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(54) **ELECTROENCEPHALOGRAPHY SENSORS**

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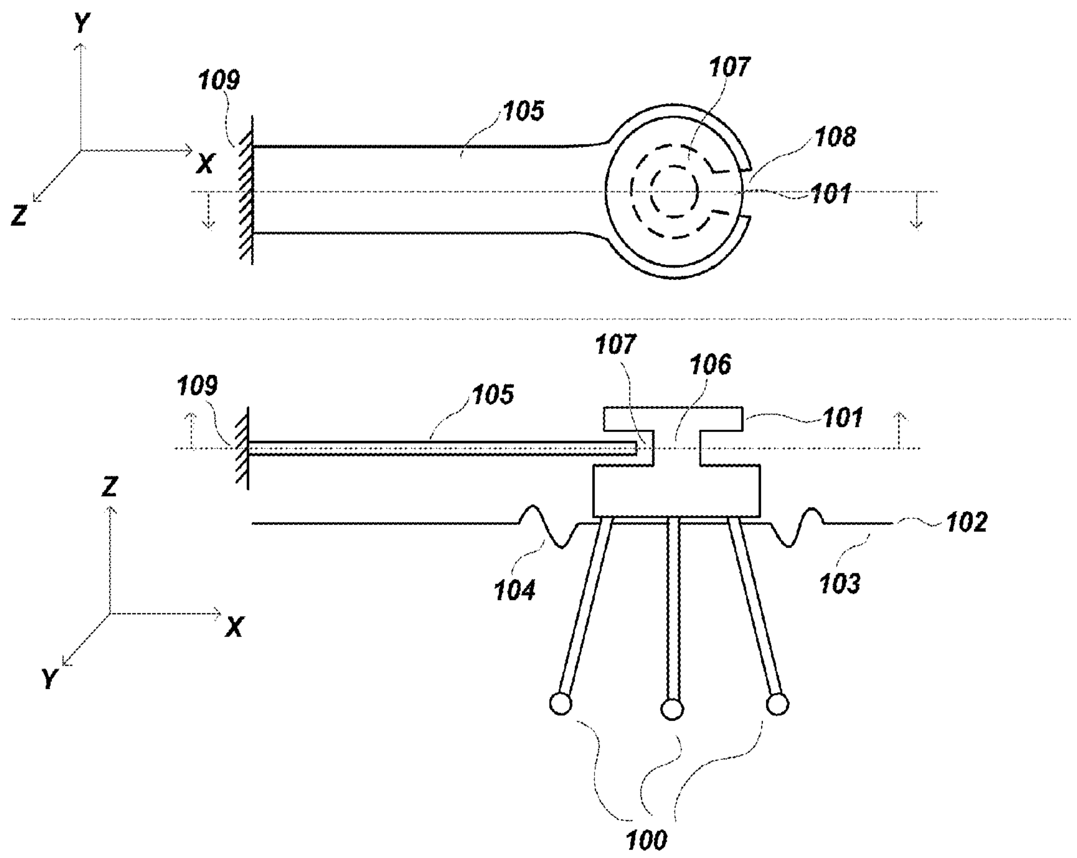
(57) **ABSTRACT**

Various designs of dry EEG sensor are described to permit movement of the sensor contacts with respect to the device in which the sensor is mounted.



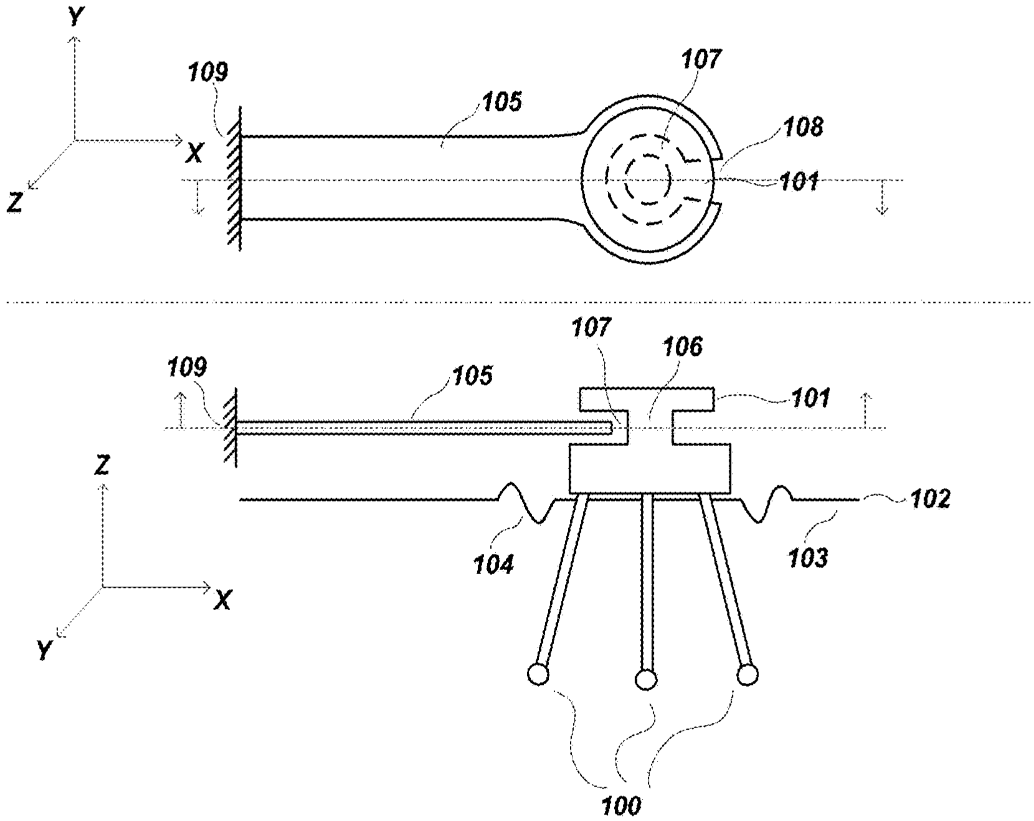


FIG. 1

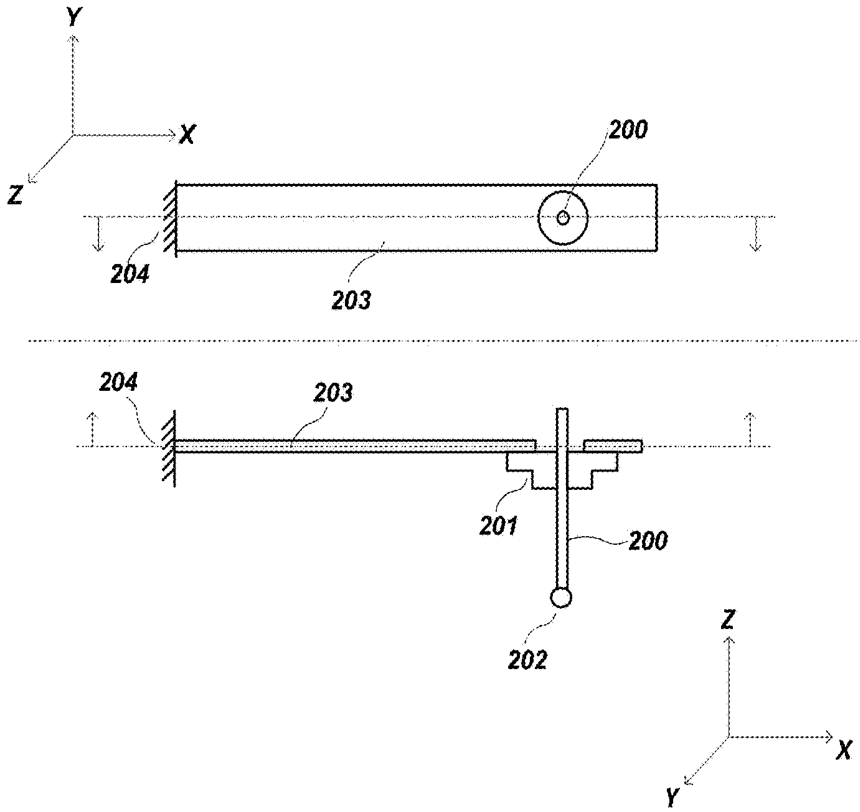


FIG. 2

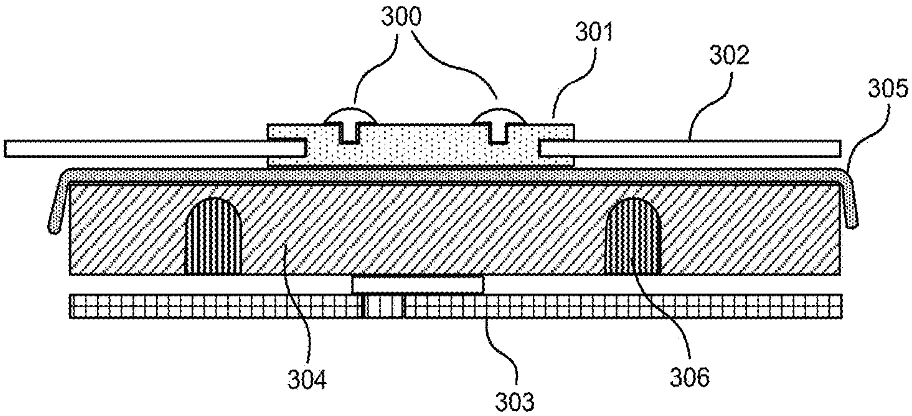


FIG. 3

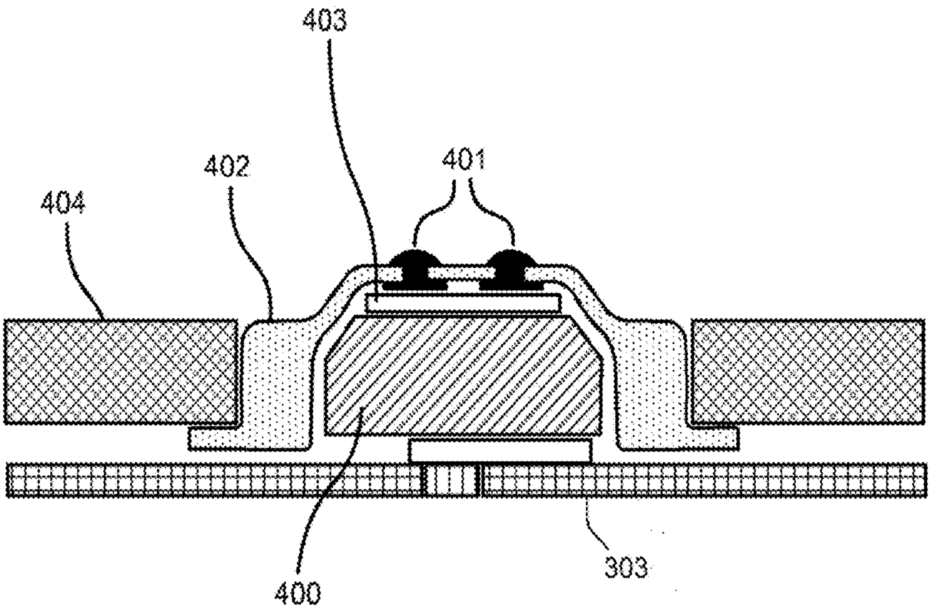


FIG. 4A

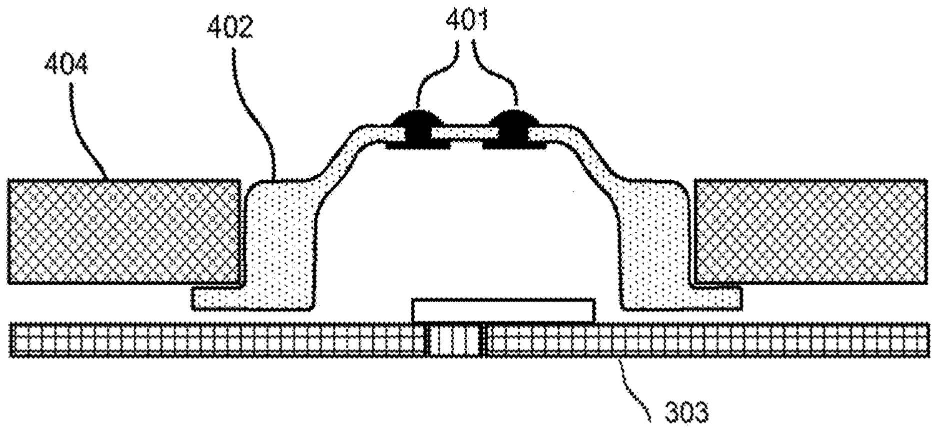


FIG. 4B

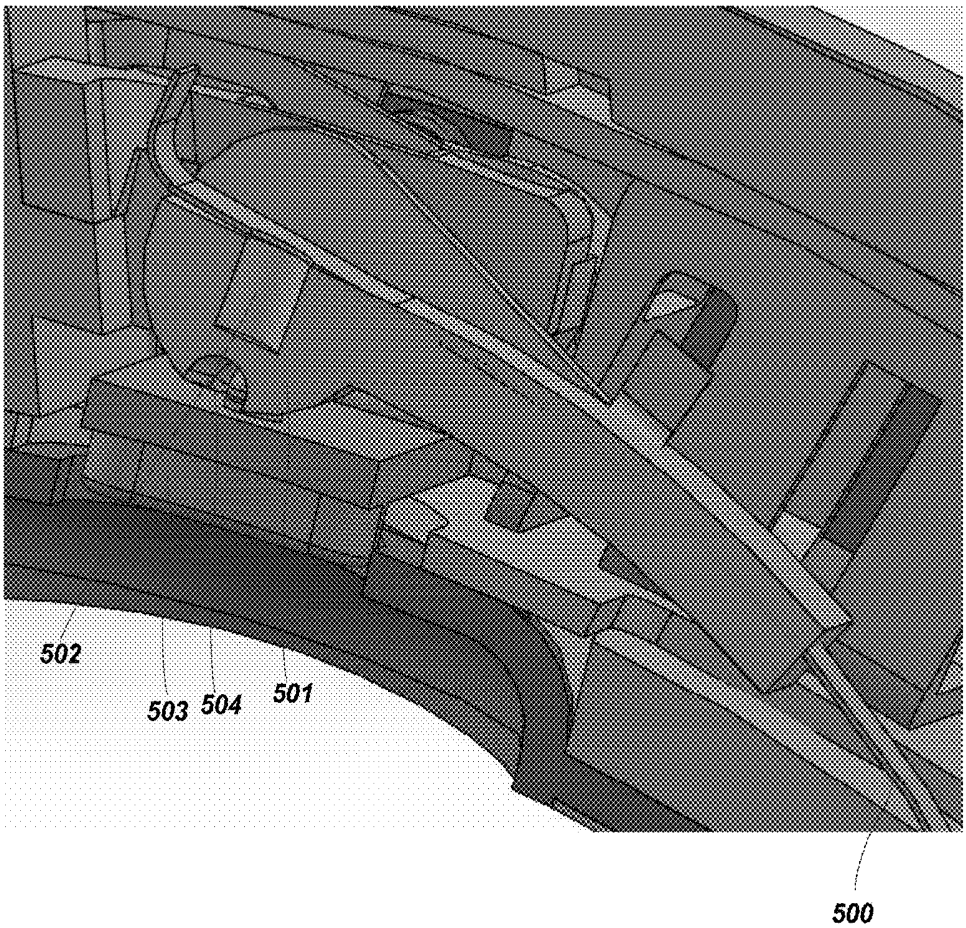


FIG. 5

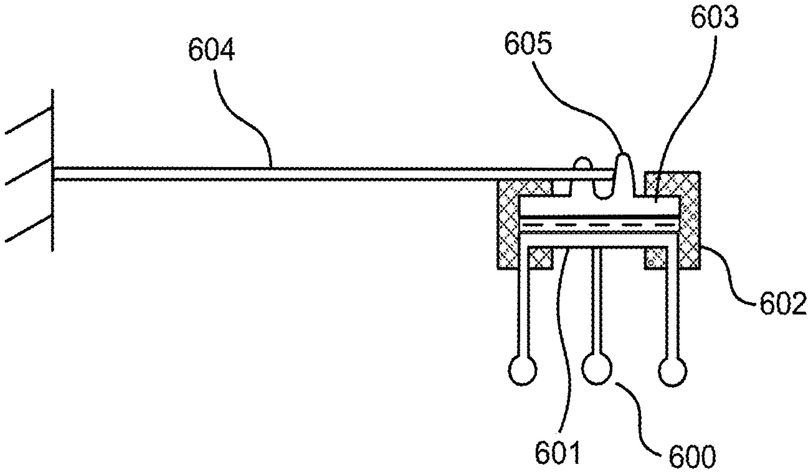


FIG. 6

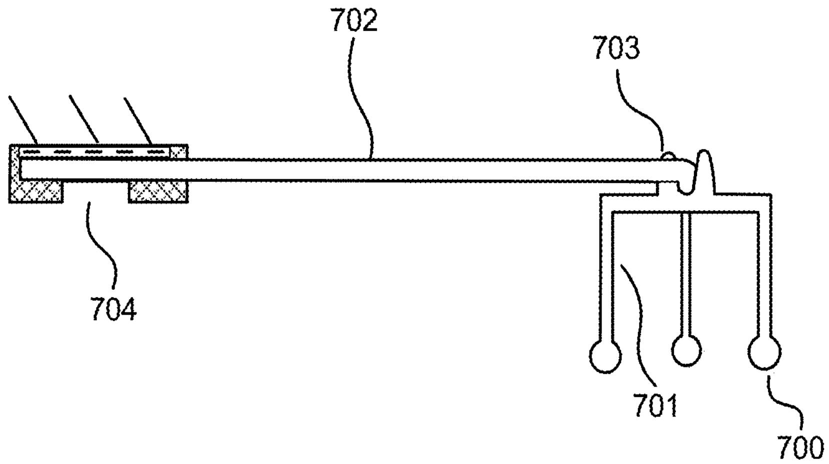


FIG. 7

ELECTROENCEPHALOGRAPHY SENSORS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation application of International Application PCT/EP2017/082257, which was filed on Dec. 11, 2017, the entire contents of which are incorporated herein by reference. International Application PCT/EP2017/082257 is based upon and claims the benefit of priority of the prior United Kingdom Patent Application No. 1621074.2, filed on Dec. 12, 2016, the entire contents of which are also incorporated herein by reference.

TECHNICAL FIELD

[0002] Embodiments of the present invention generally relate to sensors for use in Electroencephalography (EEG) systems and in particular dry EEG sensors for contacting the head and ear.

BACKGROUND

[0003] Electroencephalography (EEG) measures electrical potential fluctuations on the head (mostly on the scalp) which are caused by brain activity. Analysis of the fluctuations can be utilised to analyse brain activity, for example to determine whether a user is awake or asleep, or their state of sleep.

[0004] EEG systems utilise sensors positioned around the head to sense the electrical potential at one or more locations. Non-contact sensors attempt to sense the potential using field sensors, whereas contact-based sensors make an electrical contact to the skin.

[0005] Contact-sensors can be categorised as wet or dry, which indicates whether a conductive gel is used to ensure a good electrical contact. Wet sensors are common in clinical applications, but are a disadvantage in consumer devices as they rely on the correct application of the gel. Dry sensors are more convenient for use, but may present difficulties in maintaining the contact stationary with regard to the user's skin.

[0006] There is a requirement for an EEG sensor that is comfortable to wear that remains sufficiently static with respect to a users.

[0007] The embodiments described below are not limited to implementations which solve any or all of the disadvantages of known systems.

SUMMARY

[0008] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0009] There is provided an electroencephalography (EEG) sensor, comprising at least one elongate electrical contact for contacting the skin of a user, the at least one electrical contact being mounted in a bobbin; a resilient arm for connection at a proximal end to a device in which the sensor is located, the bobbin being mounted at a distal end of the resilient arm, wherein the resilient arm permits movement of the electrical contacts in an axis substantially aligned with the axis of the at least one elongate electrical contact, and wherein movement between the bobbin and resilient arm permits lateral movement of the tips of the electrical contacts in a plane substantially perpendicular to the axis of the at least one elongate electrical contact.

[0010] There is also provided an electroencephalography (EEG) sensor, comprising at least one elongate electrical contact for contacting the skin of a user, the at least one electrical contact being mounted to a bobbin; and a resilient arm for connection at a proximal end to a device in which the sensor is located, the bobbin being mounted at a distal end of the resilient arm via a pivotable joint component permitting pivoting in at least one dimension, wherein the resilient arm permits movement of the electrical contacts in an axis substantially aligned with the axis of the at least one elongate electrical contact, and wherein movement between the bobbin and resilient arm permits lateral movement of the tips of the electrical contacts in a plane substantially perpendicular to the axis of the at least one elongate electrical contact.

[0011] 24. An electroencephalography (EEG) sensor, comprising at least one elongate electrical contact for contacting the skin of a user, the at least one electrical contact being mounted to a bobbin via a pivotable joint component permitting pivoting in at least one dimension; a resilient arm for connection at a proximal end to a device in which the sensor is located, the bobbin being mounted at a distal end of the resilient arm, and a joint for connecting the proximal end of the resilient arm to a device in which the sensor is located, wherein the resilient arm permits movement of the electrical contacts in an axis substantially aligned with the axis of the at least one elongate electrical contact, and wherein the joint permits movement between the resilient arm and a device in which the sensor is located along a longitudinal axis of the resilient arm.

[0012] There is also provided an electroencephalography (EEG) sensor, comprising at least one elongate electrical contact for contacting the skin of a user; a resilient arm for connection at a proximal end to a device in which the sensor is located, the bobbin being mounted at a distal end of the resilient arm, wherein the resilient arm permits movement of the electrical contacts in an axis substantially aligned with the axis of the at least one elongate electrical contact, and wherein movement between the bobbin and resilient arm permits lateral movement of the tips of the electrical contacts in a plane substantially perpendicular to the axis of the at least one elongate electrical contact.

[0013] There is also provided an EEG sensor, comprising at least one elongate electrical contact for contacting the skin of a user; a resilient material positioned between the at least one electrical contact and a part of a device in which the EEG sensor is mounted; and a low-friction material positioned between the at least one electrical contact and the resilient material.

[0014] A selection of optional features are set out in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Embodiments of the invention will be described, by way of example, with reference to the following drawings, in which:

[0016] FIGS. **1** to **4**B, and **6** to **7** show various EEG sensors; and

[0017] FIG. **5** shows a mechanism to withdraw an EEG sensor.

DETAILED DESCRIPTION

[0018] Embodiments of the present invention are described below by way of example only. These examples represent the best ways of putting the invention into practice that are currently known to the Applicant although they are not the only ways in which this could be achieved. The description sets forth the functions of the example and the sequence of steps for constructing and operating the example. However, the same or equivalent functions and sequences may be accomplished by different examples.

[0019] Dry sensors rely on a direct contact between the sensor and skin to obtain a signal, and must be held sufficiently stationary on the skin to avoid interference with the signal. Movement of a sensor across the surface of the skin can generate artefact signals many times larger than the actual EEG signals thus making recovery of the actual signals difficult. It is believed that movement on a micron-scale is sufficient to generate artefacts that will interfere with the actual signals. For example, it can be possible to detect the user's heartbeat from artefacts created by skin movement due to the heart beat.

[0020] Maintaining static contact is particularly difficult with devices intended to be worn for extended periods of time. For example a device worn overnight must be sufficiently comfortable to allow the user to sleep, while also securing the sensors and preventing movement during sleep. A further challenge is that sensors must reach through hair on the user's head to make contact with the skin.

[0021] In order to minimise movement between an EEG sensor and the skin of the user a sensor design which can stay sufficiently static, while also applying only a reasonable amount of force to ensure comfort of the user, is required. Furthermore, to sense locations on the user's scalp, the sensor must reach through hair. FIG. **1** shows plan and cross-section diagrams of a sensor arrangement intended to meet these requirements.

[0022] Axis X, Y, Z will be used to describe the arrangements shown in the figures. The X/Y plane will be referred to as the lateral plane, and movement in that plane will be described as lateral movement. The Z axis will be described as the vertical axis, and movement in that axis as vertical movement. Terms such as lateral and vertical are used only for description in relation to the figures, and are not descriptive of the actual orientation of the device. In use the sensor is oriented such that the skin of the user is positioned substantially in the X/Y plane.

[0023] Electrical contacts **100** are mounted to a bobbin **101** in a substantially rigid arrangement such that the position of the contact tips is maintained relative to each other. The electrical contacts **100** may be formed of any appropriate conductive material, for example copper with a gold coating at the tip for providing good electrical contact to the user's skin. The electrical contacts **100** are in turn connected to electrical circuitry to process the signals detected. Typically the contact is initially connected to an input buffer amplifier (which may be mounted as part of the sensor arrangement). Any electrical connection from the sensor **100** is provided using sufficiently flexible wire to prevent restraining sensor movement. The electrical contacts are elongate to penetrate through a user's hair. For example the electrical sensors may have a length in the range of 5-10 mm.

[0024] The electrical contacts **100** protrude through a barrier layer **102** which may be formed as part of the device in which the sensor is positioned. In use the sensor is positioned such that surface **103** of barrier layer **102** faces towards the user and hence the electrical contacts **100** protrude towards the user's skin. Barrier layer **102** is formed with a flexible region **104** (which extends around and encircles the electrical contacts). Flexible region **104** is provided to allow lateral movement of the electrical contacts **100** and bobbin **101**. The barrier layer may be formed of a thin flexible material, with folds or concertina sections in the flexible region **104** to permit movement of the electrical contacts **100**. For example, the layer may be formed of silicone. In an example silicone with a thickness of less than 0.8 mm may be utilised. In alternative configurations a material with sufficient flexibility to not require concertina sections may be utilised.

[0025] Bobbin **101** is attached at a first end of arm **105**. In the specific design shown in FIG. **1** the bobbin has a neck portion **106** which fits within an opening **107** in the arm **105**. Gap **108** is provided to enable neck portion **106** to be positioned in opening **107**. Neck portion **106** has a smaller diameter than opening **107** (but larger than gap **108**) such that the bobbin **101** can move laterally relative to the arm **105**. In an example the diameter of the opening **107** may be 1 mm larger than the diameter of the neck portion **106** to allow 1 mm of lateral movement in X/Y plane.

[0026] The height of the neck portion **106** is substantially the same as the thickness of arm **105** around the opening **107** such that vertical movement is substantially prevented, but lateral movement does not suffer significant friction (the height is shown differently in FIG. **1** for clarity). The arm and bobbin surfaces may be coated to reduce friction. In an example, the bobbin may be formed of Nylon, metal with a PTFE coating, or formed as a composite material with regions of low-friction PTFE in the areas of contact between the bobbin **101** and arm **105**.

[0027] An opposite end of arm **105** is mounted to the body **109** of the device comprising the sensor. In an example the sensor may be mounted in a pair of headphones, and the arm **105** may be mounted to the headband of those headphones. Arm **105** is flexible in the vertical (Z) direction such that the bobbin **101** can move vertically relative to the body **109** by bending of the arm **105**. Arm **105** is, however, substantially stiff in the X/Y plane to prevent lateral movement of the bobbin once it is positioned against the edge of the opening **107**. The arm **105** is resilient such that the arm **105** deforms under pressure but provides a force against the surface applying pressure. In use the surface is the user's head against which the electrical contacts **100** are pushed when the device comprising the sensor (for example headphones) is placed on the head. In an example the arm **105** may be formed of annealed spring steel having a thickness of 0.15 mm. The spring-steel arm may have a width of 5 mm and a length of 35 mm, which provides a force of approximately 0.5N at the electrical contacts. Other materials may also be utilised for the arm, with appropriate modification of the parameters to provide a comparable force (or different force as required).

[0028] Although not shown in FIG. **1** electrical contacts **100** are connected by suitable wires or electrical connections to an EEG system. The example of FIG. **1** utilises three electrical contacts **100** as this may provide a stable contact to the skin of the user. However, other numbers of contacts may also be utilised. Furthermore the contacts may be electrically connected to a sensor system either collectively or individually.

[0029] In a variation of the sensor of FIG. **1**, the bobbin **101** may be configured to allow angular movement of the electrical contacts **100** around the Z-axis. This may be achieved by utilising resilient material for the bobbin, or allowing angular movement between the bobbin and arm **105**.

[0030] The sensor arrangement of FIG. **1** thus provides a force against the user's skin to hold the electrical contacts in position, while allowing movement in the lateral direction. In use this means that when the user's skin moves relative to the device on which the sensor is mounted the electrical contacts move with the user's skin rather than sliding over the surface. Electrical artefacts caused by movement of the sensor over the skin are thus reduced, improving the quality of the signals that can be obtained.

[0031] FIG. **2** shows a further example of an EEG sensor for holding an electrical contact static on the skin of a user. Electrical contact **200** is mounted in a flexible bush **201** which permits angular movement of the electrical contact **200** about the X/Y-axis. In an example the flexible bush **201** is formed of rubber. The angular movement provides lateral movement in the X/Y axis at the tip **202** of the electrical contact **200**, thus allowing movement between the skin of the user and the device in which the sensor is mounted. In an example the tip may be provided with movement of up to 1 mm about a centre point, or up to 2 mm about a centre point.

[0032] The flexible bush **201** is mounted in arm **203**, which is resilient, and mounted to the body **204** of the device in which the sensor is positioned. As described in relation to FIG. **1**, arm **203** is resilient to movement in the X/Y-axis such that pressure on the electrical contact **200** causes movement of the contact in the Z-axis and the creation of a force against the surface pressing on the contacts.

[0033] Bush **201** and electrical contact **200** are mounted to the arm **203** such that the desired movement is possible, and such that the electrical contact **200** is insulated from the arm **203**.

[0034] As described in relation to FIG. **1**, the electrical contact **200** may be formed from gold-plated copper, and the arm **203** may be formed from spring steel. The example values and dimensions provided in relation to FIG. **1** are equally applicable to this example.

[0035] A barrier layer may be provided, as described in relation to FIG. **1** with the electrical contact protruding through the barrier layer to contact the user.

[0036] In alternative configurations the electrical contact **200** may be curved, for example with an s-bend, which may better enable the contact to penetrate the user's hair.

[0037] FIG. **3** shows a further example of an EEG sensor. In this example the sensor is not designed to penetrate through significant hair and is intended for use in contacting regions such as the ear.

[0038] Electrical contacts **400** are mounted in a bobbin **301**, and are electrically connected to the sensing system (not shown) by an appropriate electrical connection. The sensor is mounted in device **303** (of which the figure show a small part in the region of the sensor). The bobbin **301** is mounted in a barrier layer **302**, which may be formed of a stretchy fabric which allows relatively free movement of the bobbin in the X/Y plane. As described above the barrier layer may form part of the device. A resilient layer **304**, typically formed of foam, is mounted on the device **303**. A low-friction material **305** is positioned between the resilient layer **304** and the bobbin **301** such that even when a force is applied to the electrical contacts **300** along the Z-axis the bobbin **301** can still move with little resistance. The resilient layer **304** provides a force against a surface pressing on the electrical contacts **300** and bobbin **301** to maintain the electrical contacts **300** in place

[0039] The low-friction material **305** may be provided by the surface of the resilient layer **304** or may be coated onto the surface of the resilient layer **304**. Alternative a separate layer may be positioned between the resilient **304** and bobbin **301**. The layer **305** may be PTFE (for example PTFE coated tape). Layer **304** may be formed of memory foam or spring type foam material.

[0040] A bumper component **306** may be provided to limit movement of the sensor. For example a region of rubber may be provided within the resilient element to stop further movement of the sensor after it has compressed the resilient layer by a defined amount.

[0041] The sensor of FIG. **3** can thus maintain a force against the user by the electrical contacts, while also allowing movement of the electrical contact in the X/Y plane to avoid the difficulties of prior sensors.

[0042] FIG. **4**A shows a further example of an EEG sensor. The sensor of FIG. **4** is similar to that of FIG. **3**, utilising a resilient layer **400** to provide a force to press the electrical contacts **401** against the skin of a user. In this example the electrical contacts **401** are mounted in a flexible layer **402** which permits movement in all directions. As with the example of FIG. **3** a low-friction layer **403** is provided between the electrical contacts **501** and resilient layer **400** to permit movement of the electrical contacts in the X/Y plane.

[0043] The flexible layer **402** may be formed of silicone as described in relation to FIG. **1**, and concertina regions may be provided to permit movement of the electrical contacts. A spacer material **404** gives a level surface across the area around and including the sensor.

[0044] Resilient layer **400** and low-friction layer **403** may be omitted in certain examples, such as that shown in FIG. **4**B, with the flexible layer **402** providing the required support for the electrical contacts **401**. FIG. **4**B shows a further example of an EEG sensor suitable for mounting on a device **303** such as a set of headphones. The example sensor of FIG. **4**B is similar to that of FIG. **4**A, but with the resilient layer **400** and low-friction layer **403** omitted and with the flexible layer **402** providing the required support for the electrical contacts **401** on the body of the device **303**, and providing a force to press the electrical contacts **401** against the skin of a user when the device **303** is in use (i.e. when the headphones are being worn by a user). In this example the electrical contacts **401** are mounted in a flexible layer **402** which permits movement in all directions, for example, as the skin of the user moves relative to the device. The electrical contacts are configured in some examples to extend through a barrier to make contact with the skin of a user. In examples where the device is a headset of set of headphones, one or more of the electrical contacts may contact the ear of the user. In the example shown in FIG. **4**B (and FIG. **4**A), the flexible layer **402** may be formed of silicone as described in relation to FIG. **1**, and concertina regions may be provided to permit movement of the electrical contacts. A spacer material **404** gives a level surface across the area around and including the sensor.

[0045] FIG. **5** shows a schematic diagram of a mounting system to allow an EEG sensor, such as that described hereinbefore, to be retracted when not required. The arm **500** of the EEG sensor is mounted on a pivoting mount **501**. Mount **501** is configured to pivot about an axis **502** together with the arm **500**. As the mount rotates anti-clockwise the arm **500** also rotates and the sensor contacts at the distal end of arm **500** are lifted towards the body of the device in which the sensor is mounted. Sliding switch **503** engages with a recess **504** on the mount **501** and is used by the user to move the sensors towards or away from the device.

[0046] FIG. **6** shows a schematic diagram of a further mounting system for an EEG sensor. Electrical contacts **600** are mounted to, or form unitarily with, a bobbin **601**, which is held by a resilient mounting **602**. The resilient mounting **602** connects the bobbin and contacts **600**, **601** to a mounting component **603**. Mounting component **603** is connected to resilient arm **604** by a ball joint **605**. Ball joint **605** provides a pivot connection between the mounting component **603** (and hence bobbin **601** and contacts **600**) and resilient arm **604**. Any pivoting connection that provides a pivotable connection in 1 or 2 dimensions may be utilised in place of the ball joint **605**.

[0047] A low-friction surface is provided between bobbin **601** and mounting component **603** to allow lateral movement of the bobbin **601** relative to mounting component **603**. This surface may be provided as described hereinbefore. The resilient mounting **602** may be formed of any material which holds the bobbin **601** against the mounting component **603**, but which is sufficiently flexible to allow sufficient lateral movement, for example rubber or silicone. The mounting component can also be formed of any appropriate material, with particular examples being nylon, Teflon, or other low friction rigid material.

[0048] The resilient arm **604** is comparable to the arms described for the examples set out hereinbefore and may use comparable materials and dimensions. Resilient arm **604** is mounted to the body of the device as described hereinbefore.

[0049] As described hereinbefore, the bobbin **601** can move laterally to allow movement of the contacts in the lateral plane, which the resilient arm **604** allows vertical movement of the contacts. The ball joint **605** allows pivoting movement of the contacts **600** to accommodate different geometries of the surface which the electrical contacts **600** make contact with, typically the head.

[0050] FIG. **7** shows a variation on the arrangement of FIG. **6**. The contacts **700** and bobbin **701** are attached directly to the resilient arm **702** by a ball joint **703** which allows pivoting movement between the bobbin **701** and resilient arm **702**. Any type of joint may be utilised which provides a pivoting movement in one or more dimension. The resilient arm **702** is mounted to the body of the device in which the sensor is mounted by a joint **704** which allows lateral movement of the resilient arm relative to the body the device. For example, the joint **704** may be provided with a through-slot in which the arm is mounted and which allows the arm to slide along its longitudinal axis.

[0051] Various examples of EEG sensors suitable for sensing signals on the scalp or other regions have been described. The sensors are intended to address the difficulties of prior art sensors by maintaining the sensor in a static location on the user's skin, thus avoiding the generation of artefact signals caused by movement. A mechanism to allow retraction of an EEG sensor, for example to avoid damage when not in use, has also been described.

[0052] Any range or device value given herein may be extended or altered without losing the effect sought, as will be apparent to the skilled person.

[0053] It will be understood that the benefits and advantages described above may relate to one embodiment or may relate to several embodiments. The embodiments are not limited to those that solve any or all of the stated problems or those that have any or all of the stated benefits and advantages.

[0054] Any reference to 'an' item refers to one or more of those items. The term 'comprising' is used herein to mean including the method blocks or elements identified, but that such blocks or elements do not comprise an exclusive list and a method or apparatus may contain additional blocks or elements.

[0055] The steps of the methods described herein may be carried out in any suitable order, or simultaneously where appropriate. Additionally, individual blocks may be deleted from any of the methods without departing from the spirit and scope of the subject matter described herein. Aspects of any of the examples described above may be combined with aspects of any of the other examples described to form further examples without losing the effect sought. It will be understood that the above description of a preferred embodiment is given by way of example only and that various modifications may be made by those skilled in the art. Although various embodiments have been described above with a certain degree of particularity, or with reference to one or more individual embodiments, those skilled in the art could make numerous alterations to the disclosed embodiments without departing from the scope of this invention.

[0056] An example of an EEG sensor may be a dry EEG sensor, comprising: at least one electrical contact for contacting the skin of a user, each electrical contact being connected to electrical circuitry to process any detected signals. The at least one electrical contact may be mounted in a flexible layer mounted on a part of a device in which the EEG sensor is mounted. The flexible layer may permit movement in all directions with the user's skin when the user's skin moves relative to the device/The flexible layer may support the electrical contact to press the electrical contacts against the skin of the user in use of the device. The electrical contacts may pass through the flexible layer. A void may exist between the electrical contacts and the device. The flexible layer may be formed from silicone. The flexible layer may be provided with concertina regions to permit movement of the electrical contacts. The EEG sensor may be a dry EEG sensor. The flexible layer may be formed from silicone and be provided with concertina regions to permit movement of the electrical contacts. The at least one electrical contact may be mounted in a bobbin. The flexible layer is formed from silicone and is provided with concertina regions to permit movement of the electrical contacts, and wherein the at least one electrical contact is mounted in a bobbin.

[0057] Another example of a dry EEG sensor, comprises: at least one elongate electrical contact for contacting the skin of a user, each electrical contact being connected to electrical circuitry to process any detected signals; wherein the at least one electrical contact is mounted in a flexible layer mounted on a part of a device in which the EEG sensor is mounted, wherein the flexible layer permits movement in all directions with the user's skin when the user's skin moves relative to the device, wherein the flexible layer supports the electrical contact to press the electrical contacts against the skin of the user, wherein the electrical contacts pass through the flexible layer, wherein a resilient material is positioned between the at least one electrical contact and a part of a device in which the EEG sensor is mounted; and wherein a low-friction material is positioned between the at least one electrical contact and the resilient material. The EEG sensor may be sufficiently elongate to sense signals on a scalp and reaches through hair on a user's head to make contact with skin. The device may be a set of headphones, and when the headphones are worn by a user, an example EEG sensor as described herein may contact a region of a user's ear. A barrier layer may surround the at least one electrical contact through which the at least one electrical contact protrudes to contact the user's ear.

[0058] A set of headphones may include at least one EEG sensor as described herein. At least one EEG sensor may be mounted on the set of headphones to contact skin in the region of a user's ear when the set of headphones is worn.

[0059] Another example of a electroencephalography EEG sensor is mounted in a set of headphones. The example EEG sensor may comprise: a flexible layer (**402**) which permits movement in all directions; at least one elongate electrical contact for contacting the skin of a user, wherein the at least one electrical contacts are mounted in the flexible layer, and the flexible layer provides support for the at least one electrical contacts, wherein in use the EEG sensor contacts a region of an ear of the user.

[0060] Another example of a dry EEG sensor which may be mounted in a set of headphones comprises: at least one electrical contact for contacting the skin of an ear of a user; a resilient material positioned between the at least one electrical contact and part of a set of headphones in which the EEG sensor is mounted; and a low-friction material positioned between the at least one electrical contact and the resilient material.

[0061] The example EEG sensor may further comprise a barrier layer surrounding the at least one electrical contact. The example EEG sensor may further comprise a bumper within the resilient layer to prevent excessive movement of the at least one electrical contact. The resilient layer may be formed of foam. The example EEG sensor may further comprise a barrier layer surrounding the at least one electrical contact, wherein the barrier layer is formed of fabric. The example EEG sensor may further comprise a barrier layer surrounding the at least one electrical contact, wherein the barrier layer is formed of silicone. The at least one electrical contact may be mounted in a bobbin.

1. A dry EEG sensor, comprising

at least one electrical contact for contacting the skin of a user, each electrical contact being connected to electrical circuitry to process any detected signals;

wherein the at least one electrical contact is mounted in a flexible layer mounted on a part of a device in which the EEG sensor is mounted, wherein the flexible layer permits movement in all directions with the user's skin when the user's skin moves relative to the device,

wherein the flexible layer supports the electrical contact to press the electrical contacts against the skin of the user, wherein the electrical contacts pass through the flexible layer and a void exists between the electrical contacts and the device.

2. A dry EEG sensor as claimed in claim **1**, wherein the flexible layer is formed from silicone.

3. A dry EEG sensor as claimed in claim **1**, wherein the flexible layer is provided with concertina regions to permit movement of the electrical contacts.

4. A dry EEG sensor according to claim **1**, wherein the flexible layer is formed from silicone and is provided with concertina regions to permit movement of the electrical contacts.

5. A dry EEG sensor according to claim **1**, further comprising a barrier layer surrounding the at least one electrical contact.

6. A dry EEG sensor according to claims **1**, wherein the at least one electrical contact is mounted in a bobbin.

7. A dry EEG sensor according to claim **1**, wherein the flexible layer is formed from silicone and is provided with concertina regions to permit movement of the electrical contacts, and wherein the at least one electrical contact is mounted in a bobbin.

8. A dry EEG sensor as claimed in claim **1**, wherein in the void between the electrical contacts and the device, a resilient material is positioned between the at least one electrical contact and a part of a device in which the EEG sensor is mounted; and

wherein a low-friction material is positioned between the at least one electrical contact and the resilient material.

9. A dry EEG sensor according to claim **1**, wherein at least one EEG sensor is sufficiently elongate to sense signals on a scalp and reaches through hair on a user's head to make contact with skin.

10. A dry EEG sensor according to claim **1**, wherein the device is a set of headphones, and in use at least one EEG sensor contacts a region of a user's ear.

11. A dry EEG sensor according to claim **1**, further comprising a barrier layer surrounding the at least one electrical contact through which the at least one electrical contact protrudes to contact the user.

12. A set of headphones in which at least one EEG sensor according to claim **1** is mounted.

13. A electroencephalography EEG sensor mounted in a set of headphones, comprising:

a flexible layer which permits movement in all directions; and

at least one elongate electrical contact for contacting the skin of a user,

wherein the at least one electrical contacts are mounted in the flexible layer and the flexible layer provides support for the at least one electrical contacts,

wherein in use the EEG sensor contacts a region of an ear of the user.

14. An EEG sensor mounted in a set of headphones, comprising

at least one electrical contact for contacting the skin of an ear of a user;

a resilient material positioned between the at least one electrical contact and part of a set of headphones in which the EEG sensor is mounted; and

a low-friction material positioned between the at least one electrical contact and the resilient material.

15. An EEG sensor according to claim **14**, further comprising a barrier layer surrounding the at least one electrical contact.

16. An EEG sensor according to claim **14**, further comprising a bumper within the resilient layer to prevent excessive movement of the at least one electrical contact.

17. An EEG sensor according to claim **14**, wherein the resilient layer is formed of foam.

18. An EEG sensor according to claim **14**, further comprising a barrier layer surrounding the at least one electrical contact, wherein the barrier layer is formed of fabric.

19. An EEG sensor according to claim **14**, further comprising a barrier layer surrounding the at least one electrical contact, wherein the barrier layer is formed of silicone.

20. An EEG sensor according to claims **14**, wherein the at least one electrical contact is mounted in a bobbin.

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专利名称(译)	脑电图传感器		
公开(公告)号	US20190290159A1	公开(公告)日	2019-09-26
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申请(专利权)人(译)	KOKOON科技有限公司		
当前申请(专利权)人(译)	KOKOON科技有限公司		
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摘要(译)

描述了干式EEG传感器的各种设计，以允许传感器触点相对于安装传感器的设备移动。