiments may have a point or buckle in the watch strap.

[0022] Some watch straps may comprise two watch strap parts (the 6 o'clock watch strap part and the 12 o'clock watch strap part) that are joined by a watch strap clasp or watch strap closure instead of having a buckle on the 12 o'clock watch strap part. The 12 o'clock watch strap part and the 6 o'clock watch strap part in this example are connected to the watch strap clasp. The electronics module is not encapsulated within the watch strap clasp.

[0023] In another embodiment, the watch strap comprises both a 6 o'clock watch strap part and a 12 o'clock watch strap part. The electronics module comprises a first electronics module part encapsulated within the flexible material of the 6 o'clock watch strap part. The electronics module comprises a second electronics module part encapsulated within the flexible material of the 12 o'clock watch strap part. In this way the electronics module is incorporated into both watch strap parts. This may for example enable a larger variety of electronic enhancements to be incorporated into the watch strap.

[0024] In another embodiment the 6 o'clock strap attaching portion is within 3 mm of a portion or edge of the electronics module.

[0025] In another embodiment the 6 o'clock strap attaching portion is within 1 cm of a portion or edge of the electronics module.

[0026] The strap attaching portion is the portion of a watch strap which is configured for receiving a spring bar or screw pin and enables attachment to the lug of a mechanical watch.

[0027] In another embodiment the watch strap comprises a comfort pad adjacent to the 6 o'clock strap attaching portion. The electronics module is cushioned by the comfort pad. This embodiment may be beneficial because the comfort pad may provide additional space to integrate even more sensors or other electronic modules. The comfort pad may also provide additional mechanical protection to the sensors and/or electronics module.

[0028] In some examples the comfort pad is an extension of material which extends out from the inner surface of the watch strap. In this case the electronics module would still be embedded within the watch strap but it is protected by this extension that forms the comfort pad. In another example the comfort pad could be a solid pad or cushion. In the case that it is solid, the comfort pad may also house or contain the electronics module.

[0029] In another embodiment the electronics module has a flexible printed circuit board extending along a length extension of the watch strap. The line following along the length of the watch strip is the length extension.

[0030] In another embodiment the flexible printed circuit board is a polyimide circuit board. The use of a polyimide circuit board may be beneficial because it may provide excellent mechanical and thermal stability while being flexible. A flexible polyimide circuit board material is sometimes referred to as polyimide flex.

[0031] In another embodiment the flexible printed circuit board comprises a bendable or flexible substrate.

[0032] In some embodiments, the flexible substrate may for example be formed from polyimide, liquid crystal polymer, or polyurethane.

[0033] In another embodiment the flexible printed circuit board comprises a substrate formed from a shape memory polymer. This may for example enable greater bendability, elasticity, and comfort when wearing the watch strap. In some instances the shape memory polymer may be shaped to have a curvature that preforms the watch strap to fit more comfortably on the wrist.

[0034] In another embodiment the flexible substrate comprises fibers that pre shape the watch strap to have a curvature matching a wrist.

[0035] In another embedment the flexible substrate has multiple layers. The electronic components of the electronics module are embedded within the flexible substrate.

[0036] In another embodiment the watch strap is formed from the flexible printed circuit board and encapsulates the electronics module that may be constituted by a variety of discrete or integrated electronics components with conventional bonding techniques or as bare dice.

[0037] Watch straps are often formed from leather or elastomers. In this embodiment the watch strap has a core formed from the flexible printed circuit board and the flexible material is laminated or attached to the flexible printed circuit board to encapsulate the electronics module and form the watch strap.

[0038] In another embodiment the electronics module has a hard board which has several narrow full flexible parts extending along a length extension of the watch strap. For example, the flexible circuit board of the electronics module could be formed from a number of rigid circuit boards that are connected together by flexible or bendable electrical connections. This may in some examples provide for a circuit board that is more mechanically stable. The electronics can be incorporated into mechanically robust rigid circuit boards. To accommodate the bending of the watch strap these rigid circuit boards are joined by the bendable electrical connections. In this example, the electronics module could be structured like a bracelet that is encapsulated by the flexible material.

[0039] In another embodiment the watch strap has a cavity with an opening towards an inner side of the watch strap to allow the sensor to be brought into close proximity to or to touch the skin of the subject for sensing the at least one physiological parameter. As used herein the inner side of the watch strap is the side of a watch strap that comes into contact with the skin of the subject when the watch strap is worn. The cavity may be filled with a filling material to encapsulate a printed circuit board. The filling material may in some examples be, but is not limited to: a flexible resin, flexible plastic, synthetic or natural rubber, or silicone.

[0040] In some examples, the cavity may be sealed with a sealing element such as a cap, a foil, or a cover. Removal of the sealing element may enable access to or replacement of the electronics module.

[0041] In another embodiment the watch strap comprises a metal support extending along the length extension of the watch strap. For example a thin sheet of metal or wire may be encapsulated in the watch strap or partially encapsulated in the watch strap to provide mechanical structure and support. The metal support is at least partially covered by the flexible material. In many cases the metal support may be entirely covered by the flexible material. In other examples the flexible material may be detachable from the metal support. In other examples the combination of the metal support and the flexible material are both visible and form part of the ornamental design of the watch strap.

[0042] The metal support is configured for mechanically shielding an inner surface of the watch strap when the watch strap is worn by the subject. The inner surface as used herein encompasses the surface which is directed towards the subject when the watch strap is worn. The inner surface is therefore protected by the metal support. The flexible printed circuit board is attached to the inner surface of the planar metal support. This may be advantageous because the metal support may provide superior mechanical support and protection for the electronics module.

[0043] In another embodiment the flexible printed circuit board has a varying width extension along the length extension of the watch strap. For example there may be multiple sections of the flexible printed circuit board which have a larger number of discrete or integrated circuit components on them. These regions may be connected by smaller regions which for example have a smaller width extension. This may enable the entire printed circuit board to be flexed more easily. This may make it easier to integrate the electronics module into a watch strap.

[0044] In another embodiment the electronics module further includes a rechargeable battery. The rechargeable battery is a foil battery. A foil battery is flatter and more compact than a normal rechargeable battery. The use of the foil battery may for example enable more easily the integration of the electronics module into the watch strap. In some examples the rechargeable battery may extend along the length extension. This may have the benefit of making the watch strap less bulky.

[0045] In another embodiment the rechargeable battery is arranged within a cavity in the watch strap next to or adjacent to the flexible circuit board and it is electrically connected to the circuit board by a means of electrical connection. The cavity may in some examples be filled with a filling material such as a flexible resin, flexible plastic, synthetic or natural rubber, or silicone.

[0046] In another embodiment the foil battery is a lithium polymer rechargeable battery that may for example be chargeable by means of a wireless charger. For example there may be loops or coils of wire within the watch strap which enable an inductive charging of the rechargeable battery.

[0047] In another embodiment the electronics module further comprises an accelerometer. The accelerometer may be configured to acquire accelerometer data. This may be beneficial because it may be useful for monitoring the number of paces and/or movement of the subject wearing the watch. This for example could be correlated with a pulse rate and/or blood oxygen level for measuring the health of the subject. This could be useful for determining the type of motion of a subject as well as monitoring changes in the movement and/or health of a subject.

[0048] In another embodiment, the electronics module further comprises a geolocation receiver configured to acquire geolocation data which is descriptive of a location of the electronics module. The geolocation receiver may for example be a satellite navigation device such as a Global Positioning System (GPS) receiver, a Global Navigation Satellite System (GLONASS) receiver, Indian Regional Navigation Satellite System (IRNSS) receiver, Galileo receiver, or BeiDou receiver.

[0049] In another embodiment the physiological parameter is a pulse rate. This for example may be measured using an electrode which contacts the skin or surface of the subject or it may be measured using an optical sensor.

[0050] In another embodiment the physiological parameter is a blood oxygenation level. This for example may be measured using an optical sensor.

[0051] In another embodiment the flexible material comprises any one of the following: leather, plastic, natural rubber, synthetic rubber, an elastomer, and combinations thereof. All of these materials may be useful in building a flexible watch strap.

[0052] In another embodiment the electronics module comprises a wireless communications interface for sending and/or receiving data. This for example may be beneficial because it may be useful for transferring the data to other devices such as a computer via a wireless or Wi-Fi system or a smartphone. The smartphone for example may be useful in logging data or providing an analysis of the sensor data.

[0053] In another embodiment the wireless communication interface is configured for communicating via a telecommunications network and/or via a point-to-point local connection such as a Bluetooth low energy connection. This embodiment may for example be beneficial because the physiological parameter or other data such as accelerometer data or geolocation data may be provided to other systems. For example if there is a pulse rate monitor an alarm can be sent via the wireless communications interface if the pulse rate is abnormal. Likewise, if a blood oxygen level is too low then an alarm may be sent for this also.

[0054] In another embodiment the electronics module comprises a wireless network communications module. The wireless network communications module is configured for sending a medical alert signal via the wireless network communications module if the sensor data meets a predetermined criterion. In some examples the wireless network communication module may be a system for connecting to a LAN or wireless local area network.

[0055] This for example may enable sending the medical alert signal via the internet to a central server or be used as a request for help. In other examples the wireless network communication module may be a wireless telecommunications module such as a cellular phone module. In this case the wearer of the watch strap would be able to send a medical alert signal automatically even when away from home. This may for example be useful in providing the medical alert signal for workers or people with pre-existing health conditions.

[0056] In another aspect the invention provides for a mechanical watch that comprises a watch strap according to an embodiment.

[0057] In another embodiment the mechanical watch has a weight of at least 115 g not counting the weight of the watch strap or watch strips. In other words, the mechanical watch comprises a watch head with a weight of at least 115 g. This may be beneficial because the weight of the watch may help the function of the sensor by increasing the contact between the subject and the sensor.

[0058] In another embodiment the mechanical watch has a weight of at least 150 g not counting the watch

strap. In other words, the mechanical watch comprises a watch head with a weight of at least 150 g. This increase in weight may be further beneficial because the increase in weight may further aid contact between the subject and the sensor.

[0059] In another aspect the invention provides for a method of using a watch strap according to an embodiment. The watch strap is attached to a mechanical watch. The method comprises acquiring data using the electronics module. The method further comprises processing the data to provide an output signal.

[0060] In one example, the step of acquiring the data comprises acquiring the sensor data using the sensor. The processing of the data to provide an output signal comprises determining a blood oxygen level from the sensor data. The providing of a signal comprises providing a warning signal using the electronics module if at least the blood oxygen level is below a predetermined level. If other data such as accelerometer data or pulse rate or geolocation data is available these may also be incorporated into a criterion used to determine whether the warning signal is provided. This embodiment may be beneficial because it may provide constant monitoring of the health of a subject and may be useful in situations when the health of the subject is compromised, for example, when the subject is infected with a virus that may cause the blood oxygen levels to decrease if there is damage to the lungs.

[0061] The processing of the data to provide the output signal may be performed in different ways. In one example a neural network such as a recurrent neural network receives the data as a data stream. The output signal may then be the output of the recurrent neural network. In some cases, the output signal may be continuous and may be provided as a signal which can be displayed, for example on the display of a smart phone. In other examples the data input into a neural network may be used to trigger the providing of an output signal. For example the output signal may be a warning signal instructing the subject to seek medical attention or the output signal may be data that is automatically sent to the physician of the subject for review.

[0062] The processing of the data to provide the output signal may also be provided using standard statistical means such as averaging or monitoring to ensure that the data is within a predetermined range.

[0063] In another aspect the invention further provides for a monitoring system that comprises a watch strap according to an embodiment. The monitoring system may be configured for performing the method as described above and may be implemented as machine executable instructions for execution by one or more computational or computing systems.

[0064] The machine executable instructions may for example be executed entirely by a computational system of the electronics module. In another example the electronics module is connected wirelessly to a computing device such as a remote computing system, mobile computing system, or a telecommunications device such as a smartphone. The electronics module acquires the data. The electronics module then transfers all or a portion of the data to the computing device and then the computing device processes the data to provide the output signal.

[0065] It is understood that one or more of the aforementioned embodiments of the invention may be combined as long as the combined embodiments are not mutually exclusive.

[0066] As will be appreciated by one skilled in the art, aspects of the present invention may be embodied as an apparatus, method or computer program product. Accordingly, aspects of the present invention may entirely take the form of a hardware embodiment, a software embodiment (including firmware, resident software, microcode, etc.) or an embodiment combining software and hardware aspects that may all generally be referred to herein as a "circuit," "module" or "system." Furthermore, aspects of the present invention may take the form of a computer program product embodied in one or more computer readable medium(s) having computer executable code embodied thereon.

Brief description of the drawings

[0067] In the following embodiments of the invention are explained in greater detail, by way of example only, making reference to the drawings in which:

- Fig. 1 illustrates an example of a mechanical watch;
- Fig. 2 illustrates the integration of a metal support into the watch strap;
- Fig. 3A illustrates an example of incorporating of the electronics module into a watch strap with a comfort pad;
- Fig. 3B illustrates a further example of incorporating the electronics module into a watch strap with a comfort pad;
- Fig. 4 illustrates an example of an electronics module;
- Fig. 5 illustrates the integration of an electronics module into the watch strap; and
- Fig. 6 illustrates a method of using a watch strap.

Detailed Description

[0068] Like numbered elements in these figures are either equivalent elements or perform the same function. Elements which have been discussed previously will not necessarily be discussed in later figures if the function is equivalent.

[0069] Fig. 1 illustrates an example of a mechanical watch 100. The mechanical watch 100 is shown as comprising a mechanical watch head 102 and two watch strap parts 104, 106. The watch strap 104, 106 comprises a 6 o'clock watch strap part 104 and a 12 o'clock watch strap part 106. The 6 o'clock watch strap part 104 is connected to lugs of the mechanical watch head 102 adjacent to 6

o'clock. The 6 o'clock watch strap part 104 may also be referred to as the watch strap 6 o'clock side or as the point side. The 12 o'clock watch strap part 106 is also sometimes referred to as the watch strap 12 o'clock side or the buckle side of the watch strap. It can be seen that within the 6 o'clock watch strap part 104 there is an electronics module 110 embedded within a flexible material 108. The electronics module 110 is adjacent to a 6 o'clock strap attaching portion 112. The 6 o'clock strap attaching portion 112 may for example have a hole for receiving a spring clip or screw pin for attaching the watch strap to the mechanical watch.

[0070] It can be seen that the electronics module 110 is adjacent to the 6 o'clock strap attaching portion 112. When the electronics module 110 is in this position it is naturally over the radius bone when mounted conventionally on the wrist of a subject. This may afford greater protection for the electronics module 110 when a subject for example, places a hand on a table. As it is normally, the ulna bone contacts the surface and the radius bone does not.

[0071] In Fig. 1 the line 114 represents a length extension of the watch strap 104. Area labeled 116 represents a width extension.

[0072] The example in Fig. 1 may be modified in several ways. In some examples the electronics module is alternatively embedded within the 12 o'clock watch strap part 106.

[0073] In yet other examples there are two electronics modules. There may for example be a first electronics module part embedded with the 6 o'clock watch strap part and a second electronics module part embedded within the 12 o'clock watch strap part. There may be for example a connection between the first electronics module and the second electronics module using a wireless communication channel. In other examples there may be a wired connection between the first electronics module and the second electronics module. The wired connection may in some examples be provided by an electrical connection in a clasp joining the 6 o'clock watch strap part and the 12 o'clock watch strap part

[0074] Fig. 2 shows an alternative view of a watch strap 104. In this example the watch strap 104 has an optional metal support 200 which extends along the length extension 114. The electronics module 110 is a flexible electronics module made on a flexible printed circuit board. The watch strap 104 has two sides. There is an inner surface 204 which is towards the subject and an outer surface 206 which is away from the subject. The electronics module 110 is optionally mounted on the inner surface 204 of the metal support 200. The 6 o'clock strap attaching portion 112 is also visible as well as a hole 202 for a spring clip or screw pin. The hole 202 may for example be optionally formed at least partially by the metal support 200. It can also be seen that the electronics module 110 extends in the length extension 114 and is embedded in the flexible material 108. It is also close to the 6 o'clock strap attaching portion 112.

[0075] The electronics module may also incorporate a sensor 208 which has an opening towards the inner surface 204. This enables the sensor 208 to be in close proximity to or touch the skin of the subject for sensing the physiological parameter. The sensor 208 may for example be an optical sensor which may be used for measuring the pulse rate and/or blood oxygenation level of the subject.

[0076] Fig. 3A shows a cross-sectional view of one example of a watch strap 104 in the plane of the width extension 116 and near the 6 o'clock strap attaching portion 112. On the inner surface 204, which is towards the skin of the subject, there is a comfort pad 300. In this example, the comfort pad 300 is formed as a solid pad or cushion from the flexible material 108. Electronics module 110 can be seen as being embedded in the comfort pad 300. In this example the comfort pad 300 additionally cushions the electronics module 110. In other examples, the electronics module 110 can extend away from the 6 o'clock strap attaching portion 112 so that the sensor 208 is positioned beyond the comfort pad.

[0077] Fig. 3B shows a cross-sectional view of another example of a watch strap 104. This view is also in the plane of the width extension 116 and is also near the 6 o'clock strap attaching portion 112. In this example the comfort pad 300' is formed as a hanging structure supported by a bellows structure 302 and the electronics module is encapsulated by the flexible material 108 within the comfort pad 300'. In this example the comfort pad 300' not only serves to adjust the fit of the watch strap 104 to the wrist of the subject but is also serves to maintain consistent contact between the sensor 208 and the skin of the subject.

[0078] Fig. 4 shows a further view of one example of electronics module 110. The electronics module 110 comprises a flexible printed circuit board (PCB) 400. The printed circuit board can be seen as having a varying width along the width extension 116. There are several wide sections 402 and several narrow sections 404. The addition of the narrow sections 404 provides additional flexibility to the electronics module 110 and helps it bend with the flexible watch strap. A rechargeable battery 406 in the form of a foil battery is shown as being adjacent to the flexible PCB 400 and electrically connected to the flexible PCB 400 via solder connections 408. This supplies power for the electronics module 110.

[0079] The example illustrated in Fig. 4 may be modified. Electronic components may be on one or both sides of the flexible PCB 400. In some examples the flexible PCB 400 may be a multilayer PCB.

[0080] In yet other examples the electronics module 110 may be constructed using bare die components. Bare die components are electronic components such as semiconductors that are provided without packaging. The electronic components may then be imbedded or encapsulated directly within the flexible PCB 400.

[0081] An inducive charging system may be incorporated into the watch strap to provide a means of charging

the rechargeable battery 406.

[0082] The electronics module illustrated in Fig. 4 may also be augmented with a microgenerator that converts mechanical kinetic energy (motion of the watch strap 104) into electrical energy for charging the battery 406 or alternatively a capacitor.

[0083] Fig. 5 shows a further example of a watch strap 104. It is again made of a flexible material 108 and this time there is a cavity 500 into which the electronics module 110 has been encapsulated. The cavity 500 may be filled or sealed with a filling material 502 such as a flexible plastic, a flexible resin, natural rubber, synthetic rubber, and/or silicone. The flexible printed circuit board 400 as is illustrated in Fig. 4 and the battery 406 are also visible. Additionally, a sensor 208 which has an opening towards the inner surface 204 is visible. This enables the sensor 208 to contact or touch the skin of the subject for sensing the physiological parameter.

[0084] Fig. 6 illustrates a method of operating a watch strap that is attached to a mechanical watch. The method comprises acquiring 600 the data using the electronics module 110. The method then further comprises processing 602 the data to provide an output signal. The data may be from different sources. For example the data could comprise the sensor data measured by the sensor 208. The sensor data could comprise data that is used to determine a blood oxygen level from the sensor data. This for example may provide data that could assist in determining if the subject is suffering from a condition such as a viral infection of the lungs.

[0085] The sensor data could also comprise data which is descriptive of a heart rate of the subject. In other examples, the data could comprise accelerometer data measured by an accelerometer and/or geolocation data measured by a geolocation receiver. This data could provide detailed information on the movement and/or position of the subject.

[0086] The processing of the data to provide an output signal may be performed in different locations. In one instance the electronics module comprises a computational system configured to process the data to provide the output signal. In this case the electronics module may send the output signal via a wireless means such as a Bluetooth connection, a cellular data network connection, or a wireless local area network.

[0087] In other examples, the output signal may be provided by a computing device such as a remote computing system, mobile computing system, or a telecommunications device such as a smartphone. In this case the electronics module may transfer all or a portion of the data to the computing device via the wireless means.

[0088] The output signal may take different forms. In one case the output signal may be a summary or compilation of the data. In another example a comparison between a predetermined criterion and the data may be used to trigger the content and/or timing of the output signal. In another example a trained machine learning module such as a neural network is used to process the data to provide the output signal. The output signal may in some examples be descriptive of a physiological state or condition of the subject.

[0089] The output signal may be a sensor fusion of different types of data. For example the blood oxygen level and the motion of the subject may be compared. For a particular type of motion the blood oxygen content of a subject may have a baseline range. If the blood oxygen content is outside of this range it may trigger the output signal.

[0090] The method of Fig. 6 may be implemented as machine executable instructions that control the operation of a monitoring system. In some cases, the monitoring system comprises just the watch strap and the electronics module performs the processing of the data to provide the output signal. In other cases the monitoring system comprises the watch strap and a computing device such as a remote computing system, mobile computing system, or a telecommunications device such as a smartphone. In this case the electronics module may transfer all or a portion of the data to the computing device via the wireless means.

List of reference numerals

[0091]

100	mechanical watch
102	mechanical watch head
104	6 o'clock watch strap part (point side)
106	12 o'clock watch strap part (buckle side)
108	flexible material
110	electronics module
112	6 o'clock strap attaching portion
114	length extension
116	width extension
200	metal support
202	hole for spring clip or screw pin
204	inner surface
206	outer surface
208	sensor
300	comfort pad
300'	comfort pad
302	bellows structure
400	flexible PCB
402	wide section
404	narrow section
406	rechargeable battery
408	solder connections
500	cavity
502	filling material
600	acquire data
602	process the data to provide an output signal

Claims

1. A watch strap (104) configured for attaching a me-

chanical watch (100) to a wrist of a subject, wherein the watch strap is formed from a flexible material (108), wherein the watch strap comprises an electronics module (110) encapsulated by the flexible material, wherein the electronics module comprises a sensor (208) configured for acquiring sensor data descriptive of at least one physiological parameter of the subject, the electronics module having a flexible printed circuit board (400) extending along a length extension (114) of the watch strap, **characterized in that** the flexible printed circuit board has a varying (402, 404) width extension (116) along the length extension of the watch strap.

2. The watch strap of claim 1, wherein the electronics module is located in an area of the watch strap configured for covering the radius bone when worn by the subject.

3. The watch strap of claim 1 or 2, wherein the watch strap comprises a 6 o'clock watch strap part (104) with a 6 o'clock strap attaching portion (112) configured for attaching the 6 o'clock watch strap part to a mechanical watch head (102), wherein the electronics module is encapsulated within the 6 o'clock watch strap part and is at least partially adjacent to the 6 o'clock strap attaching portion.

4. The watch strap of claim 3, wherein the watch strap comprises a comfort pad (300, 300') adjacent to the 6 o'clock strap attaching portion, wherein the electronics module is cushioned by the comfort pad.

5. The watch strap of any one of the preceding claims, wherein the watch strap comprises a metal support (200) extending along the length extension of the watch strap, wherein the metal support is at least partially covered by the flexible material, wherein the metal support is configured for mechanically shielding an inner surface (204) of the watch strap when the watch strap is worn by the subject, wherein the flexible printed circuit board is attached to the inner surface of the metal support.

6. The watch strap of any one of the preceding claims, the electronics module further including a rechargeable battery (406), the rechargeable battery being a foil battery.

7. The watch strap of any one of the preceding claims, wherein the electronics module further comprises an accelerometer and/or a geolocation receiver.

8. The watch strap of any one of the preceding claims, wherein the flexible material is any one of the following: leather, plastic, an elastomer, synthetic rubber, natural rubber, and combinations thereof.

9. The watch strap of any one of the preceding claims, wherein the electronics module comprises a wireless network communications module, wherein the electronics module is configured for sending a medical alert signal via the wireless network communications module if the sensor data meets a predetermined criterion.

10. The watch strap of any one of the preceding claims, wherein the physiological parameter is a pulse rate and/or a blood oxygenation level.

11. A mechanical watch (100) comprising the watch strap according to any one of the preceding claims.

12. The mechanical watch of claim 11, wherein the mechanical watch has a weight of at least 115 grams without the watch strap, preferably greater than 150 grams.

13. A method of using a watch strap (104, 106) according to claim 10, the watch strap being attached to a mechanical watch (102), wherein the method comprises:

- acquiring (600) data using the electronics module, wherein the data comprises any one of the following: the sensor data, geolocation data, accelerometer data, blood oxygen level data, pulse rate data, and combination thereof; and
- processing (602) the data to provide an output signal.

Patentansprüche

1. Uhrenarmband (104), das zum Befestigen einer mechanischen Uhr (100) an einem Handgelenk einer Person konfiguriert ist, wobei das Uhrenarmband aus einem flexiblen Material (108) gebildet ist, wobei das Uhrenarmband ein Elektronikmodul (110) umfasst, das durch das flexible Material eingekapselt ist, wobei das Elektronikmodul einen Sensor (208) umfasst, der zum Erfassen von Sensordaten konfiguriert ist, die mindestens einen physiologischen Parameter der Person beschreiben, wobei das Elektronikmodul eine flexible gedruckte Leiterplatte (400) aufweist, die sich entlang einer Längserstreckung (114) des Uhrenarmbands erstreckt, **dadurch gekennzeichnet, dass** die flexible gedruckte Leiterplatte eine variierende (402, 404) Breitenausdehnung (116) entlang der Längserstreckung des Uhrenarmbands aufweist.

2. Uhrenarmband nach Anspruch 1, wobei das Elektronikmodul in einem Bereich des Uhrenarmbandes angeordnet ist, der so konfiguriert ist, dass er den Radiusknochen bedeckt, wenn er von der Person

getragen wird.

3. Uhrenarmband nach Anspruch 1 oder 2, wobei das Uhrenarmband einen 6-Uhr-Uhrenarmbandteil (104) mit einem 6-Uhr-Armbandbefestigungsabschnitt (112) umfasst, der zum Befestigen des 6-Uhr-Uhrenarmbandteils an einem mechanischen Uhrenkopf (102) konfiguriert ist, wobei das Elektronikmodul innerhalb des 6-Uhr-Uhrenarmbandteils eingekapselt ist und zumindest teilweise an den 6-Uhr-Armbandbefestigungsabschnitt angrenzt.

4. Uhrenarmband nach Anspruch 3, wobei das Uhrenarmband ein Komfortpolster (300, 300') angrenzend an den 6-Uhr-Armbandbefestigungsabschnitt umfasst, wobei das Elektronikmodul durch das Komfortpolster gepolstert ist.

5. Uhrenarmband nach einem der vorhergehenden Ansprüche, wobei das Uhrenarmband einen Metallträger (200) aufweist, der sich entlang der Längserstreckung des Uhrenarmbandes erstreckt, wobei der Metallträger zumindest teilweise von dem flexiblen Material bedeckt ist, wobei der Metallträger so konfiguriert ist, dass er eine Innenfläche (204) des Uhrenarmbandes mechanisch abschirmt, wenn das Uhrenarmband von der Person getragen wird, wobei die flexible Leiterplatte an der Innenfläche des Metallträgers befestigt ist.

6. Das Uhrenarmband nach einem der vorhergehenden Ansprüche, wobei das Elektronikmodul ferner eine wiederaufladbare Batterie (406) enthält, wobei die wiederaufladbare Batterie eine Folienbatterie ist.

7. Uhrenarmband nach einem der vorangehenden Ansprüche, wobei das Elektronikmodul ferner einen Beschleunigungsmesser und/oder einen Geolokalisierungsempfänger umfasst.

8. Uhrenarmband nach einem der vorhergehenden Ansprüche, wobei das flexible Material eines der folgenden ist: Leder, Kunststoff, ein Elastomer, synthetischer Kautschuk, Naturkautschuk und Kombinationen davon.

9. Uhrenarmband nach einem der vorhergehenden Ansprüche, wobei das Elektronikmodul ein drahtloses Netzwerkkommunikationsmodul umfasst, wobei das Elektronikmodul so konfiguriert ist, dass es ein medizinisches Alarmsignal über das drahtlose Netzwerkkommunikationsmodul sendet, wenn die Sensordaten ein vorbestimmtes Kriterium erfüllen.

10. Das Armband nach einem der vorhergehenden Ansprüche, wobei der physiologische Parameter eine Pulsfrequenz und/oder ein Blutsauerstoffgehalt ist.

11. Mechanische Uhr (100) mit dem Uhrenarmband nach einem der vorangehenden Ansprüche.

12. Mechanische Uhr nach Anspruch 11, wobei die mechanische Uhr ohne das Uhrenarmband ein Gewicht von mindestens 115 Gramm, vorzugsweise von mehr als 150 Gramm, aufweist.

13. Verfahren zur Verwendung eines Uhrenarmbands (104, 106) nach Anspruch 10, wobei das Uhrenarmband an einer mechanischen Uhr (102) angebracht ist, wobei das Verfahren umfasst:

- Erfassen (600) von Daten unter Verwendung des Elektronikmoduls, wobei die Daten eines der folgenden umfassen: die Sensordaten, Geolokalisierungsdaten, Beschleunigungsmesserdaten, Blutsauerstoffpegeldaten, Pulsfrequenzdaten und eine Kombination davon; und
- Verarbeiten (602) der Daten, um ein Ausgangssignal bereitzustellen.

Revendications

1. Un bracelet de montre (104) configuré pour attacher une montre mécanique (100) au poignet d'un sujet, dans lequel le bracelet de montre est formé d'un matériau flexible (108), dans lequel le bracelet de montre comprend un module électronique (110) encapsulé par le matériau flexible, dans lequel le module électronique comprend un capteur (208) configuré pour acquérir des données de capteur descriptives d'au moins un paramètre physiologique du sujet, le module électronique ayant une carte de circuit imprimé flexible (400) s'étendant le long d'une extension de longueur (114) du bracelet de montre, **caractérisé en ce que** la carte de circuit imprimé flexible a une extension de largeur (116) variable (402, 404) le long de l'extension de longueur du bracelet de montre.

2. Bracelet de montre selon la revendication 1, dans lequel le module électronique est situé dans une zone du bracelet de montre configurée pour couvrir l'os du radius lorsqu'il est porté par le sujet.

3. Bracelet de montre selon la revendication 1 ou 2, dans lequel le bracelet de montre comprend une partie de bracelet de montre de 6 heures (104) avec une partie de fixation de bracelet de 6 heures (112) configurée pour fixer la partie de bracelet de montre de 6 heures à une tête de montre mécanique (102), dans lequel le module électronique est encapsulé dans la partie de bracelet de montre de 6 heures et est au moins partiellement adjacent à la partie de fixation de bracelet de 6 heures.

4. Bracelet de montre selon la revendication 3, dans lequel le bracelet de montre comprend un coussin de confort (300, 300') adjacent à la partie de fixation de bracelet de 6 heures, dans lequel le module électronique est amorti par le coussin de confort.

5. Bracelet de montre de l'une quelconque des revendications précédentes, dans lequel le bracelet de montre comprend un support métallique (200) s'étendant le long de l'extension de longueur du bracelet de montre, dans lequel le support métallique est au moins partiellement recouvert par le matériau flexible, dans lequel le support métallique est configuré pour protéger mécaniquement une surface interne (204) du bracelet de montre lorsque le bracelet de montre est porté par le sujet, dans lequel la carte de circuit imprimé flexible est fixée à la surface interne du support métallique.

6. Le bracelet de montre de l'une quelconque des revendications précédentes, le module électronique comprenant en outre une batterie rechargeable (406), la batterie rechargeable étant une batterie à feuille.

7. Le bracelet de montre de l'une quelconque des revendications précédentes, le module électronique comprenant en outre un accéléromètre et/ou un récepteur de géolocalisation.

8. Le bracelet de montre de l'une quelconque des revendications précédentes, dans lequel le matériau flexible est l'un quelconque des matériaux suivants : le cuir, le plastique, un élastomère, le caoutchouc synthétique, le caoutchouc naturel, et leurs combinaisons.

9. Le bracelet de montre de l'une quelconque des revendications précédentes, dans lequel le module électronique comprend un module de communication en réseau sans fil, dans lequel le module électronique est configuré pour envoyer un signal d'alerte médicale via le module de communication en réseau sans fil si les données du capteur répondent à un critère prédéterminé.

10. Le bracelet de montre de l'une quelconque des revendications précédentes, dans lequel le paramètre physiologique est une fréquence de pouls et/ou un niveau d'oxygénation du sang.

11. Montre mécanique (100) comprenant le bracelet de montre selon l'une quelconque des revendications précédentes.

12. Montre mécanique selon la revendication 11, dans laquelle la montre mécanique présente un poids d'au moins 115 grammes sans le bracelet de montre, de préférence supérieur à 150 grammes.

13. Procédé d'utilisation d'un bracelet de montre (104, 106) selon la revendication 10, le bracelet de montre étant attaché à une montre mécanique (102), dans lequel le procédé comprend :

- l'acquisition (600) de données en utilisant le module électronique, dans lequel les données comprennent l'un quelconque des éléments suivants : les données du capteur, les données de géolocalisation, les données de l'accéléromètre, les données du niveau d'oxygène dans le sang, les données de la fréquence du pouls, et une combinaison de celles-ci ; et
- traiter (602) les données pour fournir un signal de sortie.

FIG. 1

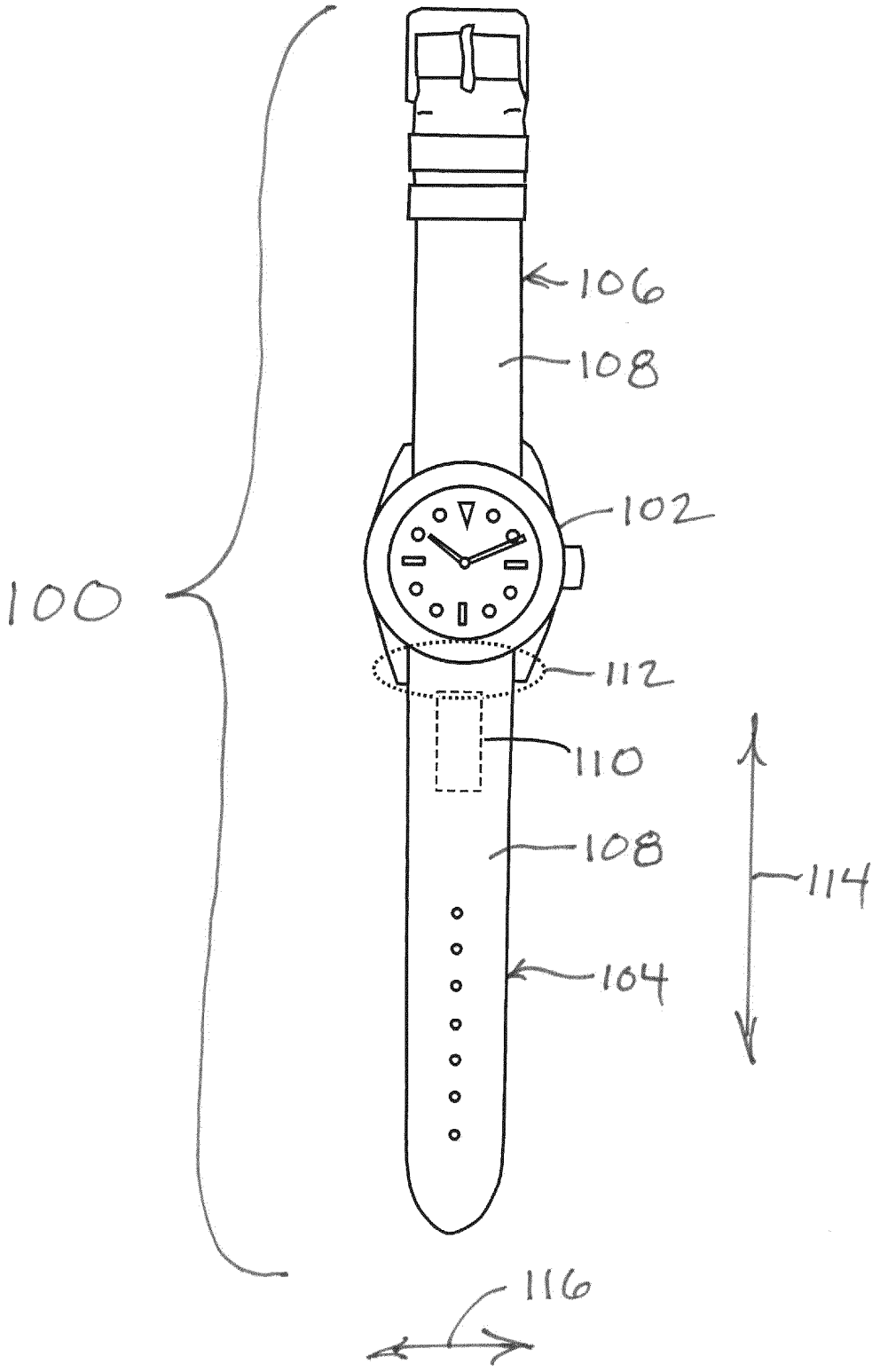


FIG. 2

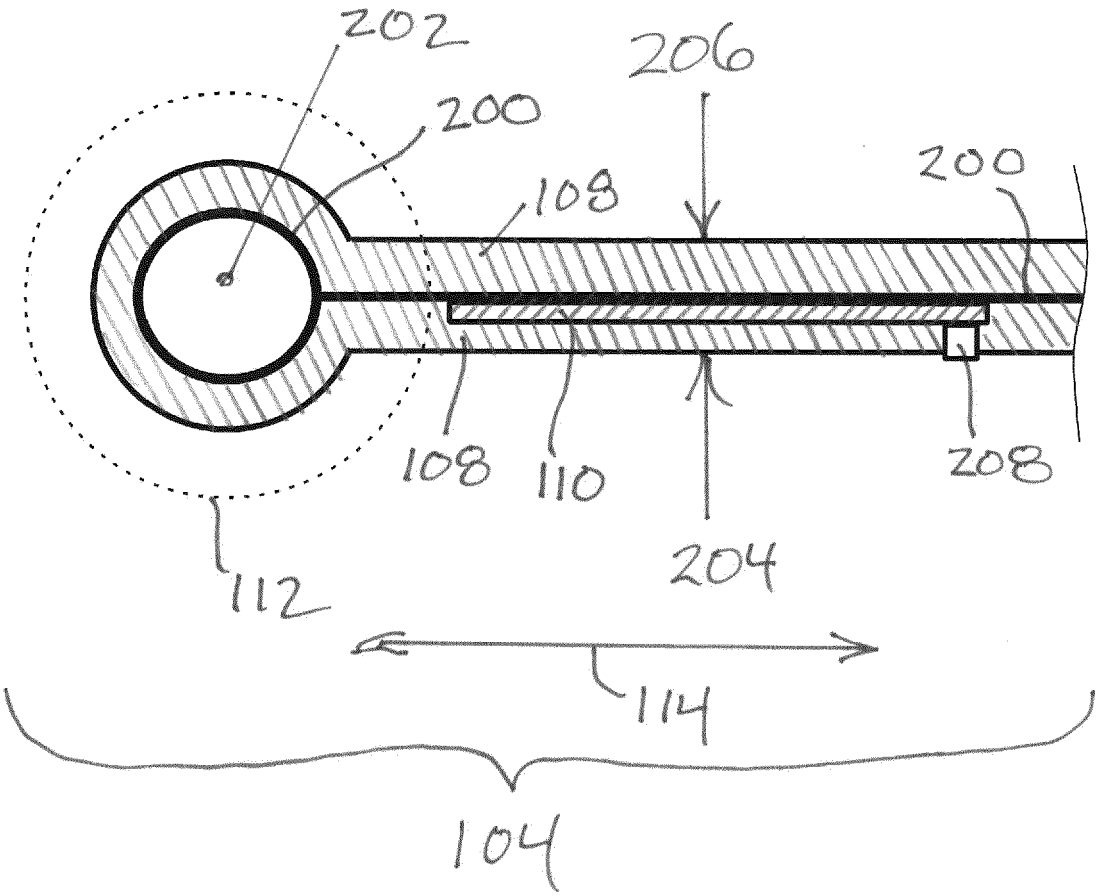


FIG. 3A

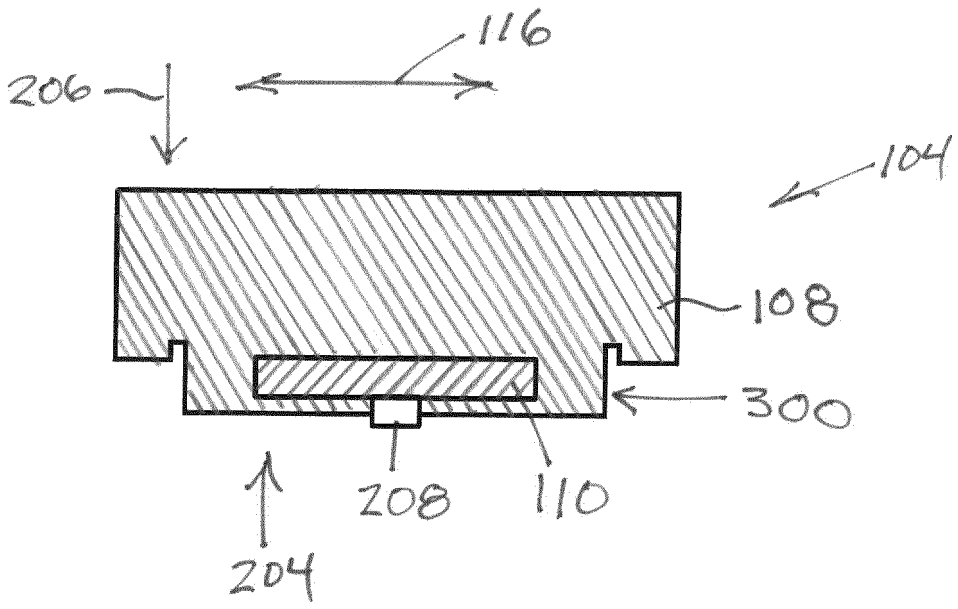

116
206
104
108
300
208
110
204

FIG. 3B

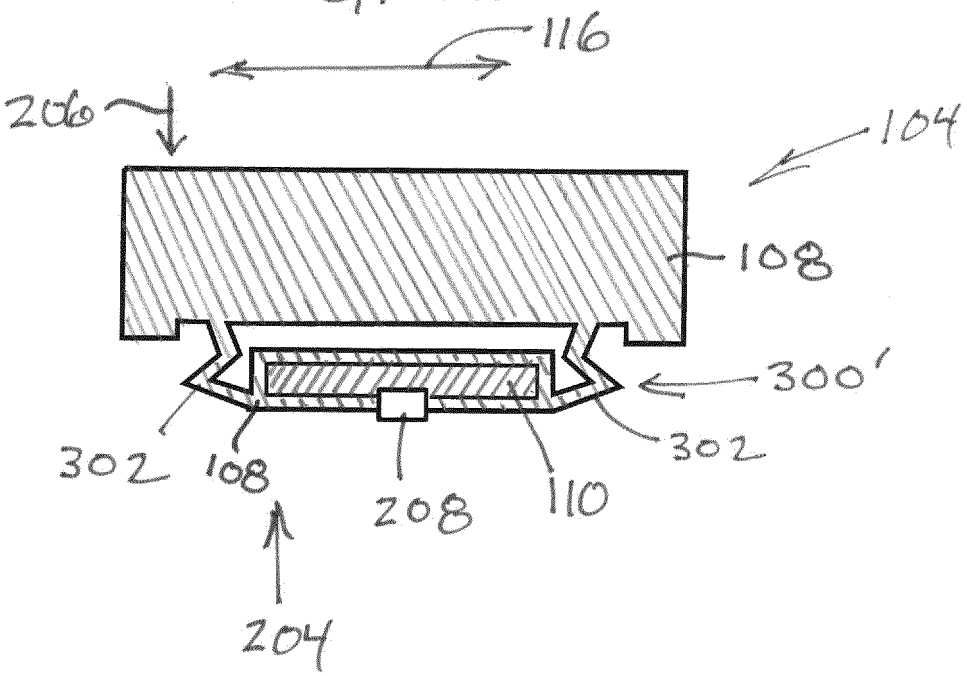

116
206
104
108
300'
302
108
208
110
302
204

FIG. 4

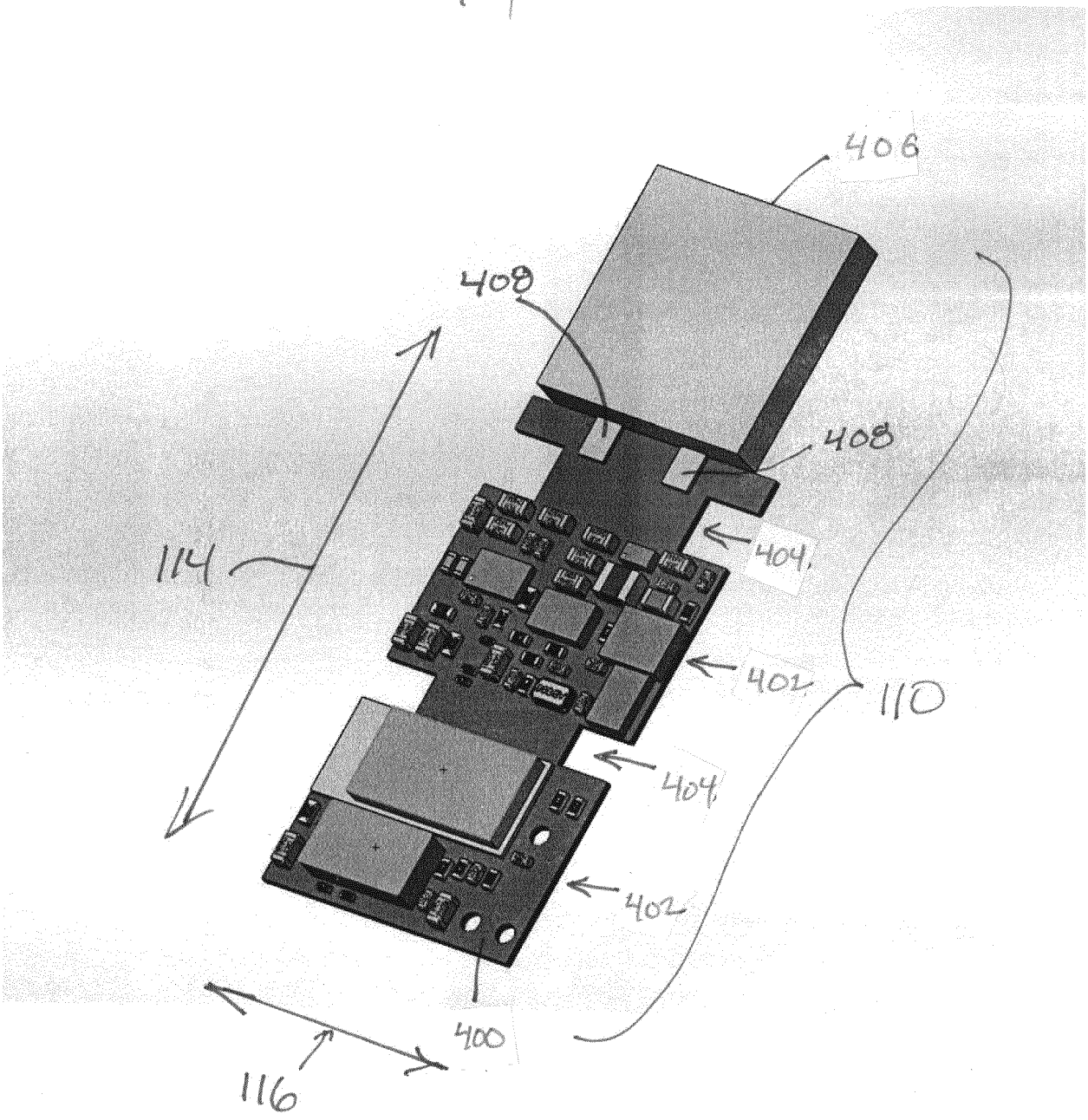


FIG. 5

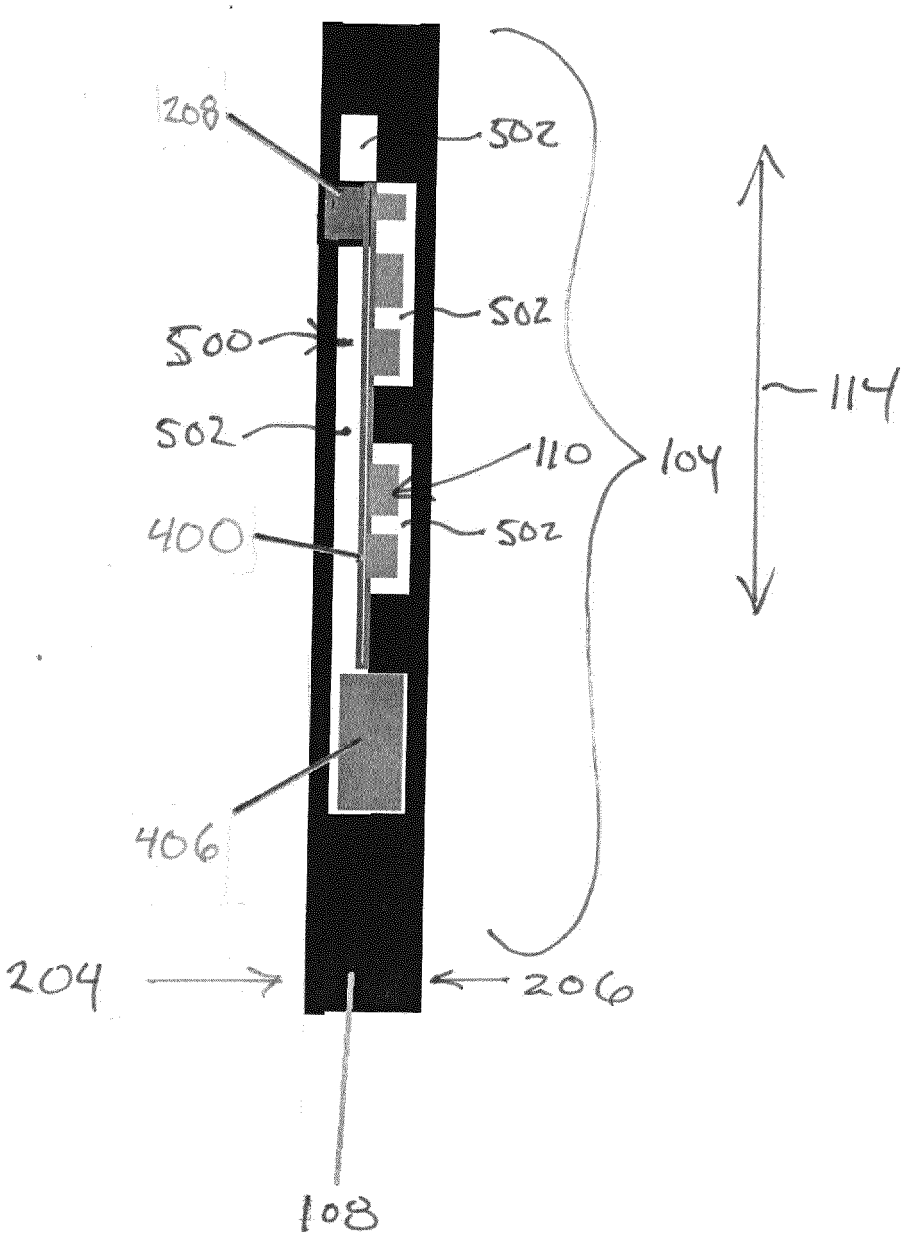
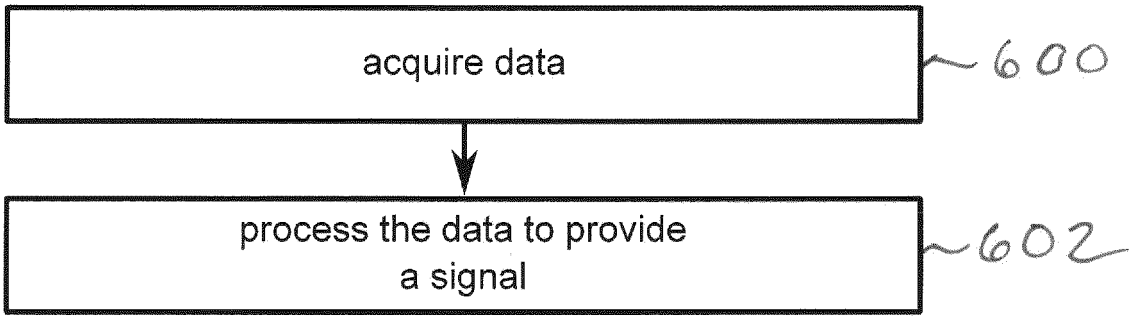


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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