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(54) Title: MULTI-ELECTRODE SENSING PATCH FOR LONG-TERM PHYSIOLOGICAL MONITORING WITH SWAPPABLE ELECTRONICS, RADIO, AND BATTERY, AND METHODS OF USE

(57) Abstract: Provided herein is an electrode device comprising an interface comprising at least one magnetic contact. The interface can be adaptable to be in communication with an electronic member, wherein the magnetic contact on the interface is adaptable to align and position the electronic member with respect to the interface. The interface can be further adaptable to remain affixed to a patient while an electronic member is removed and/or inserted from the interface. Further provided herein are methods of using the electrode device and kits.

MULTI-ELECTRODE SENSING PATCH FOR LONG-TERM PHYSIOLOGICAL MONITORING WITH SWAPPABLE ELECTRONICS, RADIO, AND BATTERY, AND METHODS OF USE

CROSS-REFERENCE

[0001] This application claims the benefit of U.S. Provisional Application No. **60/982,233**, filed October 23, 2007, which application is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] When long-term monitoring – from a few hours to multiple months – of human-generated signals (such as electrocardiogram (ECG), electroencephalogram (EEG) and electromyogram (EMG)) is required, currently available devices fall short of adequately meeting the requirements of both the clinician and patient. A medical patch is typically a thin, adhesive-coated flexible material applied to the skin, in this case, for medical monitoring or therapy (drug, electric stimulus, etc.) delivery. A patch may additionally be comprised of one part attached to the skin and a second part that includes electronics circuitry, a radio and a battery, which is in turn attached to the first (skin) part. For long-term monitoring applications, it may be important to leave the skin-contacting portion of the patch attached for the entire monitoring period. Not only will this yield the most consistent signals, but the patient's skin will experience less trauma resulting from the patch. Adhesives commonly used for attaching ambulatory electrodes or patches typically remove one or two layers of skin when they are pulled off, and repeated removals at the same body site can cause skin trauma and a painful rash. Reapplying a patch to a different site avoids the skin irritation, but is unlikely to produce identical signals in monitoring applications.

[0003] To accommodate leaving the electrodes in place for extended periods, a method for removing and replacing the electronics, radio and battery is needed. Replaceability of the electrodes/electronics is desirable for the following reasons including: replacing batteries, preventing damage to the electronics during swimming or bathing, replacing malfunctioning electronics, radios or battery, reducing discomfort during certain physical activities, eliminating interference while undergoing medical scanning procedures, and/or removing a battery or capacitor power supply for recharging.

[0004] It would be desirable to develop a wireless patch for long-term monitoring, including the ability to change out or swap the electronics circuitry, radio and battery, either as a single unit or in separate modules, without having to remove the electrodes contacting the patient's skin.

SUMMARY OF THE INVENTION

[0005] Provided herein is an electrode device comprising an interface. The interface comprises at least one magnetic contact, the interface adaptable to be in communication with an electronic member. The magnetic contact can be adaptable to slidably align and position the electronic member with respect to the interface. The interface can be further adaptable to remain affixed to a patient while the electronic member used with the interface can be removed and/or inserted from the interface. The interface can be a pouch, pocket or container. Additionally, the device can further comprise an electronic member. In some embodiments, the device can be a flexible substrate. The magnetic contact on the interface can be used with the electronic device to align and position the electronic member. Alternatively, the magnetic contact on the interface can be used with a contact on the electronic member to align and position the electronic member with respect to the electronic interface. The electronic member can be a replaceable electronic member such that the electronic member can be removed from the interface and reinserted into the interface without disturbing the interface. Alternatively, the electronic member can be removed from the interface and replaced with another electronic interface without disturbing the interface. Multiple electronic members can be used with the electronic interface. In some embodiments, the electrode device can further comprise a ferromagnetic metal adaptable to facilitate the connection between the interface and the electronic member. The ferromagnetic metal can be located on the interface and form a connection with a magnet that is part of the electronic member. Alternatively, the ferromagnetic metal can be located on the electronic member and form a connection with a magnet that is part of the interface. In addition to forming a connection between the interface and the electronic member, the interface can also maintain the connection between the electronics member and the interface. The contact on the interface can be used to maintain the connection between the electronics member and the interface. In some embodiments, an additional support structure can be used with the interface to maintain the connection between the interface and the electronics member. The additional support can be a tab holding the electronic member in communication with the interface. The additional support can be a slot that can be used to hold the electronic member in communication with the interface. The magnetic contact can be adaptable to provide a low engagement force between the interface and the electronic member.

[0006] Further provided herein is an electrode device comprising an interface in communication with a patient, an electronic member adaptable to be inserted and/or removed from the interface without disturbing the interface, and at least one compliant electronic connection. The interface can be adaptable to slidably engage the electronic member. The interface can facilitate self-

alignment and self-positioning of the electronic member in the interface. The interface can be a pouch, pocket or container. In some embodiments, the interface can be a flexible substrate. In some embodiments, the electrode device can comprise more than one compliant electronic connection. The device can further comprise an interface that has at least one contact located on the interface. The contact can be adaptable to facilitate the self-alignment and self-positioning of the electronic member with respect to the interface. Furthermore, the electronic member can be adaptable to be inserted, removed, and then reinserted into the interface. Alternatively, the electronic member can be inserted, removed, and replaced with a second electronic member. In some embodiments, the interface can be adaptable to be in communication with more than one electronic component. The interface can be in communication with more than one electronic component at the same time. In some cases, the interface can be in communication with more than one electronic component having different configurations.

[0007] Further provided here in is a method for detecting a physiological parameter with at least one electrode comprising: positioning an interface on the surface of a patient; sliding an electronic member into contact with the interface to engage the electronic member with the interface; and detecting the physiological parameter from the patient. The electronics member can be adaptable to be inserted and/or removed from the interface without disturbing the interface. The method can further comprise the step of removing the electronic member from the interface and replacing the electronic member with a second electronic member. The second electronic member can be the same electronic member as the first electronic member. Alternatively, the second electronic member can be a different electronic member than the first electronic member. The method can further comprise the use of an interface wherein the interface comprises at least one magnetic contact, the interface adaptable to be in communication with an electronic member, wherein the at least one magnetic contact is adaptable to align and position the electronic member in the interface. The interface can be a pouch, pocket or container. The method can comprise a device that can be designed such that the device can be adaptable to facilitate insertion of the electronic member in the interface. The device can slidably engage the communication member with the interface.

[0008] Further provided herein is a method of detecting a physiological parameter comprising: forming an interface from a flexible substrate, the flexible substrate comprising at least one magnetic contact; sliding the interface in contact with a surface of a patient; inserting an electronic member in the interface, the electronic member comprising at least one magnetic contact; connecting the interface and electronic member using the at least one magnetic contact on the interface and the at least one contact on the electronic member; and detecting at least one

physiological parameter from the patient. The interface can be further adaptable to remain affixed to a patient while the electronic member is removed and/or inserted with respect to the interface. Additionally, the method can provide the step of disconnecting the electronic member from the interface and reconnecting an electronic member with the interface. The electronic member reconnected with the interface can be the original electronic member. Alternately, the electronic member reconnected with the interface can be a new electronic member.

[0009] Provided herein is a method for detecting a physiological parameter from a patient comprising: sliding an electronic member into contact with an interface adaptable to be in communication with the electronic member; and positioning the interface on a surface of a patient. The interface can be further adaptable to remain affixed to a patient while the electronic member is removed and/or inserted with respect to the interface. Additionally, the method can further comprise the step of removing the electronic member and reinserting the electronic member. Alternatively, the method can further comprise the step of removing the electronic member and replacing the electronic member with a second electronic member.

[0010] Further provided herein is a kit for measuring a physiological parameter comprising: an interface comprising at least one magnetic contact, the interface adaptable to be in communication with an electronic member, the at least one magnetic contact adaptable to slidably engage the electronics member and if further adaptable to align and position the electronic member with respect to the interface. The kit can further comprise an electronic member.

[0011] Provided herein is a kit for measuring a physiological parameter comprising: an interface having at least one magnetic contact, the interface adaptable to be in communication with an electronic member; and at least one electronic member, the at least one magnetic contact adaptable to slidably align and position the electronic member with respect to the interface. The kit can further comprise more than one electronic member.

INCORPORATION BY REFERENCE

[0012] All publications, patents, and patent applications mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication, patent, or patent application was specifically and individually indicated to be incorporated by reference in their entirety.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The novel features of the invention are set forth with particularity in the appended claims. A better understanding of the features and advantages of the present invention will be obtained

by reference to the following detailed description that sets forth illustrative embodiments, in which the principles of the invention are utilized, and the accompanying drawings of which:

[0014] FIG. 1 illustrates an outer view of one embodiments of an unfolded patch;

[0015] FIG. 2 illustrates an inner view of one embodiment of an unfolded patch;

[0016] FIG. 3 illustrates an isolated view of one embodiment of an electrode contact from as viewed from the inner side of the substrate;

[0017] FIGS. 4A-4C illustrates steps for slidably engaging an electronics component with an interface; and

[0018] FIG. 5A is a side view of the interface being formed between the substrate and the circuit board; **FIG. 5B** is a side view of the interface with the electronics mated.

DETAILED DESCRIPTION OF THE INVENTION

[0019] The invention described herein includes is a device that uses replaceable (swappable) components. Provided herein is a device that can be adhered to the surface of a patient. The device can be placed at the beginning of the monitoring period and remain in place until sufficient data has been collected. The device can comprise several electrode connections that are in communication with the skin of the patient. The electrodes can be adaptable to collect multiple views of the desired human generated signal. The ability of a patch to collect multiple views has been described previously in U.S. Provisional Application, Serial No. **60/940,072** entitled "An Integrated Wireless Patch for Physiological Monitoring."

[0020] Further provided herein is a system with a replaceable electronics device comprising an interface adaptable to be adhered to the patient, a circuit board or electronics member comprising at least one radio and at least one battery subsystem, the circuit board being adaptable to be connected to the interface. The circuit board can perform various functions including, but not limited to, detection, amplification, processing, storage, transmittal, or any combination thereof. The method for mechanically and electrically connecting the electrodes to the electronics subsystem has some unique requirements. The method of connecting the electronics together includes making it easier for patients with limited manual dexterity to insert and remove the electronics module. The low insertion and extraction forces of the device and self-alignment further aids patient use. The design of the device also makes for a reliable and robust electrical connection especially during patient movement and during connection/disconnection cycles.

[0021] Provided herein is an electrode device comprising an interface. The interface comprises at least one magnetic contact, the interface adaptable to be in communication with an electronic member. The magnetic contact can be adaptable to slidably align and position the electronic member with respect to the interface. The interface can be further adaptable to remain affixed to

a patient while the electronic member used with the interface can be removed and/or inserted from the interface. The interface can be a pouch, pocket or container. Additionally, the device can further comprise an electronic member. In some embodiments, the device can be a flexible substrate. The magnetic contact on the interface can be used with the electronic device to align and position the electronic member. Alternatively, the magnetic contact on the interface can be used with a contact on the electronic member to align and position the electronic member with respect to the electronic interface. The electronic member can be a replaceable electronic member such that the electronic member can be removed from the interface and reinserted into the interface without disturbing the interface. Alternatively, the electronic member can be removed from the interface and replaced with another electronic interface without disturbing the interface. Multiple electronic members can be used with the electronic interface. In some embodiments, the electrode device can further comprise a ferromagnetic metal adaptable to facilitate the connection between the interface and the electronic member. The ferromagnetic metal can be located on the interface and form a connection with a magnet that is part of the electronic member. Alternatively, the ferromagnetic metal can be located on the electronic member and form a connection with a magnet that is part of the interface. In addition to forming a connection between the interface and the electronic member, the interface can also maintain the connection between the electronics member and the interface. The contact on the interface can be used to maintain the connection between the electronics member and the interface. In some embodiments, an additional support structure can be used with the interface to maintain the connection between the interface and the electronics member. The additional support can be a tab holding the electronic member in communication with the interface. The additional support can be a slot that can be used to hold the electronic member in communication with the interface. The magnetic contact can be adaptable to provide a low engagement force between the interface and the electronic member.

[0022] Further provided herein is an electrode device comprising an interface in communication with a patient, an electronic member adaptable to be inserted and/or removed from the interface without disturbing the interface, and at least one compliant electronic connection. The interface can be adaptable to slidably engage the electronic member. The interface can facilitate self-alignment and self-positioning of the electronic member in the interface. The interface can be a pouch, pocket or container. In some embodiments, the interface can be a flexible substrate. In some embodiments, the electrode device can comprise more than one compliant electronic connection. The device can further comprise an interface that has at least one contact located on the interface. The contact can be adaptable to facilitate the self-alignment and self-positioning of

the electronic member with respect to the interface. Furthermore, the electronic member can be adaptable to be inserted, removed, and then reinserted into the interface. Alternatively, the electronic member can be inserted, removed, and replaced with a second electronic member. In some embodiments, the interface can be adaptable to be in communication with more than one electronic component. The interface can be in communication with more than one electronic component at the same time. In some cases, the interface can be in communication with more than one electronic component having different configurations.

I. DEVICES

[0023] The devices described herein is a patch comprising a thin, flexible material of suitable size and shape adaptable to collect physiological signals with multiple electrode contacts and adhesives on one side. In some embodiments, the device shape comprises a circle. The circle can have a diameter of approximately 50 mm. In some embodiments, the device shape comprises a square. The device shape can comprise any suitable shape. In some embodiments, the distance across the longest axis of the device can be approximate 20 mm. In some embodiments, the distance across the longest axis of the device can be approximately 10 mm. In some embodiments, the distance across the longest axis of the device can be approximately 100 mm.

[0024] On the back side of the device, a second piece of flexible material in approximately the same shape as the first piece. The second piece of material joins with the first piece of material to form a interface. The second piece of material can be a separate piece of material from the first piece of material. Alternatively, the second piece of material can be the same piece of material as the first piece of material, where the second piece of material is comprised of a folded over portion of the first piece of material, as seen in **FIG. 1**. **FIG. 1** is an outside view of one embodiment of a device, where the first and second pieces of material can form a interface and that are part of the same piece of material. In the embodiment shown in **FIG. 1** the device is unfolded. The first piece of material *1* is connected to the second piece of material *3* at the fold line *2*. The second piece *3* is folded into contact with the first piece of material *1* at the hinge *2*. The first and second substrates can then be joined together along the edges to form an interface.

[0025] Materials from which the interface can be made include biodegradable materials and biocompatible materials. In some embodiments, the interface can be made from a "plastic" sheet material, where the plastic material has suitable mechanical and electrical characteristics. Alternatively, the interface can be fabricated from a woven material for increased flexibility.

[0026] **FIG. 1** also illustrates the first substrate *1* comprising electrodes contact areas *4* that can come into contact with the patient's skin. The number of electrodes on the substrate can be

adjusted based on the application for which the device is needed. Additionally, the electrode configuration can also be varied depending on the application.

[0027] The second piece of material *3* when folded upward along the hinge *2* and sealed together with the first piece of material *1* forms the interface. The second piece of material *3* can be folded away from the patient. In some embodiments, the second piece of material *3* is substantially the same shape as the first piece of material *1*. In some embodiments, the second piece of material is only a portion of the size of the first piece of material *1*. In some embodiments, the second material is at least half of the size of the first material. The electronic member that is inserted into the interface may extend from the interface.

[0028] The outside of the first piece of substrate *1* as shown **FIG. 1** can be positioned in contact with the patient. The outer surface of the first piece of substrate can have gel contact areas *4* that are in communication with the patient and in communication with the external electronics. The external electronics include the electronic module, or any other suitable external electronic component. In some embodiments, once the second piece of material is attached to the first piece of material, circular donut pads can be cut around the gel contact areas 4 to expose an adhesive section *5*. The adhesive *5* can be a biocompatible adhesive that can facilitate sticking the device to the patient's skin. After the adhesive section *5* is formed, a gel can be positioned on the electrode gel contact areas. The gel can be in contact with conducting rivets located through the substrate carry any physiological signal detected to the inside of the interface. The metallic rivets and conducting traces may be fabricated from carbon based or other conductive materials without loss of function. These materials may be more compatible with magnetic resonance (MR) imaging, allowing the patch to remain in place during the procedure, while the electronics module is removed.

[0029] The second piece of material *3* can further comprise ferromagnetic disks *7*. The ferromagnetic disks *7* can be used to form a connection between the device and an electronics board. In some embodiments, the connection is an electrical connection. In some embodiments, the connection is a mechanical connection. The connection can be both a mechanical and an electrical connection. The disks *7* can be attracted to magnets located on the electronics board. In some embodiments, crescent shaped cut-outs *8* are located around each ferromagnetic disk. The cut-outs allow the disks to independently comply with slight mechanical differences. The cut-outs can also facilitate the use of smaller magnets and ferromagnetic disks. The ferromagnetic disks, on the other hand, may not be compatible with MR procedures, and may require removal. By definition, they need to respond to a magnetic field in order to provide the

connection function described in this patent, and the large magnetic fields employed in MR imaging could cause them to overheat or interfere with the imaging process.

[0030] Since the disks do not provide an electric connection per se, it is possible to remove them for an MR procedure and then replace them afterwards. A single adhesive carrier strip would contain the disks for easy removal and replacement. Such a design would also have benefits for recycling, as the disks could be easily removed and discarded, or recycled separately before recycling the interface.

[0031] **FIG. 2** illustrates the inside of the device showing the second piece of material *3* unfolded from the first piece of material *1*. **FIG. 2** illustrates the interior of the electrode contact areas as seen in **FIG. 1**. **FIG.2** illustrates the contacts *10* that are in communication with the patient's skin surface through the gel as shown in **FIG. 1**. The contacts can be made from metal, carbon, composite materials, or any suitable combination thereof. Once the signal has reached the contact *10* on the inside of the interface, the signal can be carried to a second set of contact patches *12* located on the second piece of material. The contacts *10* located on the first piece of material and the contact patches *12* located on the second piece of material are in communication with each other. In some embodiments, the contacts *10* and the contact patches *12* are in communication with each other through traces *11*. The traces *11* can be conductive traces. The traces can be made out of gold, platinum, or any other suitable metal from which the traces can be formed. In some embodiments, the traces can be mad from any suitable non-metallic conductor. The contact patches *12* are located underneath the ferromagnetic disks *7* as shown in **FIG. 1**.

[0032] The contact patches make contact with the electronics with a circuit board. The contact patches can be plated with a conductive material. The contact material choice and fabrication method can depend on specific application requirements. Additional treatments can be applied to the contact patches to improve the functionality of the contact area including, but not limited to, forming a dimple in the contact area. A series of spiral cut-outs *6* in the substrate material around each skin contact electrode can improve patient comfort by allowing some amount of independent electrode movement.

[0033] After the first and second parts of the substrate, *1* and *3*, respectively, are folded together along the hinge *2*, they can be joined together along the periphery to form a pouch, pocket or container. The first and second parts of the substrate can be joined together using any suitable joining method including, but not limited to, thermal bonding, using glue, or other suitable adhesives, or by additional external features that allow the two parts of the substrate to be snapped together, or any combination thereof. In some embodiments, the shape of the substrate

can be altered to facilitate the bonding of the substrate parts. For example purposes only, tabs can be added to the substrate shape to define the bonding area. In some embodiments, the joining of the first and second part of the substrates is in the form of a tight seal. In some embodiments, the first and second parts of the substrates are joined together in a discontinuous manner. This can allow water to drain from the interface after swimming or bathing or other situations including water exposure.

[0034] A close-up view of one embodiment of one of the electrode is shown in **FIG. 3**. **FIG. 3** illustrates an electrode comprising a contact ***10*** and a trace ***11*** exiting from the contact ***10***. The electrode can be surrounded by spiral shaped cut-outs ***6*** to facilitate individual movement of the electrode to reduce the strain between the electrode and the surface of the patient. The spiral cutting 6 around the electrode can allow the contacts to float somewhat with respect to the substrate and/or with respect to each other. The spiral cut can be created by any suitable means including, cutting, burning, etching or punching the substrate material, or any combination thereof. The central contact ***10*** is then supported by bridges located in between the cut-outs. The trace exits the contact along one of the bridges. In some embodiments, only one trace exits from the contact, as shown in **FIG. 3**. In some embodiments, more than one trace exits from the contact. The spiral bridges allow for more flexibility than using radial bridges. In some embodiments, the spiral bridges can be embossed with a three dimensional pattern, such as corrugation, that can provide for even more flexibility, especially with regards to circumferential or turning motions. In some embodiments, spiral shaped bridges are used. In some embodiments, radial bridges can be used.

[0035] The electronics member ***24***, or circuit board, that can be used with the interface ***23*** as described herein, comprises a circuit board and a battery. The electronics member 24 can comprise an array of magnets ***25*** as shown in **FIG. 4A**. The array of magnets ***25*** can be positioned such that the magnets ***25*** correspond to the positions of the plated contact ***26*** of the interface ***23***. As shown in **FIG. 4B**, once the electronics member ***24*** is inserted into the interface ***23***, the magnets ***25*** will pull the ferromagnetic disks ***26*** toward the circuit board, thereby closing the circuits between the plated contacts and the circuit board, as shown in **FIG. 4C**. The position and force of the magnets can also be used to provide an alignment function and the electronics module is being inserted. Additionally, the connection formed between the interface and the electronics module can serve as mechanical restraints to hold the electronics module in place during use. The electronics member can be used to detect, amplify, process, store, and/or transmit signals.

[0036] **FIGS. 5A** and **5B** illustrate cut-away side views of the interface with electronics member. In **FIG. 5A**, the electronic module ***24*** has been inserted into the interface ***23***, but the connections between the electronics member ***24*** and the interface ***23*** have not been made. In some embodiments, magnets can be located along the surface of the electronics member. In embodiments, magnets ***25*** can be located in the interior of the circuit board ***24***, as shown in **FIG. 5A**. The ferromagnetic metal ***27*** can be positioned on the second part of the substrate ***3*** and the magnet ***25*** positioned near the electronics member. Alternatively, the ferromagnetic metal ***27*** can be positioned on the electronics member and the magnet positioned on the second part of the substrate. The magnet and ferromagnetic metal can then bring the contacts ***26*** on the electronic member and interface together. Alternate designs using one magnet to complete more than a single circuit are also possible. In addition, the polarity of the magnets can be used to align the electronics member in the interface. This is particularly true if one or more of the ferromagnetic metal disks are replaced with a magnet. The repulsion and attraction forces of the magnets could then help to guide the circuit board into proper position. **FIG. 5A** further illustrates the electrode gel ***21*** positioned in the adhesive ***22*** on the first part of the substrate.

[0037] **FIG. 5B** illustrates the electronic member ***24*** positioned in the interface. In **FIG. 5B**, the electronic member and the interface are mated together as indicated by the touching of the contact pads ***26*** on the interface ***23*** and electronic member ***24***.

[0038] Magnetic forces can be used to hold the electronics module in position in the interface. Additionally, other features can be used with the device to hold the electronics member in position. For example purposes only, the device can comprise a tab on the rear of the interface that can engage a portion of the electronics module. The tab can directly engage the electronics module. Alternatively, the tab can engage a slit located on the electronics module. Alternatively, the interface can comprise a slit which can engage the electronics module thereby holding it in place.

[0039] Described herein is a device comprising magnets for aligning an electronics board with respect to the interface. In some embodiments, the device can comprise alternative features for aligning and engaging the electronics board. Alternative features include any suitable feature that has a low insertion force engagement mechanism including a spring force to hold the electronics member in position including, but not limited to, clamps to hold the electronics member in position from behind, interfaces which can be clamped over the electronics member, or any other suitable method for engaging the electronics module, which allows for rapid and easy removal of the electronics member from the interface.

III. METHODS

[0040] Further provided here in is a method for detecting a physiological parameter with at least one electrode comprising: positioning an interface on the surface of a patient; sliding an electronic member into contact with the interface to engage the electronic member with the interface; and detecting the physiological parameter from the patient. The electronics member can be adaptable to be inserted and/or removed from the interface without disturbing the interface. The method can further comprise the step of removing the electronic member from the interface and replacing the electronic member with a second electronic member. The second electronic member can be the same electronic member as the first electronic member. Alternatively, the second electronic member can be a different electronic member than the first electronic member. The method can further comprise the use of an interface wherein the interface comprises at least one magnetic contact, the interface adaptable to be in communication with an electronic member, wherein the at least one magnetic contact is adaptable to align and position the electronic member in the interface. The interface can be a pouch, pocket or container. The method can comprise a device that can be designed such that the device can be adaptable to facilitate insertion of the electronic member in the interface. The device can slidably engage the communication member with the interface.

[0041] Further provided herein is a method of detecting a physiological parameter comprising: forming an interface from a flexible substrate, the flexible substrate comprising at least one magnetic contact; sliding the interface in contact with a surface of a patient; inserting an electronic member in the interface, the electronic member comprising at least one magnetic contact; connecting the interface and electronic member using the at least one magnetic contact on the interface and the at least one contact on the electronic member; and detecting at least one physiological parameter from the patient. The interface can be further adaptable to remain affixed to a patient while the electronic member is removed and/or inserted with respect to the interface. Additionally, the method can provide the step of disconnecting the electronic member from the interface and reconnecting an electronic member with the interface. The electronic member reconnected with the interface can be the original electronic member. Alternately, the electronic member reconnected with the interface can be a new electronic member.

[0042] Provided herein is a method for detecting a physiological parameter from a patient comprising: sliding an electronic member into contact with an interface adaptable to be in communication with the electronic member; and positioning the interface on a surface of a patient. The interface can be further adaptable to remain affixed to a patient while the electronic member is removed and/or inserted with respect to the interface. Additionally, the method can

further comprise the step of removing the electronic member and reinserting the electronic member. Alternatively, the method can further comprise the step of removing the electronic member and replacing the electronic member with a second electronic member.

IV. KITS

[0043] Further provided herein is a kit for measuring a physiological parameter comprising: an interface comprising at least one magnetic contact, the interface adaptable to be in communication with an electronic member, the at least one magnetic contact adaptable to slidably engage the electronics member and if further adaptable to align and position the electronic member with respect to the interface. The kit can further comprise an electronic member.

[0044] Provided herein is a kit for measuring a physiological parameter comprising: an interface having at least one magnetic contact, the interface adaptable to be in communication with an electronic member; and at least one electronic member, the at least one magnetic contact adaptable to slidably align and position the electronic member with respect to the interface. The kit can further comprise more than one electronic member.

[0045] While preferred embodiments of the present invention have been shown and described herein, it will be obvious to those skilled in the art that such embodiments are provided by way of example only. Numerous variations, changes, and substitutions will now occur to those skilled in the art without departing from the invention. It should be understood that various alternatives to the embodiments of the invention described herein may be employed in practicing the invention. It is intended that the following claims define the scope of the invention and that methods and structures within the scope of these claims and their equivalents be covered thereby.

CLAIMS

WHAT IS CLAIMED IS:

1. An electrode device comprising:

an interface comprising at least one magnetic contact, the interface adaptable to be in communication with an electronic member, the at least one magnetic contact adaptable to slidably align and position the electronic member with respect to the interface,

2. The device of claim 1 wherein the interface is further adaptable to remain affixed to a patient while an electronic member is removed and/or inserted from the interface.

3. The device of claim 1 wherein the interface is a pouch.

4. The device of claim 1 wherein the device further comprises an electronic member.

5. The device of claim 1 wherein the device comprises a flexible substrate.

6. The device of claim 1 wherein the magnetic contact is adaptable to contact a contact located on the electronic member.

7. The device of claim 1 wherein the device is adaptable to be used with a replaceable electronic member.

8. The device of claim 1 further comprising a ferromagnetic metal adaptable to facilitate a connection between the interface and an electronic member.

9. The device of claim 8 wherein the interface is adaptable to maintain the connection between the electronic member and the interface.

10. The device of claim 1 further comprising an additional support structure adaptable to maintain the position of the electronics component.

11. The device of claim 1 wherein the at least one magnetic contact is adaptable to provide a low engagement force between the interface and an electronic member.

12. An electrode device comprising:

an interface in communication with a patient;

an electronic member adaptable to be inserted and/or removed from the interface without disturbing the interface; and

at least one compliant electronic connection,

wherein the interface is adaptable to slidably engage the electronic member and further adaptable to facilitate self-alignment and self-positioning of the electronic member with respect to the interface.

13. The device of claim 12 wherein the interface is a pouch.

14. The device of claim 12 wherein the interface further comprises a flexible substrate.

15. The device of claim 12 further comprising more than one compliant electronic connection.

16. The device of claim 12 further comprising at least one contact located on the interface, the contact adaptable to facilitate the self-alignment and self-positioning of the electronic member.

17. The device of claim 12 wherein the electronic member is adaptable to be inserted, removed, and then reinserted into the interface.

18. The device of claim 12 wherein the electronic member is adaptable to be inserted, removed, and replaced with a second electronic member.

19. The device of claim 12 wherein the device is further adaptable to be in communication with more than one electronic component.

20. A method for detecting a physiological parameter with at least one electrode comprising:

positioning an interface on the surface of a patient;

sliding an electronic member into contact with the interface to engage the electronic member with the interface; and

detecting the physiological parameter from the patient.

21. The method of claim 20 wherein the electronics member is adaptable to be inserted and/or removed from the interface without disturbing the interface.

22. The method of claim 20 further comprising the step of removing the electronic member from the interface and replacing the electronic member with a second electronic member.

23. The method of claim 22 wherein the second electronic member is the electronic member.

24. The method of claim 20 wherein the interface comprises at least one magnetic contact, the interface adaptable to be in communication with an electronic member, wherein the at least one magnetic contact is adaptable to align and position the electronic member in the interface.

25. The method of claim 20 wherein the interface is a pouch.

26. The method of claim 20 wherein the device is adaptable to facilitate insertion of the electronic member in the interface.

27. A method of detecting a physiological parameter comprising:

forming an interface from a flexible substrate, the flexible substrate comprising at least one magnetic contact;

sliding the interface in contact with a surface of a patient;

inserting an electronic member in the interface, the electronic member comprising at least one magnetic contact;

connecting the interface and electronic member using the at least one magnetic contact on the interface and the at least one contact on the electronic member; and

detecting at least one physiological parameter from the patient,

28. The method of claim 27 wherein the interface is further adaptable to remain affixed to a patient while the electronic member is removed and/or inserted from the interface.

29. The method of claim 27 further comprising the step of disconnecting the electronic member from the interface and reconnecting an electronic member with the interface.

30. The method of claim 29wherein the electronic member is the original electronic member.

31. The method of claim 29wherein the electronic member is a new electronic member.

32. A method for detecting a physiological parameter from a patient comprising:

sliding an electronic member into contact with an interface adaptable to be in communication with the electronic member; and

positioning the interface on a surface of a patient.

33. The method of claim 32 wherein the interface is further adaptable to remain affixed to a patient while an electronic member is removed and/or inserted from the interface.

34. The method of claim 32 further comprising the step of removing the electronic member and reinserting the electronic member.

35. The method of claim 32 further comprising the step of removing the electronic member and replacing the electronic member with a second electronic member.

36. A kit for measuring a physiological parameter comprising:

an interface comprising at least one magnetic contact, the interface adaptable to be in communication with an electronic member, the at least one magnetic contact adaptable to slidably engage the electronics member and is further adaptable align and position the electronic member in the interface,

37. The kit of claim 31 further comprising an electronic member.

38. A kit for measuring a physiological parameter comprising:

an interface at least one magnetic contact, the interface adaptable to be in communication with an electronic member; and

at least one electronic member adaptable to be inserted and/or removed from the interface without disturbing the interface,

wherein the at least one magnetic contact is adaptable to slidably align and position the electronic member in the interface.

39. The kit of claim 33 further comprising more than one electronic member.

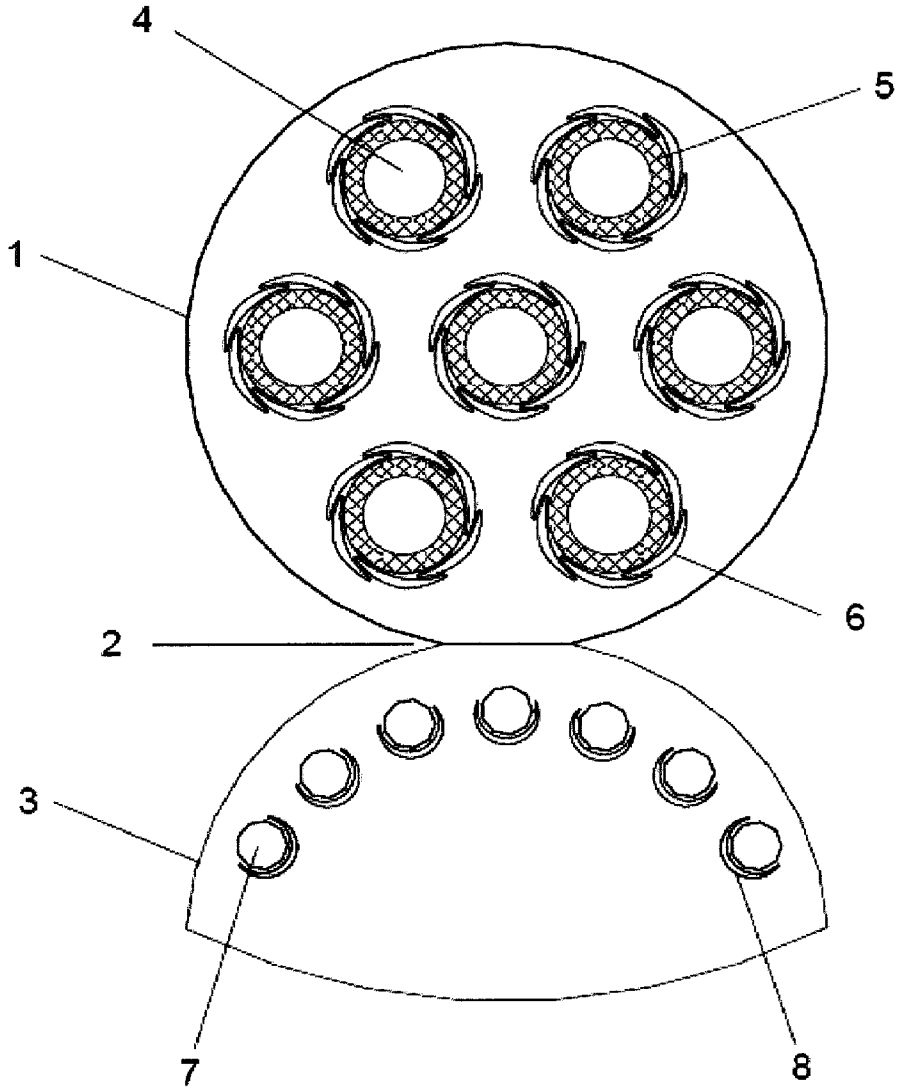

FIG. 1

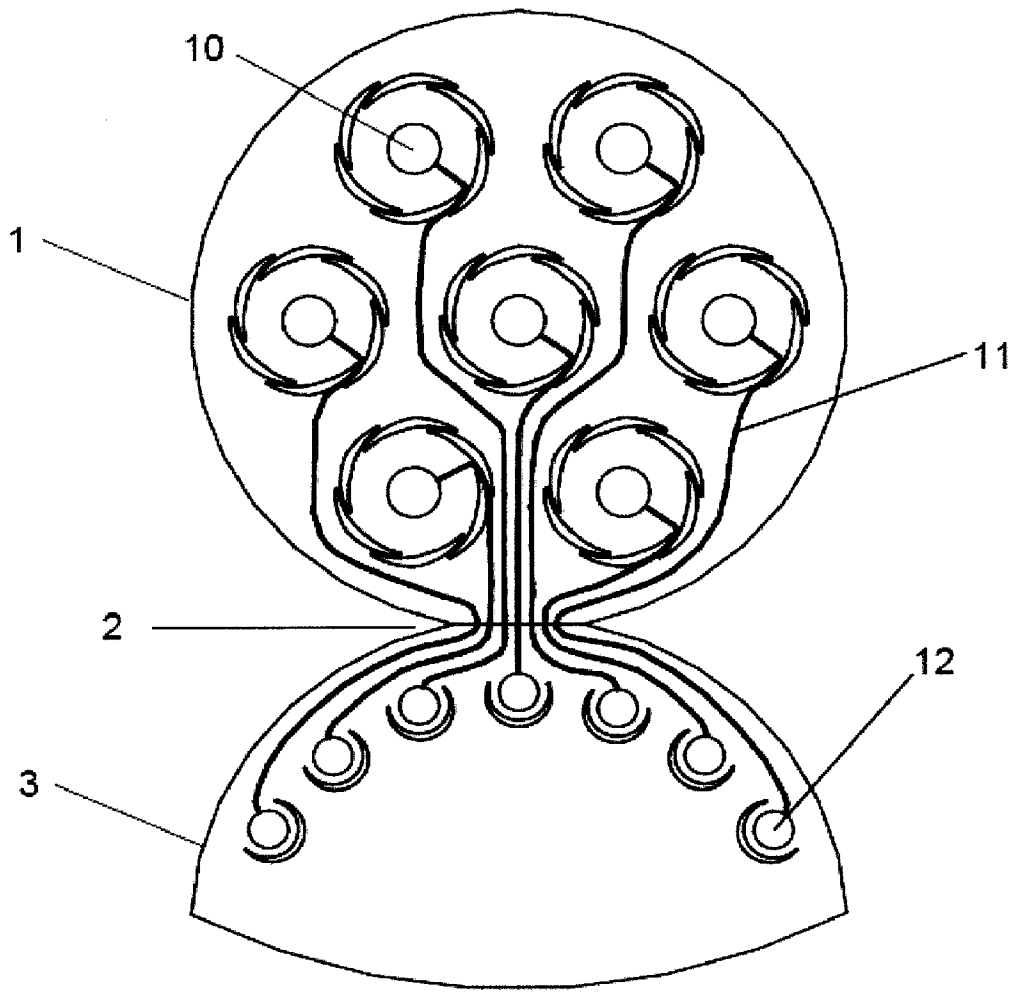

FIG. 2

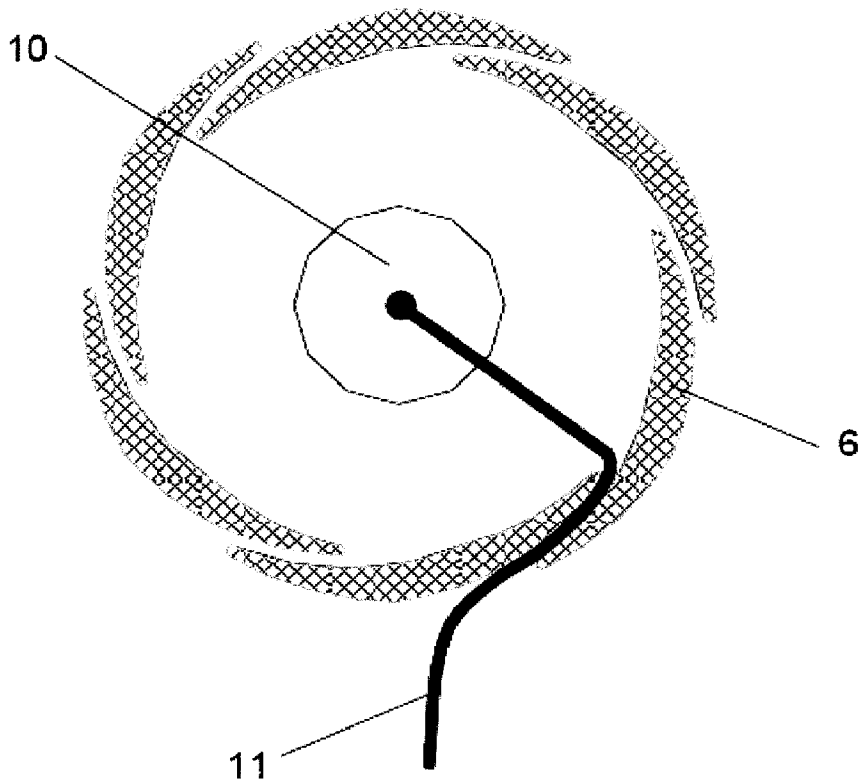

FIG. 3

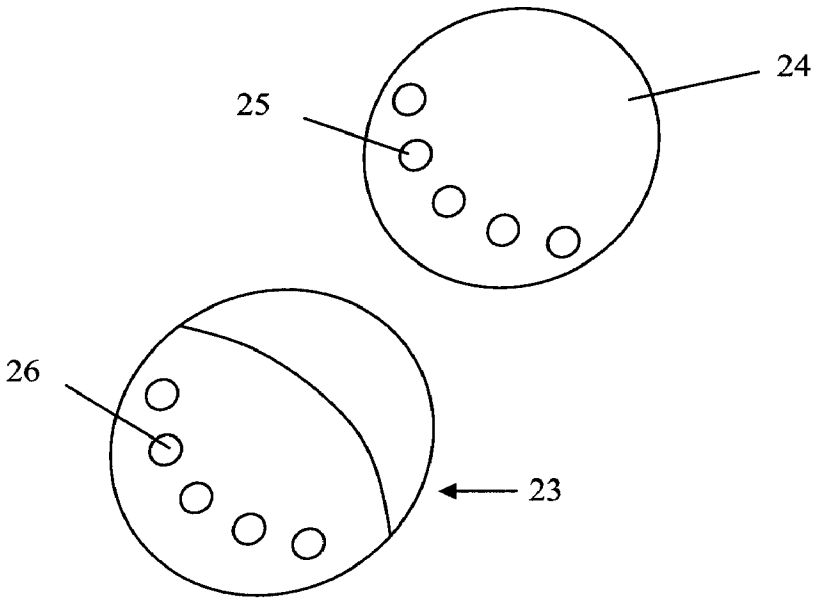

FIG. 4A

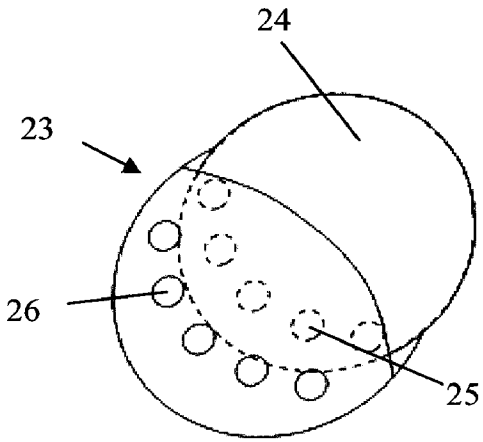

FIG. 4B

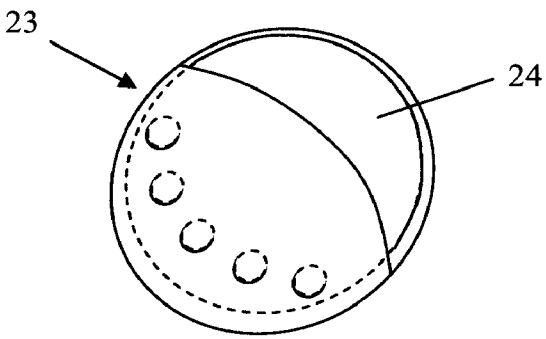

FIG. 4C

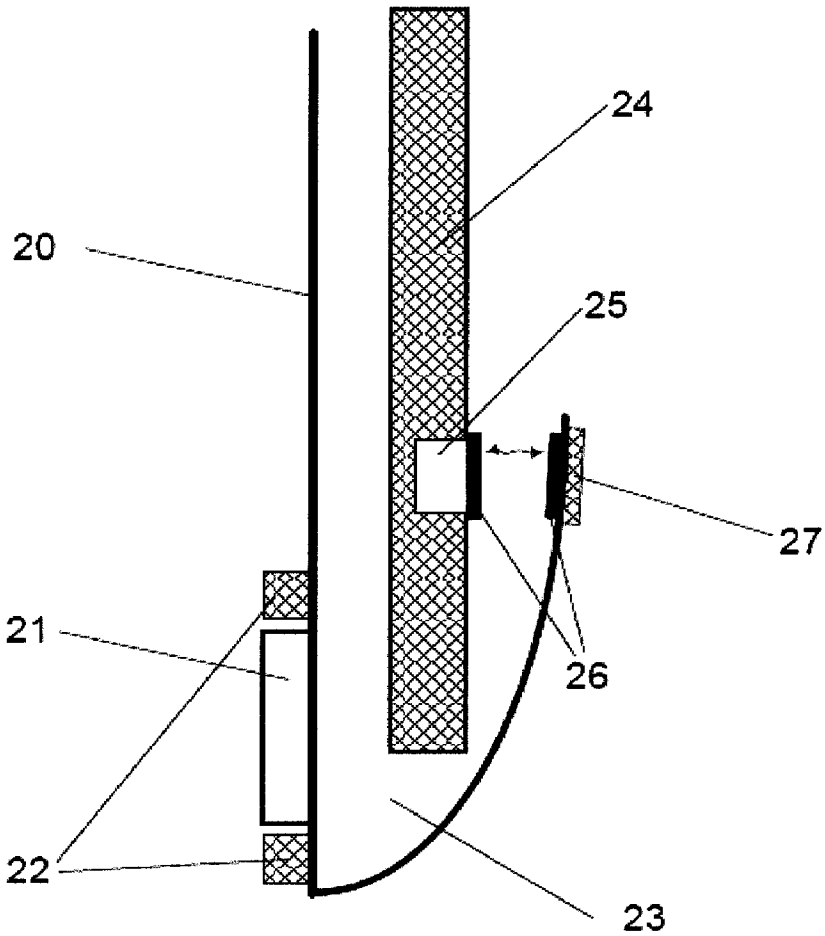

FIG. 5A

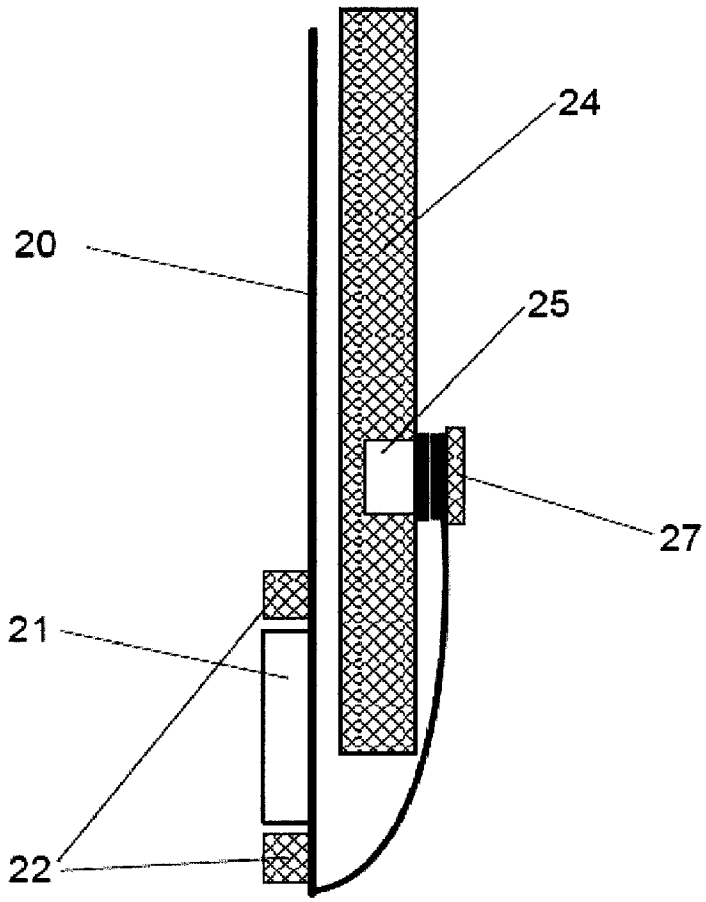

FIG. 5B