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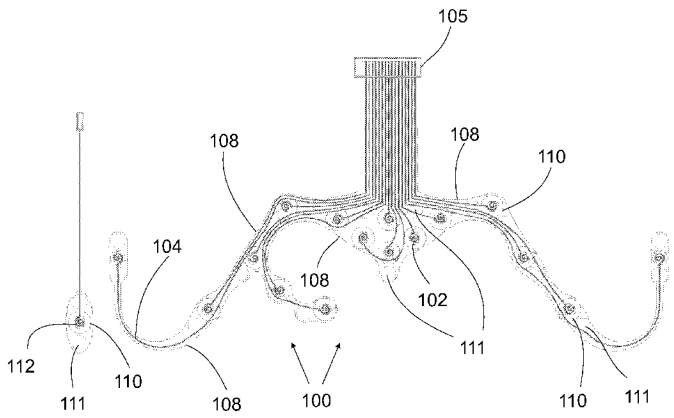

Fig. 2

(57) Abstract: An arrangement for carrying out electrode measurements on the surface of the skin of a patient's head for recording the electrical activity of the brain comprises a matrix electrode configuration comprising a body part (100) of non-conductive material conforming to the contours of the surface of the skin. The arrangement comprises electrodes (102) for producing the measurement data connected to the said body part (100), means (104) for transmitting said measurement data and a measurement data unit for receiving sad measurement data for further processing. The body part (100) comprises an electrode placement configuration (108) for maintaining the mutual placements of the electrodes essentially the same with respect to one another and further comprises an active attachment surface (110) located between the electrodes (102) and the surface of the skin for forming a firm and electroconductive contact between the electrodes and the surface of the skin.

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Arrangement and method for carrying out electrode measurements

Field of the invention

The invention relates to the field of medical technology, more specifically to electroencephalogram (EEG) measurement.

Prior art

By means of electroencephalography (EEG) is examined the electrical activity of the brain. Changes in the membrane stresses of neurons of the brain are recorded by means of electrodes attached to the patient's scalp. When changes take place simultaneously in several neurons, the voltage fluctuations in single neurons are summed and a measurable EEG signal is produced. In practice, a signal recorded from the scalp originates from simultaneous changes in the post-synaptic potentials of the pyramidal neurons of the cortex. The voltage fluctuation in an EEG is typically 5-250 µV and the frequency range 1-70 Hz.

EEG examinations are used especially in specialised neurophysiological units in diagnosing epilepsy. There, the EEG recording is carried out by specialist staff with high-level training and experience in using measuring devices and in the correct placement of the electrodes. However, EEG recordings would undoubtedly be useful also outside units specialising in EEG, for example, in intensive care, paramedic care and health centres, where by means of recordings could be detected various disorders in the electrical activity of the brain relating to, for example, severe brain damage, cerebral infarction, cerebral haemorrhage, subarachnoid haemorrhage, intoxication and unclear consciousness disorders. For example, in paramedic care, the electrical activity of the heart (ECG) is recorded routinely, but the electrical activity of the brain, the EEG, is recorded rarely. The reason for this are presumably the clumsy EEG sensor applications on the market, which are slow and difficult to place correctly on the patient without specialised training and extensive experience. The lack of EEG monitoring currently presents a central diagnostic challenge; for example in emergencies and in paramedic care, often hardly anything is known about the patient's brain activity or possible damage to the brain until the patient

has been moved to a hospital and to EEG monitoring. It would be essential to be able to diagnose a dysfunction in the electrical activity of the brain as soon as possible and start the appropriate treatment as quickly as possible.

Currently, the EEG is most commonly measured by using an internationally standardised, so-called 10-20 system. As electrodes are most often used cup electrodes made of, for example, silver-silver chloride (Ag-AgCl), silver, tin, gold or platinum. The said 10-20 system has several disadvantages. The system uses 21 different electrodes, the positions of which in relation to the skull must be determined accurately, in order to be able to make a reliable diagnosis. A measuring wire connected to each electrode makes the measuring connection rigid and uncomfortable, hindering the patient's normal movements, and may cause interferences (movement artefacts) in the measuring signal and thus complicate the interpretation of the EEGs. Placing cup-like electrodes on the scalp requires preparation of the skin, that is, mechanical scraping of the skin to remove the dead surface layer (epidermis), and dosing of a conductive medium (electrode gel). Finally, the adhesion of the electrodes is ensured by different attachment systems, such as tapes, bands, nets, caps or adhesive fixing paste. The preparations for measurement thus require a lot of experience and special know-how. In addition, the said known equipment requires a considerable amount of time (30-50 min), thus delaying the initiation of the patient's proper treatment and considerably increasing the treatment costs.

Many of the current clinically used electrodes are not compatible with magnetic imaging (MRI) and computed tomography (CT) equipment, and thus the electrodes have to be removed from the patient to ensure safety and imaging quality. Removing and reattaching the electrodes cause a time-wise long interruption in the EEG recording, in which case a clinically significant abnormality in the EEG may remain completely undetected, leading in the worst case to an incorrect diagnosis. The removal and reattachment of the electrodes also cause the patient skin irritation, pain and a potential risk of skin infection.

Commercially (e.g. in patent publication EP0951233B1) are available simple disposable electrodes which are adhered to the forehead, which typically have only a few (1-4) measuring channels and are mainly used for determining the depth of

anaesthesia during operations. Due to the small number of electrodes, such solutions are, however, unsuitable for diagnosing disorders in brain activity (for example, epilepsy, coma, cerebral haemorrhages).

One prior art solution is a quick-to-use matrix electrode (StatNet™, HydroDot Inc., WO2009/061920A1), which consists of two strips placed crosswise over the head. The strips have a sandwich structure with silver-silver chloride electrodes and silver signal transmission lines integrated in flexible plastic film. In each strip, the transmission lines end on the edge of the strip, from where the signals measured are led by means of a quick coupling to an amplifier. The strips are coated with an adhesive by means of which the sensor remains adhered to the skin by itself. On top of the electrodes is a porous pre-moistened pad construction. No preparation of the skin or other pre-treatment are thus required. The set-up time of the sensor is said to be 5 minutes and the operating time of the electrodes 4 hours. StatNet's sensor, for example, is placed over the hair and is structurally relatively rigid (bends only in the direction of the strip), conforms poorly to surfaces curving in several directions, moves easily with the hair, and requires monitoring to ensure that it has remained in place. This sensor application is also unsuitable for patients whose head or neck must not be moved or who have injuries or measuring instruments in the cranial area. The prior art implementation in question is suitable for paramedic and intensive care unit use, but not for several other EEG examinations, such as long-term epilepsy studies or sleep studies.

Patent publication US6032065A discloses an easy-to-use and disposable EEG matrix electrode for use in the hairless areas of the face. The substrate is preferably made of a non-conductive polymer, such as mylar. In the said publication, the ground electrode is located centrally, the reference electrode on the neck, and the movement of the eyes and the EMG signal from the chin are monitored by means of the said electrodes. There are only two EEG electrodes on the temples. In this prior art implementation, a separate medium (electro-gel) has to be used to be able to affix the electrodes on the surface of the skin and to form a proper electrode contact.

Patent publication US2010/0041962A1 discloses a matrix electrode intended for EEG monitoring, which comprises electrode contacts placed on the hairless areas of the

face. It shows a sensor construction which makes possible lateral extension of the sensor in order for the sensor construction to fit the different face sizes of patients. The mutual placement of the electrodes with respect to one another changes when attached to faces of different size. In addition, stable attachment of the sensor construction is ensured with a separate adhesive layer. The attachment of the sensor construction is ensured with a structure extending behind the ear.

Brief description of the invention

The aim of the invention is to eliminate and reduce the problems relating to the prior art EEG electrode solutions disclosed, which relate to the difficult and slow placement of the electrodes, to instable skin contact, to the drying of the electrodes (in other words, increase in measuring resistance, that is, impedance), to noise and interference levels, and to incompatibility with magnetic imaging (MRI) and computed tomography (CT) equipment. In other words, the aim of the invention is to realise an electrode measurement implementation for recording the electrical activity of the brain on the surface of the skin of the patient's head, by means of which implementation electrode measurements are substantially facilitated and speeded up to produce high-quality measurement data for examination or monitoring. This is achieved by means of an arrangement for carrying out electrode measurements on the surface of the skin of a patient's head for recording the electrical activity of the brain, the arrangement comprising a matrix electrode configuration, which comprises a body part of non-conductive material conforming to the contours of the surface of the skin, and which arrangement comprises electrodes for producing the measurement data connected to the said body part, means for transmitting the measurement data connected to the said body part, and a measurement data unit for receiving the measurement data transmitted by the said means for further processing of the measurement data. The body part comprises an electrode placement configuration for maintaining the mutual placements of the electrodes essentially the same with respect to one another, and the arrangement comprises an active attachment surface located between the electrodes and the surface of the skin for forming a firm and electroconductive attachment contact between the electrodes and the surface of the skin for transmitting measurable signals from the patient's head to the electrodes through the said electroconductive active attachment surface to produce measurement data.

A further object of the invention is a method for making electrode measurements for carrying out recording of the electrical activity of the brain from the surface of the skin of the patient's head, in which method is used a body part of an electrode configuration which is of non-conductive material conforming to the contours of the surface of the skin, the measurement data is produced by measuring with electrodes, the measurement data is transmitted from the electrodes to the measurement data unit for further processing of the measurement data. In the method, electrodes are placed, using the electrode placement configuration, on the surface of the skin of the patient's head by maintaining the mutual placements of the electrodes essentially the same with respect to one another, and a firm and electroconductive attachment contact is formed by means of an active attachment surface between the electrodes and the surface of the skin for transmitting the measurable signals from the patient's head to the electrodes through the said electroconductive attachment contact for producing measurement data.

The invention is based on the utilisation of the type of matrix electrode configuration in which is implemented an electrode placement configuration for maintaining the mutual placement of the electrodes with respect to one another essentially the same. The actual attachment of the electrodes to the said mutual placements of the electrodes in the object of measurement is carried out by means of an active attachment surface located between the electrodes and the surface of the skin to form a firm and electroconductive attachment contact between the electrodes and the surface of the skin. The active attachment surface may comprise an electroconductive surface and a non-conductive surface separately. Through the said attachment contact are transmitted measurable signals from the patient's head to the electrodes for producing measurement data.

An advantage of the invention is that rapid and reliable attachment of the matrix electrode configuration is provided in the hairless areas of the patient's head in such a way that the real mutual placement of the electrodes is known. Both the successful electroconductive attachment of the electrodes and the correct and desired placement of the electrodes make it possible to produce high-quality measuring information.

List of figures

Figure 1 shows the preferred placement of the electrodes of the matrix electrode configuration in the hairless areas of the patient's head.

Figure 2 shows a preferred embodiment of the invention of an arrangement for carrying out electrode measurements.

Figure 3 shows an example of a spiral electrode configuration made with printing technique.

Detailed description of the invention

In the arrangement according to the present invention for carrying out electrode measurements, electrical activity of the brain is measured on the surface of the skin of the patient's head to produce measurement data. The measurement data is stored for assessment of the electrical activity of the brain. Figure 2 shows one preferred embodiment according to the invention of an arrangement for carrying out electrode measurements. The arrangement comprises a matrix electrode configuration, which comprises a body part 100 of non-conductive material conforming to the contours of the surface of the skin. To the said body part 100 are connected electrodes 102 for producing the said measuring data. The means 104 for transmitting the measurement data are also connected to the said body part 100. The means 104 are, for example, conductor lines, for example, to a ZIF-type quick coupling 105 through which the measurement data is transmitted further through a wire or wirelessly to a measurement data unit for further processing of the measurement data. The measurement data unit is, for example, a computer unit for diagnostic examinations.

Figure 1 shows the preferred placement of the electrodes of the matrix electrode configuration in the hairless areas of the patient's head. The body part 100 (Figure 2) according to the invention comprises an electrode placement configuration 108, by means of which the mutual placements of the electrodes 102 are maintained essentially the same with respect to one another. The arrangement according to the invention also comprises an active attachment surface 110 located between the

electrodes 102 and the surface of the skin for forming a firm and electroconductive attachment between the electrodes and the surface of the skin, by means of which attachment contact are transmitted measurable signals from the patient's head to the electrodes through the said electroconductive active attachment surface 110 for producing measurement data. The active attachment surface may also comprise an area or areas 111 which are of non-conductive material which adheres to the skin, which comprises hydrogel or other substance or component with the said similar properties.

In a preferred embodiment of the invention, the body part 100 comprises the said electrode placement configuration 108 for easy attachment of the matrix sensor construction in the hairless skin areas of the patient's head by means of the said active attachment surface 110. In this case, each electrode attaches to its intended measuring point in the said hairless skin areas of the head. The electroconductive active attachment surface 110 preferably comprises hydrogel in order to form a stable and essentially interference-free attachment contact between the electrodes 102 and the skin surface. Completely or partly over the body part 100 may be formed a grounding layer to prevent the effect of external electrical interferences. The grounding layer is isolated by an isolation layer and/or the body part from the active attachment surface 110 and the wires. If there are no holes in the body part, it may act as isolation. If there are holes in the body part, isolation can be provided by a separate layer. The grounding layer functions by preventing the induction of electrical interferences to the wires and thus to the measured EEG signal, that is, the measurement data.

The matrix electrode configuration may preferably comprise at least two reference electrodes 102 and preferably at least two ground electrodes 102, between which can, when measuring, be selected which electrode combination is used to produce the measurement data. If the electrode contact is good, the matrix electrode configuration may also comprise only one reference electrode and only one ground electrode. The grounding layer is preferably connected to the ground electrode or ground electrodes. Matrix electrode configurations may be scaled to fit optimally different sizes of heads without the scaling affecting the number of electrodes used. The arrangement according to the invention may comprise at least the matrix electrode configuration packed into a package, on the outside of which can be seen

dimensioning indicators for ensuring the correct matrix electrode configuration size to fit the patient's head without opening the package.

The signal-to-noise ratio (S/N) can be improved by forming and using an optimised electrode configuration to provide an essentially good signal-to-noise ratio (S/N), as well as MRI and CT imaging compatibility. An optimised electrode configuration is, for example, a spiral matrix electrode configuration. Figure 3 shows an example of a spiral electrode configuration 102 produced by printing technique. The area 111 surrounding the electrode 102, and the separate circular areas 111 in the examples according to Figures 2 and 3, represent areas 111 of the active attachment surface with non-conductive material attaching to the skin surface, the material comprising hydrogel or other substance or composition with the said corresponding properties.

In addition, the arrangement for carrying out electrode measurements may comprise at least one electrode 112 attached in the patient's chest area for carrying out cardiac measurements (ECG).

In the following are described, with reference to Figures 1-3 or at least some of them, different possible uses and embodiments of the invention. From here onwards, the matters disclosed in this detailed description are thus examples of the various possible implementations and properties of the different parts 100, 102, 104, 105, 106, 108, 110, 112 of the invention. According to the present invention is thus realised a matrix electrode configuration comprising a body part 100 conforming to the contours of the face, which body part is made of non-conductive material, for example polyester film, and to which the electrodes 102 and the measurement data transmission wires 104 are integrated. Thanks to the body part, the positions of the electrodes with respect to one another remain essentially unchanged and positioning the electrodes in the correct places on the patient's face and also elsewhere is easier. The electrodes fixed to the body part are placed in the hairless areas on the patient's forehead, temples, cheeks and bridge of the nose, as well as behind the ears. One electrode may in addition be placed on the chest for ECG monitoring.

The matrix electrode is designed to be attached directly onto cleansed skin and to cover all essential EEG measurements normally made in hairless head areas.

Separate gels or electrode pastes are not needed and may not be used for attachment. The active attachment surface based on hydrogel immediately provides a stable contact with the skin which may last for days. From the point of view of manufacturing technique and structure, the matrix electrode is relatively simple and economical and thus suitable to be disposable. The matrix electrode is delivered sterilised in a disposable package.

In one exemplary matrix electrode configuration, as wires 104 is used silver-plated Aracon fibre. The electrodes 102 are spiral (diameter 7 mm) structures made of silver wire, which are coated with an electroconductive hydrogel film. The matrix electrode comprises a total of 16 electrodes, of which 10 are EEG measuring electrodes (in the Figure Fp1, Fp2, Af7, Af8, F7, F8, Sp1, Sp2, T9 and T10), 2 are EOG electrodes (identification of eye movements, in the Figure "EOG" and "EOG"), 2 are reference electrodes (REF), and 2 are ground electrodes (GND). The electrodes 102 may be spiral structures (102, Figure 3) at the end of a conductive metal wire or fibre (e.g. silver-plated isolated Aracon). As wire material can be used highly electroconductive material, such as silver, silver silver-chloride, gold or various alloys. A good contact of the electrodes with the skin is ensured with an electroconductive, for example hydrogel film, developed for medical use (e.g. AG602, Amgel Technologies). Skin attachment may, if necessary, be secured at desired points with skin tape. As support for the electrodes is used a thin film conforming to the contours of the face, which film may be, for example, polyamide, polyimide (Kapton), polyester (Mylar), or other elastic material.

The electrodes according to the invention are designed to be attached directly onto cleansed skin and to cover all essential EEG measurements normally made in hairless head areas. Separate gels or electrode pastes are not needed and may not be used for attachment. The active attachment surface based on hydrogel immediately provides a stable contact with the skin which may last for days.

The matrix electrode configuration according to the invention may be formed, for example, by a method of implementation based on lamination technique. The sensor implementation has a sandwich structure, comprising, for example, the following layers when viewed from the outside towards the patient's skin: stiffener layer (1), grounding layer (2), base layer (3), conducting layer (4), insulant layer

(5), hydrogel layer (6), release liner layer (7). As the body part (base layer) of the matrix electrode is used a thin polymer film, such as mylar, which conforms to the contours of the face. The electrodes 102 and their transmission lines 104 (conducting layer) are thick-film structures made of conductive ink (e.g. Ag/AgCl ink) on the surface of the mylar. The body part of the matrix electrode is coated with insulating material (insulant layer) to avoid short-circuiting of the wires. In the insulating material are openings at the electrodes, through which the electrode spirals are in contact with the hydrogel (for example, AG602, Amgel Technologies, Fallbrock, CA, USA). The release liner layer is a protective film layer which protects the electrodes from drying; the film may be, for example, a thin plastic film, which is torn off at the stage when the attachment of the electrode is begun.

All transmission lines preferably end in the sensor's projecting part, from which the measured signals are guided by means of a quick coupling to an amplifier. As a coupling is used either an MRI-compatible coupling or an easily disconnected/reconnected coupling (e.g. so-called ZIF-type connector). The conductor layer is covered by an insulating layer (insulant layer) with oval openings at the spiral electrodes. A good contact of the electrodes with the skin is ensured by areas of hydrogel film attached at the electrodes. As a booster is in addition used non-conductive hydrogel around each electrode (hydrogel layer or other adhesive material) to facilitate the placing of the extremely flexible sensor on the patient's skin and to ensure good attachment. The hydrogel layer is covered with a protective layer (release liner layer) which gives support during the mounting of the electrode. The matrix electrode comprises a total of 17 electrodes, 10 of which are EEG measuring electrodes, 2 are EOG electrodes (identification of eye movements), 2 are ground electrodes (GND), 2 are reference electrodes (REF) and 1 is an ECG electrode (measurement of the electrical activity of the heart) placed on the chest.

In view of the exemplary implementations 1 and 2, it is obvious to a person skilled in the art that the matrix electrode described in the invention can be implemented with very different techniques, for example, with thin film and lithographic methods, silk-screen printing technique, printing techniques, various lamination techniques, etc.

The arrangement according to the invention for carrying out electrode measurements can be utilised and used, for example, in the following applications and with them can be achieved, for example, the functional improvements disclosed in the examples:

Example 1. Short-term monitoring, advantage of rapid reliable attachment of headset, no special skills required

An unconscious patient is brought to an emergency department. A paramedic is able to attach the invention on the patient's forehead and face within a few minutes, without separate EEG nurse training. Thus, a general idea of the state of the patient's brain is obtained quickly. Changes in the EEG due to possible conditions requiring emergency care (e.g. status epilepticus, subarachnoid haemorrhage, infections in the central nervous system, as well as metabolic and toxicological disorders) are detected immediately and the patient can be referred to the appropriate treatment as quickly as possible.

Example 2. Long-term monitoring

The invention is used in a hospital ward for long-term EEG monitoring to be able to detect random abnormalities in a patient's EEG in the long term. In long-term monitoring can at the same time be detected possible sudden deterioration of the patient's neurological status. The electrodes according to the invention withstand long-term recording without drying, and no allergic reactions appear on the skin. The matrix electrode is lightweight, flexible and breathable and does not, therefore, cause the patient additional stress. Measurements were carried out with a Telefactor electroencephalograph and the contact impedances of the electrodes and the signals measured maintained a high quality throughout the 48 hour measurements.

Example 3. Status epilepticus

Status epilepticus (SE) is a life-threatening neurological state of emergency which requires fast and efficient treatment. SE is caused by excessive excretion of excitatory transmitters (glutamate) from their nerve endings. It is estimated that as

many as 20% of the discharges are non-convulsive, that is, do not cause observable convulsions. Therefore, without EEG measurement, a patient may be suffering from epileptic discharge activity without it being observed and treated. The invention provides a fast and easy way of verifying whether an unconscious patient is in a non-convulsive state. The matrix electrode can also be used during the loading of status epilepticus medication, in which case any cerebral or cardiac complications can be detected immediately. In addition, the matrix electrode can be used for monitoring the burst decay state used in the treatment of status epilepticus. The burst decay can be seen extremely well from the forehead electrodes.

Example 4. SAH patient (subarachnoid haemorrhage)

An SAH patient is bleeding into the space between the arachnoid and the pia mater immediately surrounding the brain. A sudden severe headache is the single most significant symptom of subarachnoid haemorrhage. Partly due to the lack of suitable, easy-to-use EEG electrodes, EEG monitors are not generally used in monitoring the status of SAH patients, although this has been reported as being of primary importance for successful treatment. The invention provides a fast and easy way of carrying out the monitoring of an SAH patient.

Example 5. Damage to cranium or cervical spine, normal EEG not suitable; one example of intensive care

The patient was found unconscious in the street and has, or is suspected to have, sustained an injury to the cranium or cervical spine. Normal EEG is not suitable because a conventional measuring connection cannot be attached on the injury. Also, due to the injury, the patient's head may not be moved and placing a conventional measuring connection would require that. The invention makes possible EEG measurement of this type of neck/head injury patient without having to move the patient's head or place the electrodes on the injury.

Example 6. Craniotomy

Craniotomy refers to a surgical procedure in which the skull is opened to gain access to the brain. Craniotomy is also used for treating cerebral edema and

increased intracranial pressure to reduce the pressure and give the brain room to swell. Different types of epileptic phenomena are common in the EEG in this type of treatments. Using a normal EEG connection is, however, impossible, because electrodes cannot be placed on the craniotomy. An easy-to-use matrix electrode fixed on the forehead and face makes EEG monitoring of the of this type of patient possible without endangering the patient's health.

Example 7. Isolation patient (disposability, safety and ease of use)

A patient is suspected as having the Creutzfeldt-Jacob disease (CJD, commonly known as the "mad cow disease") and is in isolation. CJD causes distinct changes in the EEG signal, and thus measurement is extremely useful in identifying the disease. The invention speeds up and facilitates the measurement of such isolation patients. The invention also reduces the risk of contamination because it is disposable and quick and easy to attach. The matrix electrode can be destroyed immediately after the recording.

Example 8. Patient has measuring instruments connected through the skull into the brain, normal EEG is unsuitable

In the intensive care unit, a patient may have various measuring devices (for example a microdialysis device or intracranial pressure meter) connected through the skull directly into the brain. In this case, it is impossible to carry out normal EEG measurement. By means of the invention measurement can, however, be carried out, because it is placed on the patient's forehead and face instead of on the skull. Measurement carried out with the invention does not interfere with the other measuring devices and no risks are caused to the patient, because the measuring devices connected to the central nervous system do not have to be moved.

Example 9. Monitoring following resuscitation

When the heart stops or circulation to the brain is otherwise disrupted, there is always a risk of the patient sustaining temporary or permanent hypoxic ischemic encephalopathy due to lack of oxygen in the brain. Since the invention is easy and quick to attach, it provides a quick solution to EEG monitoring following

resuscitation. By means of the invention, information on possible injuries is obtained already within a few minutes following the resuscitation. The invention could be a standard accessory included in the resuscitation equipment so that it could always be placed immediately after resuscitation.

Example 10. PLED (periodic lateralized epileptiform discharges)

In connection with severe brain damage, in the EEG signal can be observed PLED waves, which appear periodically. In some cases, a PLED wavelet may be confused with an ECG artefact and thus it is good to have also the ECG signal displayed next to the EEG. In contrast to other instant EEG solutions, our invention includes a separate electrode for the ECG, which thus measures the electrical activity of the heart.

Example 11. Sensor for depth of anaesthesia

Since the invention is easy and quick to use and in addition disposable, it can also be used for recording the EEG signal for the purposes of an anaesthesia monitor. The invention is connected by means of a suitable adapter to an anaesthesia monitor and the depth of the anaesthesia can be read directly on the monitor's display using an electrode intended especially for the said use. Since the invention is versatile, it is not necessary to buy several different sensors suitable for EEG measurement for intensive care units. In addition to the matrix headset according to the invention are provided various adapter connectors, by means of which the headset can easily be connected to different types of EEG amplifiers and monitors.

Example 12. MRI compatibility (phantom measurement)

The arrangement according to the invention is not ferromagnetic. The MRI compatibility of the invention has been tested on an MRI phantom. The arrangement according to the invention does not warm up in an MRI imaging device or cause interference in MRI images. Therefore, the invention does not have to be removed for the duration of magnetic imaging, and EEG measurement can be continued immediately after the imaging. Normally, the EEG sensors have to be removed for the duration of the imaging, after which they have to be reattached if

recording is to be continued. This takes up extra time and may slow down the patient's referral to the appropriate care. In addition, the reattachment of the electrodes always involves a risk of abrading the skin, which in turn increases the risk of sustaining different allergic reactions or infections. The MRI compatibility of the invention is ensured with a disconnectable ZIF-type coupling, which is easy to remove before imaging and the connection with the amplifier is reinstated by reattaching the ZIF coupling to the matrix electrode.

Example 13. CT compatibility, phantom

The compatibility of the invention with computed tomography imaging (CT) has been tested with a phantom. The invention does not warm up in the CT device or cause significant interference in the images taken. Therefore, the invention does not necessarily have to be removed for the duration of CT imaging, and EEG measurement can be continued immediately after the imaging. Normally, the EEG sensors would have to be removed for the duration of the imaging, after which they have to be reattached if recording is to be continued. This takes up extra time and may slow down the patient's referral to the appropriate care. In addition, the reattachment of the electrodes always involves a risk of abrading the skin, which in turn increases the risk of sustaining different allergic reactions or infections.

Example 14. Ambulance or ambulance helicopter measurements

Since the invention is extremely easy to use, it can be used to carry out EEG recordings in field conditions, already in an ambulance or ambulance helicopter. In practice it is appropriate to attach the matrix electrode to the patient in the ambulance, ambulance helicopter or in the army at a dressing station or in a field hospital. In this way, the state of the patient's brain and possible dysfunctions are known already before the patient arrives at the hospital. The EEG data is also sent wirelessly to the hospital's data system. The patient can thus be referred to the appropriate care and be started on the appropriate medication immediately on arrival at the hospital.

Example 15. Wireless data transfer solutions

The invention is extremely light, easy to place and disposable. It is, therefore, highly usable as an EEG sensor for wireless EEG measuring solutions intended for various field solutions. Wireless solutions can be implemented by Bluetooth, wlan, GSM, 3G or infrared techniques.

Example 16. EEG use at health centre level, transmission of results to central hospital

Since it is easy and quick to carry out EEG measurement by means of the invention, and no special skills are required to place it, carrying it out is easy also for health centre nurses. The EEG can thus be measured immediately already at the health centre's on-call service without having to refer the patient to a central or university hospital for the recording. A neurophysiologist can read the EEG remotely through the Internet and the patient can be immediately referred to the appropriate care. This is important, because in many cases early treatment improves the prognosis for recovery. With recordings at health centres are potentially also saved considerable sums in transportation costs since the patients do not necessarily have to be transported from one hospital to another.

Example 17. Monitoring of premature infants

With very small premature infants, so-called amplitude-integrated EEG (aEEG) monitoring is started immediately after birth in order to be able to detect possible epileptic activity. As electrodes are currently used needle electrodes, which are quick and easy to attach. However, when attaching them, the skin has to be pierced, which again increases the risk of sustaining different inflammations or infections. If the invention, which is equally quick and easy to attach, was used instead of needles, the risk of inflammations and infections could be significantly reduced. It is possible to make small versions of the invention to also fit premature infants.

Example 18. Paediatric patients

Placing a conventional EEG connection on the head of an uncooperative child is a time-consuming, difficult and sometimes even an impossible task. In placing a

conventional connection, the child's head usually also has to be scraped with a wooden applicator, which the child will find unpleasant. A child may, in addition, have a fear of needles and will be afraid of being pricked when the nurse takes the scraping applicator out. Sometimes even sedatives have to be used to be able to attach the conventional connection. This is obviously undesirable because sedatives also always affect the EEG signal to some extent. Placing the invention on the skin does not require scraping and thus cooperation with the child is much easier. Furthermore, placing it takes much less time and thus the child's patience lasts longer.

Example 19. Chronic patients in health centres

In health centres, there are many chronically ill elderly patients with considerable difficulties in communication, whose neurological status has not been assessed. The invention would provide a quick and easy way of measuring these patients by routine screening and to assess their status. It is possible that some of them are, for example, in a non-convulsive epileptic state.

Example 20. Alternative ground and reference electrodes

Since one has to work in difficult conditions in paramedical situations, where a patient may be, for example, very dirty or restless, there are two ground and reference electrodes in the invenion. If one of the two is broken, it can be programmatically replaced by an unbroken one and thus the functioning of the EEG recording can be ensured.

Example 21. Solutions facilitating use contained in the package

The headset package is an essential part of the product facilitating its use. It may contain, for example, clear illustrated numbered instructions, a picture of the typical placement of the headset on the face, the means needed for cleansing the face (wet wipes, cleansing tape,...), the means for tying up the hair (if the hair would otherwise be in the way, e.g. net, headset, fastening clips,...), a coupling, etc. On the outer surface of the package can be provided, for example, a measuring scale, to function as a measuring indicator. It can be used (by trying the package on the

patient's face), without opening the package, to estimate whether the said model is suitable or whether a different modular size should be selected. This helps in selecting the right size.

Example 22. Impedance testing of different electrode heads on the skin

Preparation: in all cases cleansing with alcohol, light scraping with tape and moistening with 0.5% NaCl. As an example is presented a silver chloride cup electrode. The measurements of this exemplary implementation were carried out with a Telefactor EEG device. In this exemplary implementation, the spiral electrode gave the smallest contact impedance and the noise level of its signal was distinctly lower than with the other solutions.

The electrode implementation according to the invention, which attaches to the skin, can also be implemented by means of a suitable electroconductive adhesive. Such adhesives may be, for example, starch- and agar-based materials to which, for example, NaCl has been added to enhance electroconductivity.

Example 23. Comparison of interference levels

The electrode used in the invention has been found to provide a better signal-to-noise ratio than prior art electrodes. This is due to the choice of materials used, the active attachment surface 110 used comprising, for example, hydrogel and different shapes/patterns of the silver silver-chloride electrode (disc, elliptic disc, ring, loop, finger-like shape, snake-like shape, spiral shape, etc.). The electrode is also extremely stable, and not sensitive to interference caused by the patient's movements. These are important properties in order to be able to detect the minute changes shown in the EEG.

In the following is described in detail a preferred embodiment of the invention, that is, a new type of disposable matrix electrode for monitoring electrical activity of the brain (EEG), which can be utilised especially in paramedic care situations. In an acute situation, measuring an unconscious patient's EEG is of essential importance in assessing the patient's status. In paramedic care, the electrical activity of the heart (ECG) is measured routinely, but the electrical activity of the brain rarely. The

reason for this are the clumsy sensor implementations on the market, which are slow to place properly on the patient. With an EEG could, however, be detected various brain dysfunctions relating to, for example, severe brain damage, cerebral infarction, cerebral haemorrhage, subarachnoid haemorrhage, status epilepticus, intoxication and unclear consciousness disorders. It would, therefore, be essential to be able to diagnose brain-related disorders as early as possible and to initiate the relevant care quickly. The currently widely used EEG electrodes are metal electrodes (SS, Ag-AgCl, Pt), which are separate and adhered to the skin. The positions of the electrodes with respect to the skull must be determined accurately to be able to make a reliable diagnosis. This obviously requires special skills. Together, these factors complicate and slow down the starting of the EEG recording and it is, therefore, rarely carried out in the field.

The body part of one preferred embodiment of the invention is made of polyester film (mylar). The electrical electrodes are silver spirals (diameter 7 mm) connected to the end of conductive silver-plated insulated Aracon fibre. A good contact between the electrode and the skin is ensured by a hydrogel film (diameter 12-18 mm) developed for medical use. To facilitate skin attachment, a breathable tape part is attached around each electrode. By means of this matrix electrode can be achieved the following advantages and improvements: a significantly lighter and more flexible solution with conforms better to the contours of the face and does not fold the skin; a stable electrode contact with the skin due to the highly adhesive hydrogel, and in this example also the skin tape support. This solution does not require strong compressive forces against the skin - as the first prototypes did - to function well; the electrical contact of the electrode is good and gel is not needed and may not be used; the contact between the silver wire and the gel is optimised by means of the form and spiral structure of the wire; better breathability is essential, especially with strongly perspiring patients; strongly attaching and extensive reference electrodes in the centreline; vertical and horizontal electrodes for eye movement for detecting artefacts; and electrodes attached behind the ears to improve monitoring at the back of the skull.

The invention provides many alternative solutions regarding manufacturing techniques, choice of materials, number of electrodes and location of electrodes. The above-mentioned, at present latest development version, is quite optimal

concerning the choice of materials and their functionality. Since the size and measurements of people's skulls vary a great deal, an optimal solution takes also these into account and the sensor implementation can easily be made in a few basic sizes. Finding the correct position for the reference electrodes (here two electrodes) successfully facilitates the analysis of the measuring data considerably by eliminating various artefacts, which include, for example, confusing the electrical activity of muscles (EMG) due to eye movements with a measurable signal. According to our understanding, the type of electrode configuration according to the invention for the facial area (forehead, temples, bridge of nose) is not commercially available and thus the invention is new. The advantages of the invention include ease of use, inexpensiveness, disposability, simplicity and versatile reliable measurement.

In the following is further described a commercially viable solution representing a matrix electrode configuration according to the invention, where the matrix electrode configuration is a headset electrode configuration for implementing easy and rapid EEG monitoring. With this headset electrode configuration, or headset, are achieved solutions which facilitate the phased mounting of the headset. The protective films of the electrode attachment surfaces of the headset are divided into parts, and thus the headset can be attached in a controlled, phased manner on the face. The central forehead part is attached into place first, after which the other parts are attached on the right and left in phases, the furthest reaching parts last. By means of this headset electrode configuration are also achieved integrated solutions for good contact and prevention of drying of the headset electrodes. Outside the actual electrical electrode configuration, and in the spaces within the electrode configuration, are also parts adhering to the skin which secure the attachment. Around the electrodes is also non-conductive attachment material which facilitates attachment and for its part prevents the electrode from drying. The headsets include a quick coupling solution which makes it possible to connect a disposable sterile adapter to the headset. This coupling can be connected through a multipurpose adapter to different measuring devices. The headset is thus suitable for use, as a sterile solution with couplings, with various kinds of devices. The package of the headset is an essential part of the product which facilitates its use. It contains, for example, clear illustrated numbered instructions, a picture of the typical placement of the headset on the face, the means needed for cleansing the

face (wet wipes, cleansing tape,...), the means for tying up the hair (if the hair would otherwise be in the way, e.g. net, headset, fastening clips,...), a coupling, etc. On the outer surface of the package is provided a measuring scale. By means of it can be estimated simply (by trying the package on the patient's face), without opening the package, whether the said model is suitable or whether a different modular size should be selected. This helps considerably in selecting the right size. On the EEG headset, that is, on the electrode configuration according to the invention, can be made a grounding layer isolated from the electrodes to diminish the induction of external electrical interferences to the wires and thus to the measured EEG signal.

Although the invention is described above in the specification with reference to the accompanying figures, the invention is not, however, limited to the specification or figures, but may be modified within the limits of the accompanying claims.

Claims

1. An arrangement for carrying out electrode measurements on the surface of the skin of a patient's head for recording the electrical activity of the brain, the arrangement comprising a matrix electrode configuration, which comprises a body part (100) of non-conductive material conforming to the contours of the surface of the skin, and which arrangement comprises electrodes (102) for producing the measurement data connected to the said body part (100), means (104) for transmitting the measurement data connected to the said body part (100), and a measurement data unit for receiving the measurement data transmitted by the said means (104) for further processing of the measurement data, and which body part (100) comprises an electrode placement configuration (108) for maintaining the mutual placements of the electrodes essentially the same with respect to one another, **characterised** in that the arrangement comprises an active attachment surface (110) located between the electrodes (102) and the surface of the skin for forming a firm and electroconductive attachment contact between the electrodes and the surface of the skin for transmitting measurable signals from the patient's head to the electrodes through the said electroconductive active attachment surface (110) to produce measurement data, the said electroconductive active attachment surface (110) comprising hydrogel or other electroconductive adhesive material which adheres well to the skin in order to form a stable and essentially interference-free attachment contact between the electrodes (102) and the skin surface, and which arrangement for carrying out electrode measurements comprises an optimised electrode configuration to provide an essentially good signal-to-noise ratio (S/N).

2. An arrangement as claimed in claim 1, **characterised** in that the body part (100) comprises an electrode placement configuration (108) for maintaining the mutual placements of the electrodes (102) essentially the same with respect to one another for easy attachment of the matrix sensor construction in the hairless skin areas of the patient's head by means of the active attachment surface (110), each electrode attaching to its intended measuring point in the said hairless skin areas of the head.

3. An arrangement as claimed in claim 1, **characterised** in that the active attachment surface comprises an electroconductive surface (110) and a non-conductive surface (111).

4. An arrangement as claimed in claim 1, **characterised** in that the arrangement for carrying out electrode measurements comprises at least one electrode (112) attached in the patient's chest area for carrying out cardiac measurements (ECG).

5. An arrangement as claimed in claim 1, **characterised** in that the arrangement for carrying out electrode measurements comprises different sizes of matrix electrode configurations to fit the patients' different head sizes.

6. An arrangement as claimed in claim 1, **characterised** in that the arrangement for carrying out electrode measurements comprises, in a matrix electrode configuration, at least two reference electrodes (102) and preferably at least two ground electrodes (102), between which can, when measuring, be selected which electrode combination are used to produce the measurement data.

7. An arrangement as claimed in claim 1, **characterised** in that the arrangement for carrying out electrode measurements comprises an optimised electrode configuration to provide an essentially good signal-to-noise ratio (S/N), as well as MRI and CT imaging compatibility.

8. An arrangement as claimed in claim 1, **characterised** in that the arrangement for carrying out electrode measurements comprises a grounding layer formed completely or partly over the body part (100) to prevent the effect of external electrical interferences by isolating the grounding layer with an isolation layer from the active attachment surface (110) and the means (104) for transmitting the measurement data.

9. An arrangement as claimed in claim 1, **characterised** in that the arrangement comprises at least the matrix electrode configuration packed into a package, on the outside of which can be seen dimensioning indicators provided for ensuring the correct matrix electrode configuration size without opening the package.

10. A method for making electrode measurements for carrying out recording of the electrical activity of the brain from the surface of the skin of the patient's head, in which method is used a body part (100) of an electrode configuration which is of non-conductive material conforming to the contours of the surface of the skin, the measurement data is produced by measuring with electrodes (102), the measurement data is transmitted from the electrodes to the measurement data unit for further processing of the measurement data, **characterised** in that in the method is formed an optimised electrode configuration to provide an essentially good signal-to-noise ratio (S/N), the electrodes (102) are placed, using the electrode placement configuration, on the surface of the skin of the patient's head by maintaining the mutual placements of the electrodes essentially the same with respect to one another, and a firm and electroconductive attachment contact is formed by means of an active attachment surface (110) between the electrodes (102) and the surface of the skin for transmitting the measurable signals from the patient's head to the electrodes through the said electroconductive attachment contact for producing measurement data, the said electroconductive active attachment surface (110) comprising hydrogel or other electroconductive adhesive material which adheres well to the skin in order to form a stable and essentially interference-free attachment contact between the electrodes (102) and the skin surface.

11. A method as claimed in claim 10, **characterised** in that in the method, the electrodes (102) are placed by using an electrode placement configuration (108) in the hairless skin areas of the patient's head by maintaining the mutual placements of the electrodes (102) essentially the same with respect to one another by means of the said placement configuration and the said attachment contact, each electrode attaching to its intended measuring point in the said hairless skin areas of the head.

12. A method as claimed in claim 10, **characterised** in that the active attachment surface comprises an electroconductive surface (110) and a non-conductive surface (111).

13. A method as claimed in claim 10, **characterised** in that in the method is used at least one electrode (112) attached in the patient's chest area for carrying out cardiac measurements (ECG).

14. A method as claimed in claim 10, **characterised** in that in the method are used different sizes of matrix electrode configurations to fit the patients' different head sizes.

15. A method as claimed in claim 10, **characterised** in that in the method are used at least two reference electrodes (102) and preferably at least two ground electrodes (102), between which can, when measuring, be selected which electrode combination is used to produce the measurement data.

16. A method as claimed in claim 10, **characterised** in that the electrode configuration is optimised to provide an essentially good signal-to-noise ratio (S/N), as well as MRI and CT imaging compatibility.

17. A method as claimed in claim 10, **characterised** in that a grounding layer is formed completely or partly over the body part (100) to prevent the effect of external electrical interferences by isolating the grounding layer with an isolation layer from the active attachment surface (110) and from the means (104) for transmitting the measurement data.

18. A method as claimed in claim 10, **characterised** in that at least the electrodes (102) and their placement configuration (108) are packed into a package, on the outside of which can be seen dimensioning indicators provided for ensuring the correct matrix electrode configuration size without opening the package.

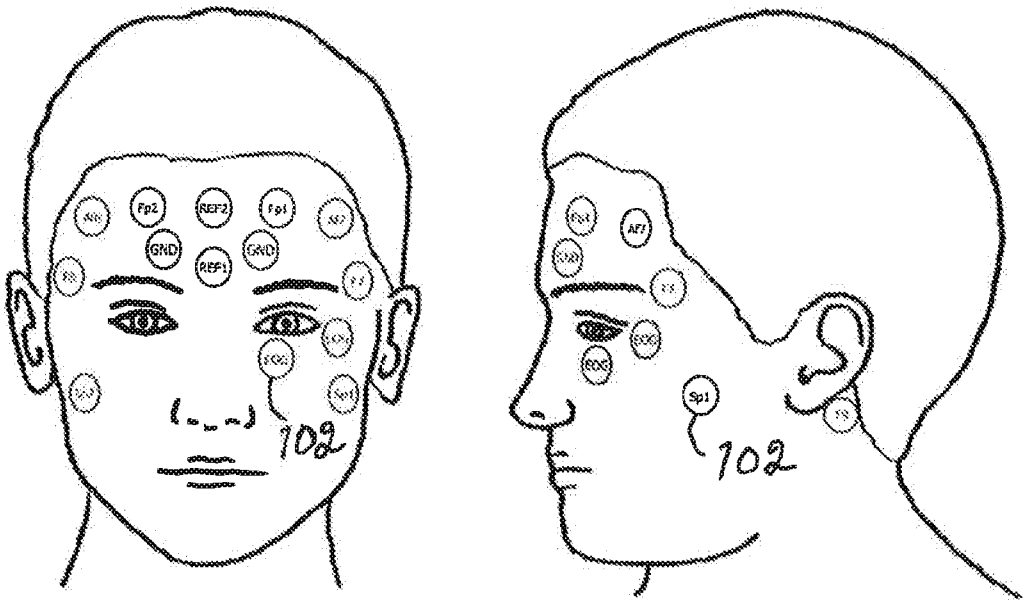

Fig. 1

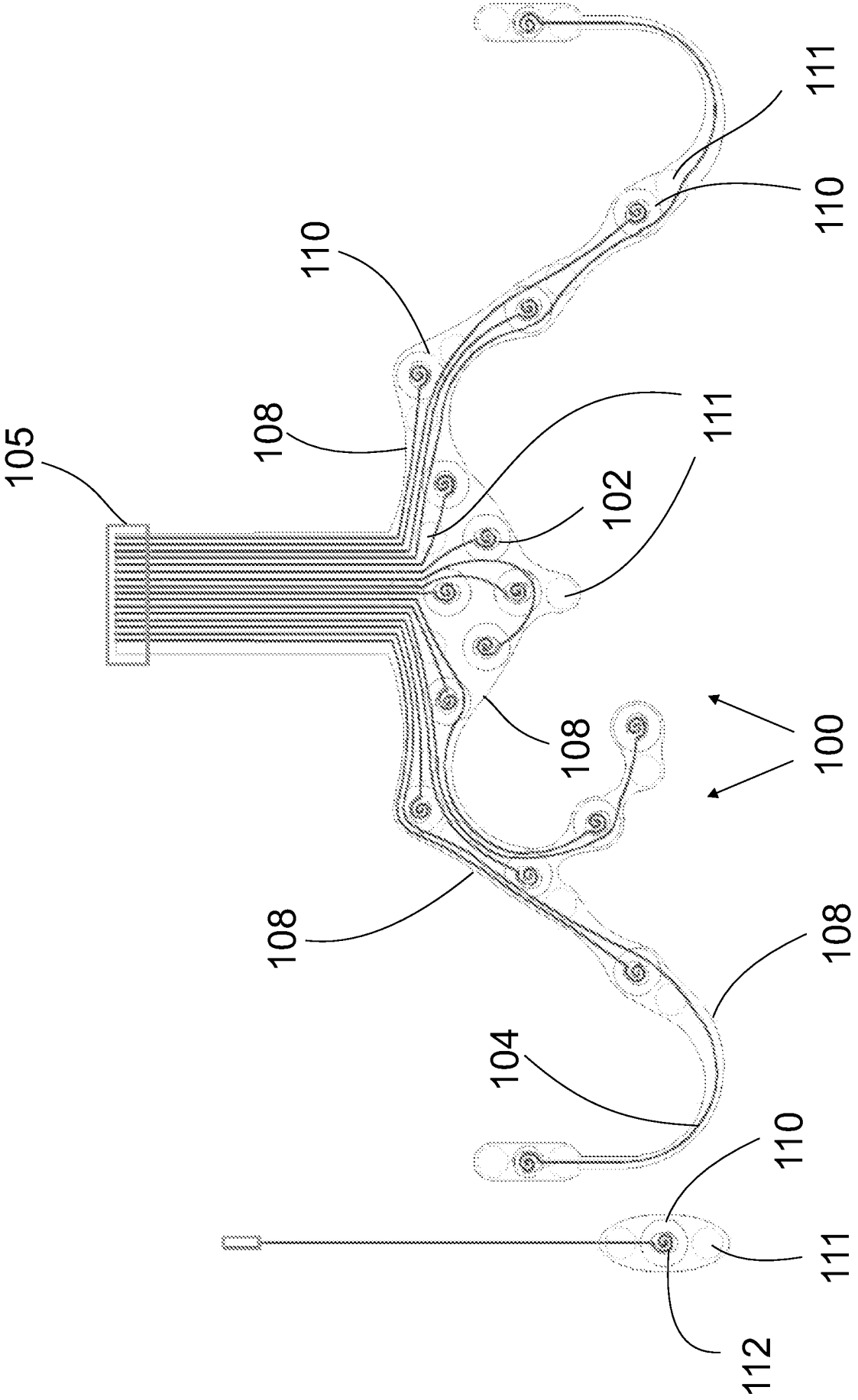

Fig. 2

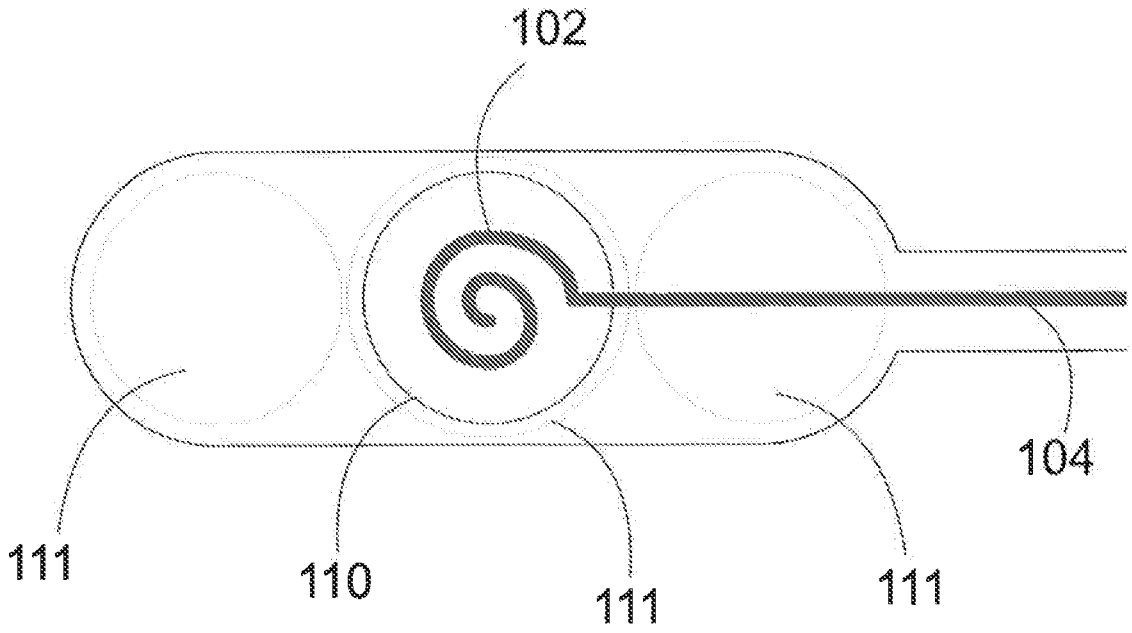

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2013/051054

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/0478
ADD. A61B5/00 A61B5/0408

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/146958 A1 (GUILLORY KENNETH SHANE [US] ET AL) 19 June 2008 (2008-06-19) figures 2,3,7-9 paragraphs [0038] - [0042], [0045] -----	1-9
X	WO 01/30232 A2 (PHYSIOMETRIX INC [US]) 3 May 2001 (2001-05-03) figures 1,2,4 page 1, lines 11-15 page 5, lines 3-4 page 6, line 20 - page 7, line 18 -----	1-9
X	US 2009/105577 A1 (WU JIANPING [CA] ET AL) 23 April 2009 (2009-04-23) figures 1,2 paragraphs [0001], [0028] - [0040] -----	1-9
	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 February 2014	19/02/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Albrecht, Ronald

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2013/051054

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/083673 A1 (AL-ALI AMMAR [US] ET AL) 5 April 2012 (2012-04-05) figures 1-3A,10 paragraphs [0079], [0094], [0097], [0098], [0106], [0109], [0113], [0150]	1-9
X	WO 03/057030 A1 (MASIMO CORP [US]) 17 July 2003 (2003-07-17) figures 1-3 page 3, lines 4-19 page 4, lines 1-13 page 5, lines 4-6	1-9
X	US 2009/247894 A1 (CAUSEVIC ELVIR [US]) 1 October 2009 (2009-10-01) figure 1B paragraphs [0024] - [0028], [0043], [0045]	1-9
A	US 2010/036275 A1 (ALKIRE BRIAN [US]) 11 February 2010 (2010-02-11) paragraph [0068]	9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2013/051054

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 10-18
because they relate to subject matter not required to be searched by this Authority, namely:

Rule 39.1(iv) PCT - Diagnostic method practised on the human or animal body

2. [ ] Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restrioted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/FI2013/051054

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008146958 A1	19-06-2008	NONE	
WO 0130232 A2	03-05-2001	AU 1241201 A	08-05-2001
		US 2002161309 A1	31-10-2002
		WO 0130232 A2	03-05-2001
US 2009105577 A1	23-04-2009	NONE	
US 2012083673 A1	05-04-2012	EP 2621333 A2	07-08-2013
		JP 2013541990 A	21-11-2013
		US 2012083673 A1	05-04-2012
		WO 2012050847 A2	19-04-2012
WO 03057030 A1	17-07-2003	US 2003225323 A1	04-12-2003
		US 2005277819 A1	15-12-2005
		WO 03057030 A1	17-07-2003
US 2009247894 A1	01-10-2009	NONE	
US 2010036275 A1	11-02-2010	AU 2008230766 A1	02-10-2008
		CA 2682060 A1	02-10-2008
		US 2010036275 A1	11-02-2010
		WO 2008119029 A1	02-10-2008
		WO 2008119031 A1	02-10-2008

专利名称(译)	用于进行电极测量的装置和方法		
公开(公告)号	EP2916730A1	公开(公告)日	2015-09-16
申请号	EP2013815541	申请日	2013-11-07
[标]申请(专利权)人(译)	MEGA ELECTRONICS		
申请(专利权)人(译)	MEGA电子有限公司		
当前申请(专利权)人(译)	MEGA电子有限公司		
[标]发明人	LAPPALAINEN REIJO MERVAALA ESA MYLLYMAA KATJA MYLLYMAA SAMI TOYRAS JUHA		
发明人	LAPPALAINEN, REIJO MERVAALA, ESA MYLLYMAA, KATJA MYLLYMAA, SAMI TÖYRÄS, JUHA		
IPC分类号	A61B5/0478 A61B5/00 A61B5/0408		
CPC分类号	A61B5/0478 A61B5/0408 A61B5/04087 A61B5/0496 A61B5/6814 A61B5/6823 A61B5/684 A61B2562/0215 A61B2562/046 A61B2562/14 A61B2562/164 A61B2562/182		
代理机构(译)	雷金格尔公司		
优先权	2012006186 2012-11-12 FI		
外部链接	Espacenet		

摘要(译)

用于在患者头部皮肤表面上进行电极测量以记录大脑电活动的装置包括矩阵电极配置，该装置包括符合表面轮廓的非导电材料的主体部分（100）。皮。该装置包括用于产生连接到所述主体部分（100）的测量数据的电极（102），用于发送所述测量数据的装置（104）和用于接收用于进一步处理的悲伤测量数据的测量数据单元。主体部分（100）包括电极放置构造（108），用于保持电极的相互位置基本上彼此相同，并且还包括位于电极（102）和表面之间的有源附接表面（110）。用于在电极和皮肤表面之间形成牢固和导电接触的皮肤。