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(54) DEVICE FOR RECORDING VIDEO-ELECTROENCEPHALOGRAMS

VORRICHTUNG ZUR AUFZEICHNUNG VON VIDEO-ELEKTROENZEPHALOGRAMMEN

DISPOSITIF D'ENREGISTREMENT D'ÉLECTROENCÉPHALOGRAMMES VIDÉO

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Description

[0001] The present invention generally relates to devices for the acquisition and recording of electroencephalograms and in particular to a portable, wireless device for video electroencephalography configured as a helmet that can be worn on the head of a patient.

[0002] Electroencephalography (EEG) is the recording of the electrical activity of the brain by detecting, i.e. acquiring, the electric potential associated with the currents flowing on the cerebral cortex. Electroencephalography is a non-invasive investigation means having a fundamental importance for the study of the physiology and pathophysiology of nervous centers. EEG is very useful in the differential diagnosis between epileptic and non-epileptic seizures and contributes to the definition of the nature of the crisis and/or epileptic syndrome.

[0003] It is known that the registration of a electroencephalographic signal is carried out by applying at different points of the head of a patient two or more electrodes, a "bias" electrode, as well as a reference electrode. These electrodes are held together e.g. by way of an elastic cap and are applied on the scalp of the patient at pre-established positions according to different standards. The standard positioning system known as "International System 10/20" is particularly widespread due to its simplicity of use and effectiveness. The "International System 10/20" exploits as skull landmarks the craniometric point "inion", i.e. the most prominent point at the back of the head, and the craniometric point "nasion", i. e. where the top of the nose meets the ridge of the forehead. According to this standard, frontal polar electrodes are placed above the eyebrows at the 10% of the inion-nasion distance, frontal electrodes are placed on the same line of the frontal polar electrodes but at the 20% of the inion-nasion distance, and, with respect to the latter, central, parietal and occipital electrodes are positioned at a respective distance progressively greater than 20%.

[0004] Electroencephalography applications are numerous and include the study of sleeping disorders such as apnea, dyssomnia (insomnia, hypersomnia, narcolepsy) and parasomnia (bruxism, bedwetting, night terror, sleep walking), detection of brain death, which is characterized by a flat EEG record, and detection of alterations caused by abscesses, calcifications, cysts, hematomas, bleeding, inflammation, malformations or benign or malignant tumors of the brain.

[0005] Electroencephalography is employed as an aid in the diagnosis of senile dementia and neurodegenerative diseases such as Parkinson's disease and Alzheimer's disease. It also represents a monitoring tool for the neuromotor apparatus in the evaluation of cognitive and motor recovery at the level of the central nervous system.

[0006] Electroencephalography is increasingly being used in the diagnosis and monitoring of seizure disorders such as epilepsy.

[0007] Epilepsy is a chronic neurological disorder that affects millions of people worldwide. It is characterized by recurrent seizures caused by abnormal activity of brain nerve cells. Seizures can occur as attention loss, fainting, convulsion and, when they are frequent there is a risk of personal injury up to death. An accurate diagnosis of epilepsy is crucial and requires several tests, including electroencephalography, which is even considered necessary and indispensable.

[0008] EEG monitoring of patients with epilepsy are typically performed in hospitals and specialized centers by placing a patient on a bed and connecting individual electrodes placed on the patient's head to a fixed EEG device provided with data processing units through wires.

[0009] In order to carry out diagnoses and management of patients with suspected or already established epilepsy traditional electroencephalograms are typically recorded also known as "Standard EEG", as well as dynamic electroencephalograms of a longer duration, such as 24 hours, known as "Holter EEG" or "Ambulatory EEG".

[0010] Also known are the so-called "Video-EEG" monitoring systems, according to which an epileptic patient is video recorded for a short or a long time while subjected to an electroencephalographic monitoring. Video-EEG monitoring is carried out in a hospital in a specific hospital room equipped with a closed circuit television system configured for both the daytime and nighttime recording. There is an increasing scientific interest in Video-EEG systems, because they allow to correlate EEG records with actual images of a patient, thus making it possible to analyze clinical data (myoclonic events, avert eyes, absences and the like) related to abnormalities detected by the EEG and hence to make differential diagnoses between epileptic and non-epileptic episodes, to improve the definition of the specific epileptic syndrome, as well as to quantify the crisis anomalies and to study sleeping disorders. Thanks to the possibility of relate EEG and images of a patient, the time required for a diagnosis can be greatly reduced.

[0011] Traditional electroencephalography is a long and uncomfortable examination for a patient and particularly for a pediatric patient, because of the time required for the positioning and connection of the electrodes to the acquisition system, and due to the duration of the recordings, which is typically between 20 and 40 minutes, but can also be longer, for example of the order of days, in the case of epilepsy since it is substantially impossibility to predict the onset of a crisis.

[0012] In the specific case of Video-EEG monitoring a patient must stay in a bed, sitting or lying thereon assisted by an attendant with the additional constraint of having to keep a position well-framed by the cameras.

[0013] For dynamic or long-term EEG monitoring EEG portable devices configured to be worn by a patient are also known. These devices are configured like helmets and are equipped with a plurality of electrodes typically arranged according to the international standard 10/20. These helmets comprise a plurality of interconnected

portions whose relative position is adjustable depending on the size of the patient's head. Bioelectric signals acquired through the electrodes can be transmitted to an electronic unit associated with the EEG device, e.g. mounted on a portion of the helmet, or to a remote electronic unit connected to the EEG device through wires or in a wireless mode.

[0014] The electrodes may be of a wet type, according to which the electrical contact with a patient's scalp is obtained indirectly through a conductive gel, or of a dry type, according to which the electrical contact with a patient's scalp is direct and requires a slight compression of an electrode on the scalp so as to penetrate through the hair and ensure a proper detection of the bioelectric signals. Dry-type electrodes are typically provided with a plurality of contact arms that contact a portion of the scalp at several points and can thus ensure an adequate electrical contact because they fit more easily through the hair.

[0015] Dynamic monitoring with portable EEG devices (Holter EEG) is considered more effective than monitoring with fixed EEG equipment, because it allows to perform monitoring either in a hospital or at home, where a patient generally has a more natural and relaxed attitude, which increases the probability of recording seizures, or more in general occurrence of the disorders to be investigated within a given time period. EEG monitoring at home is also a much less expensive than hospitalization in a specialized center and is therefore more sustainable for the public health.

[0016] A portable EEG device of the aforementioned type comprising wet electrodes is e.g. disclosed in the patent publication EP 2762069 A1.

[0017] Dry electrodes for use in EEG devices are for example disclosed in the international publication WO 2013/142316 A1.

[0018] In both cases, the electrodes have elastically deformable structures and/or means suitable to facilitate their positioning on a patient's head and to minimize the physical pain they bring during prolonged monitoring periods.

[0019] Also known are Video-EEG systems comprising a portable EEG device combined with a camera system such as a web-cam connected to a computer, allowing to carry out video monitoring at home, although in a less accurate way compared to a video monitoring carried out by way of a hospital equipment.

[0020] An example of a Video-EEG system is disclosed by the patent publication US 2014/051044 A1, which corresponds to the preamble of the independent claim 1.

[0021] Despite the availability of many types of portable devices for electroencephalography and video electroencephalography, there still exists the need to find improved devices particularly aimed at long-term monitoring of patients suffering from epilepsy, as well as at epilepsy diagnoses, which is an object of the present invention. Said object is achieved with a portable device for video electroencephalography, whose main features are specified in the first claim, while other features are specified in the remaining claims.

[0022] An idea of solution underlying the present invention is to make a portable device for video electroencephalography comprising a cap-shaped or helmet structure that may be adjusted according to the size of a patient's head, wherein the structure comprises a plurality of electrodes positioned according to the international standard 10/20.

[0023] The helmet has an ergonomic structure comprising a fixed central portion and a plurality of movable arms that can be oriented and pre-adjusted by a skilled operator in order to allow electrodes mounted thereon to reach specific positions required for the acquisition according to the international standard 10/20. The electrodes are mounted slidably on respective arms along slots wherein suitable seats are formed, the seats being configured to allow to firmly lock the electrodes at a plurality of predetermined positions, for example corresponding to those of the standard 10/20.

[0024] Thanks to these features it is possible to perform a number of monitoring cycles of a same patient without the need to reconfigure the helmet, and also dynamic or long-term monitoring (Holter), for example over a period of 24 hours, preventing the risk of modifying the position of the electrodes relative to their predetermined contact points due to movements of the patient.

[0025] The helmet arms are urged towards one another, i.e. towards a patient's head when the device is used, by way of elastic means such as torsion springs. The provision of elastic means is advantageous because it allows to approach as much as possible the electrodes to the scalp for a good acquisition of EEG signals.

[0026] The device according to the invention also comprises at least one video camera mounted on a support of the helmet structure and arranged so as to face the helmet. The camera is configured for both daytime and nighttime recording in order to allow monitoring over periods of 24 hours or longer.

[0027] Thanks to these features it is possible to provide a portable device for Video-EEG that can be worn by a patient and does not require any external device or dedicated environment for video recording, with the related constraints and movement restrictions.

[0028] In other words, thanks to the inventive device it is possible to carry out Video-EEG monitoring without resorting to specialized hospitals structures that require specially equipped rooms and have long waiting times due to their small number. Similarly to portable EEG devices, the portable device for Video-EEG according to the invention can follow a patient during his/her normal activities without forcing him/her to stay in a bed or in a confined space, thus increasing the already known benefits of portable EEG devices.

[0029] Another advantage of the portable device for Video-EEG according to the invention is that it does not require any external synchronization system between the bioelectric signals and the images, since the captured

images are directly sent to the same electronic control unit used to acquire and process the EEG signals, which is configured to associate and synchronize the EEG records with the images.

[0030] The device according to the invention may also advantageously include a microphone, for example associated with the camera, which allows to associate sound data to video recordings, which enhances the quality and completeness of the video-EEG monitoring and contributes to the accuracy of diagnoses based on such monitoring.

[0031] According to a preferred embodiment of the invention, the audio/video signals acquired are sent to an external portable electronic unit in a "wireless" mode along with the EEG signals acquired from the electrodes. The external electronic unit may be configured so as to directly process the data in real time or after their acquisition, or to be connected, e.g. in a wireless mode, to any external electronic processing system.

[0032] According to a further embodiment of the invention, in the case of registration of a potential epilepsy seizure the portable Video-EEG device is configured to mark the record and/or send it in real time to a physician together with the records of the time periods that precede and follow the epileptic seizure, the duration of which may be set according to specific needs.

[0033] It is also an idea underlying the invention to equip the device with a plurality of dry electrodes. The provision of dry electrodes, which are per se known in the field e.g. from US 2011/046502, is advantageous because it promotes long-term monitoring, which is particularly desirable with epileptic patients, because such electrodes are inherently clean thanks to the absence of a conductive gel, and because they may be sterilized and reused.

[0034] The dry electrodes of the device of the invention are configured so as to allow to have multiple contact points with the scalp in order to enhance acquisition of the EEG signals. Dry electrodes of this type are known e.g. from US 2011/237923 A1, wherein each electrode has a cylindrical body featuring an external thread and supporting at one end a sensor having a brush-like shape with contact pins protruding off the body. Dry electrodes of this type are also known from US 5038782 A, wherein each electrode is formed from a flexible metal alloy into a shape with multiple metal fingers spanning from a mount and dimpled at the free end.

[0035] Each dry electrode of the device of the invention comprises a mount made of a conductive metal material and a plurality of arms extending therefrom radially outwards. The arms are made of a conductive metal material and are partially embedded in an annular-shaped matrix made of a resilient polymeric material. Each arm includes a resilient portion restrained to the mount and a rigid portion restrained to the resilient portion, as well as a rounded portion arranged at the free end of the rigid portion.

[0036] Thanks to these features the dry electrodes are elastically deformable both axially and laterally much more than those described in the above mentioned publication US 5038782 A, which allows to ensure an improved ergonomic positioning thereof on a patient's scalp and thus a better acquisition of the EEG signal over extended periods of time.

[0037] Further advantages and features of the portable device for video electroencephalography according to the present invention will become clear to those skilled in the art from the following detailed and non-limiting description of embodiments thereof, with reference to the accompanying drawings in which:

- Figures 1 and 2 are perspective views showing a portable device for video electroencephalography according to the present invention from two different angles;
- Figures 3 and 4 respectively show a detail III and a detail IV of figure 2;
- Figure 5 is a side view schematically showing the portable device for video electroencephalography according to the present invention mounted on the head of a patient;
- Figures 6 and 7 are respectively a side view and a top plan view that schematically show the positions of the electrodes of the device on the head of a patient according to the international standard 10/20;
- Figure 8 is a perspective view showing a portion of one of the arms of the device and an electrode slidably mounted in the arm;
- Figure 9 is a plan view from below showing the portion of the arm of Figure 8 without the electrode;
- Figure 10 is a front view showing an electrode of the portable device for video electroencephalography according to the present invention;
- Figure 11 is a longitudinal section view of the electrode of Figure 10 taken along a plane passing through line XI-XI;

[0038] Referring to Figures 1 to 4, a portable device for EEG according to the invention is generally indicated by reference number 100 and is shown in a three dimensional reference system L, F, V, wherein in an operative condition of the device 100 a longitudinal direction L corresponds to the nasion-inion direction, or to a sagittal plane of a patient's body, a front direction F, perpendicular to the longitudinal direction L, represents a frontal or coronal plane of the patient's body, and a vertical direction V is perpendicular to the longitudinal direction L and the front direction F.

[0039] The device 100 comprises a central portion 110 to which, as it will be described in greater detail below, a plurality of arcuate shaped arms are connected in a movable manner, directly or indirectly. The arms and the central portion together define a helmet structure adapted to be worn on the head of a patient. Each arm is configured to receive one or more electrodes electrically connected to a central electronic unit mounted on the helmet structure.

[0040] In particular, a first arm 120 and a second arm 130 extend in opposite directions in the longitudinal direction L, while a third arm 140 and a fourth arm 150 extend in opposite directions in the front direction F. In an operative condition, the first arm 120 is intended to face the craniometric point nasion, while the second arm is intended to face the craniometric point inion.

[0041] The first and second arms 120, 130 are pivoted on the central portion 110 about respective axes parallel to the front direction F and can therefore be rotated with respect to the central portion 110 on a sagittal plane. The third and fourth arms 140, 150 are pivoted about respective axes parallel to the longitudinal direction L and can therefore be rotated with respect to the central portion 110 on a frontal plane.

[0042] As mentioned above, the arms 120, 130, 140, 150 of the device 100 all have an arcuate shape and define together with the central portion a helmet structure adapted to be fitted on the head of a patient. In the light of the kinematic constraints described above, it will be appreciated that such a helmet structure is adjustable depending on the size of the patient's head.

[0043] According to an embodiment of the invention, the device 100 may include biasing means (not shown) associated to the axes about which the arms 120, 130, 140, 150 pivoted on the central portion 110 rotate, for example torsion springs. The biasing means are configured to urge toward one another the arms that are mutually opposite with respect to the central portion 110 so as to allow the helmet to be closed on the head of a patient and thus to facilitate the contact between the electrodes and the scalp.

[0044] The device 100 also comprises a fifth arm 160 and a sixth arm 170, which are respectively restrained to the free end of the third arm 140 and extend in opposite directions in the longitudinal direction L, as well as a seventh arm 180 and an eighth arm 190, which are restrained to the free end of the fourth arm 150 and extend in opposite directions in the longitudinal direction L.

[0045] In the illustrated embodiment, the fifth and the sixth arms 160, 170 and the seventh and the eighth arms 180, 190 are e.g. restrained to appendices 141, 142 and 151, 152 of the third arm 140 and fourth arm 150, respectively.

[0046] More particularly, the fifth and the sixth arms 160, 170 and the seventh and eighth arms 180, 190 are respectively pivoted on the third arm 140 and fourth arm 150 about axes parallel to the front direction F, whereby they may be rotated relative to the third and fourth arms 140, 150 in the sagittal plane.

[0047] In order to ensure maintenance of a desired position of the fifth, sixth, seventh and eighth arms 160, 170, 180 and 190, clutch mechanisms with possible locking indentations may e.g. be used.

[0048] The fifth and the sixth arms 160, 170 and the seventh and eighth arms 180, 190 have respective arcuate shapes that extend from the ends 140 of the third arm and the fourth arm 150 towards the first and second arms 120, 130, thus completing the cap-shaped or helmet structure of the device 100.

[0049] As shown in Figure 5, the configuration of the device is such that, when mounted on the head of a patient, the first, fifth and seventh arms 120, 160 and 180 respectively extend from the head vertex and the temples towards the forehead (nasion direction), while the second, sixth and eighth arms 130, 170, 190 respectively extend from the head vertex and the temples towards the nape (inion direction). The third and the fourth arms 140, 150 instead extend from the head vertex towards the ears. In the side view of Figure 5 only the central portion 110, the first and second arms 120, 130, the third arm 140 and the fifth and sixth arms 160, 170 restrained thereto may be seen.

[0050] The third and fourth arms 140, 150, the fifth and sixth arms 160, 170, and the seventh and eighth arms 180, 190 have the same shape and size two by two, so that the helmet structure of the device 100 is symmetric with respect to a sagittal plane.

[0051] Each arm is configured for the mounting of one or more electrodes 200 of the EEG device. The electrodes of the portable EEG device according to the invention are dry electrodes providing the advantage of being not subject to fouling from conductive gels and of not causing pain to a patient over prolonged monitoring periods, as well as of being able to be individually sterilized and reused.

[0052] In the illustrated embodiment the device 100 e.g. comprises ten electrodes. With reference to Figures 1, 2 and 6, 7, a first electrode is for example mounted under the central portion 110 so as to contact the head vertex in the position Cz of the 10/20 standard. A second electrode is mounted on the second arm 130 and acts for example as a bias electrode, while on the first arm 120 a third electrode is mounted e.g. in order to contact the Fz position of the 10/20 standard. A fourth electrode that e.g. acts as reference electrode is mounted between the electrodes intended to contact the Cz and Fz positions. Additional electrodes are arranged on the arms 140, 150 intended to contact the patient's temples, on the arms 160, 180 intended to contact the patient's forehead and on the arms 170, 190 intended to contact the patient's neck, hence reaching the positions C_3 and C_4, F_{p1}, F_{p2} and O_1 and O_2 of the 10/20 standard.

[0053] The electrodes 200 are slidably restrained to the arms, so as to allow to reach all the possible positions provided by the international standard 10/20, as well as of any other standard known in the field, synergistically with the adjustment of the position of the arms relative to the central portion 110. As shown in Figures 8 and 9 one or more slots along are formed each arm for this purpose. Figure 8 e.g. shows a portion of the first arm 120 and a slot formed along it, which is schematically indicated with reference number 121.

[0054] Now referring to Figures 10 and 11, each electrode 200 includes a mount 210, having for example a cylindrical shape, from which a plurality of arms 220 ex-

tend radially outwards, five arms in the example shown in the figures. The mount 210 and the arms 220 are made of a conductive metal material such as silver/gold. Each arm 220 includes a flexible portion 221 secured to the mount 210, for example in the form of a flap or of a wire made of a conductive metal material, and a rigid e.g. straight portion 222 restrained to the flexible portion 221, and a rounded portion 223 that is arranged at the free end of the rigid portion 222 and is therefore intended to contact a patient's scalp.

[0055] The arms 220 thus configured are partially embedded in a matrix 230 having an annular shape and made of a resilient polymeric material, such as silicone, which surrounds the mount 210. More particularly the flexible portions 221 of the arms 220 are fully embedded in the matrix 230, while the rigid portions 222 and the rounded end portions 223 protrude therefrom.

[0056] The mount 210, the arms 220 and the matrix 230 of resilient polymeric material together form the contact element of each electrode 200. It will be appreciated that, thanks to the combination between the flexible portions 221 of the arms 220 and the matrix 230 of resilient polymeric material, it is possible to obtain a high degree of deformability of the contact elements of the individual electrodes 200 both axially and laterally, which facilitates their penetration between a patient's hair, and hence their contact with the scalp.

[0057] It will also be appreciated that the high degree of deformability of the contact elements of the individual electrodes 200 minimizes the pain caused to a patient during an extended monitoring period, for example of the order of hours or even days, and improves the safety of the device in case of impacts or falls, encouraging this type of monitoring that is particularly useful for patients with epilepsy.

[0058] According to a preferred embodiment of the invention, the mount 210 and the flexible portions 221 of the arms 220 restrained thereto are realized as contact portions and electric tracks made of a conductive metallic material on a flexible support made of a plastic material, for example of polyimide, with which they define a flexible electronic circuit. This embodiment offers the advantage of more robust, simpler and cheaper structure at an industrial level, which may also be more easily fitted into the matrix 230.

[0059] The connection between the flexible portions 221 and the rigid portions 222 of the arms 200 can for example be achieved by fitting the ends of the flexible portions 221 bearing contact portions into corresponding slots formed in the rigid portions 222.

[0060] A printed circuit board 240 is restrained to the mount 210. The printed circuit board 240 comprises a plurality of electronic components (not shown) mounted thereon and required for the acquisition of bioelectrical signals, and a transmission cable 241 connected to an electronic control unit 300 of the control device 100 that is housed in the central portion 110. The printed circuit board 240 may be restrained to the mount 210 by way of a screw connection element 250 as shown in the illustrated example, or with technically equivalent connection means that are known to a skilled in the art.

[0061] The printed circuit board 240, the transmission cable 241 and the possible connection element 250 are accommodated in a casing 260 made of an insulating and resilient material, for example rubber or silicone, configured to slidably engage the slots formed in the arms of the device 100.

[0062] The casing 260, which has a substantially cylindrical shape, includes an intermediate portion 261 that has a reduced cross-section and forms a circumferential groove configured to allow fitting of the electrode 200 in the slots formed in the arms. The printed circuit board 240 is housed in a first portion 262 of the casing 260, while the transmission cable 241 protrudes therefrom at a second portion 263 of the casing 260 opposite to the first portion 262 with respect to the intermediate portion 261, for example through an axial channel 264 and a radial opening 265.

[0063] It will be appreciated that the contact element of the electrode 200 described above, and in particular the matrix 230 made of a resilient polymeric material which encloses the mount 210 and the arms 220, is outside the casing 260 thus closing the first portion 262 and separating and protecting the printed circuit board 240 arranged inside it and the related electric components.

[0064] The size of the intermediate portion 261 is larger than the width of the slots 121 formed in the arms of the device 100, such that mounting of the electrodes 200 is carried out by way of an interference fit between the casing 260 and the slots 121, which allows to maintain overtime the positions of the electrodes 200.

[0065] By exploiting the elasticity of the material of which the casing 260 is made, in order to move an electrode 200 along the respective slot is sufficient to pull it axially by grabbing the first and second portions 262, 263 of the casing 260. The intermediate portion 261 so pulled becomes thinner, thus allowing to temporarily remove the interference fit constraint with the slot 121.

[0066] Still with reference to Figures 8 and 9, according to a preferred embodiment of the invention, each slot 121 advantageously comprises a plurality of openings 122 having a size larger than the width of the slot 121 and defining a plurality of predefined locations for the correct positioning of the electrodes 200 along the arms, and therefore with respect to the patient's head, according to the provisions of the international standard 10/20. To this aim the openings 122 have a surface area substantially corresponding to the size of the intermediate portion 261 of the casing 260, thereby allowing to lock the electrodes 200 in place.

[0067] In the illustrated embodiment three openings 122 are e.g. shown having a circular shape and respectively formed at the ends and in the middle of the slots 121, which define a corresponding number of positions for an electrode 200.

[0068] In order to prevent the transmission cable 241

from entering the slot 121 or simply contacting the patient's head thus hindering the maneuver of the electrode 200, each slot 121 may be advantageously provided with a sealing lip 123 which keeps it closed where no electrode 200 is present. In the illustrated embodiment, the lip seal 123 is interrupted at the three openings 122.

[0069] According to a preferred embodiment, the arms 100 of the device are hollow, thus allowing to house and protect inside them the transmission cables 241 of the electrodes 200, as shown in Figures 8 and 9. Access to the transmission cables and to the electrodes is made possible by removable covers that are not shown in Figures 8 and 9.

[0070] Maintaining the position of the electrodes 200 in the respective arms can be further facilitated by fitting their second portion 263 in a slider 124 slidably movable along the cavity of the single arm. As shown in Figure 8, the slider comprises a pair of pins 125 which engage respective notches 126 formed in the peripheral edge of the arm 120 in correspondence of each opening 122.

[0071] According to the present invention, the device 100 also comprises at least one supporting member 400 and at least one camera 500 mounted on the supporting member 400 and facing the helmet structure.

[0072] Referring again to Figures 1, 2 and 5, in the illustrated embodiment the supporting member 400 is for example made up of a pair of arms identical to each other, for example connected to the central portion 110 in a symmetrical position with respect to a sagittal plane. Each arm 400 includes, for example, a fixed portion 401 and a movable portion 402 restrained to the fixed portion 401, for example through a hinge 403. The movable portions 402 of the two arms 400 are both restrained to the camera 500 in correspondence of an attachment member 501 thereof

[0073] According to a further aspect of the invention, the position of the camera 500 with respect to the supporting member 400, and thus relative to the helmet structure, may be adjusted by way of panning means operably connected to the video camera 500 and the supporting member 400, such as e.g. a micromotor and/or a kinematic chain that is controllable, preferably from remote, through the electronic central unit 300. The panning means of the camera 500 give a physician the possibility to adjust the position of the video camera 500 relative to the supporting member 400 so as to suitably frame the specific portions of the face of a patient during a monitoring period, thus helping to improve the accuracy of a diagnosis based on the video electroencephalography device 100.

[0074] The camera 500 is advantageously configured for both daytime and nighttime recording, for example by means of an infrared LED lighting system, in order to allow monitoring over periods of 24 hours or longer.

[0075] According to the invention, the device 100 may also advantageously comprise a microphone 600, which associates sound data to the video recordings, thus helping to improve the quality and completeness of the video-EEG monitoring and the accuracy of the diagnosis it allows to make.

[0076] In the illustrated embodiment, the microphone 600 is for example associated with the camera 500 and integrated in the casing that encloses its optics. This configuration is advantageous because the positioning of the camera 500 with respect to the patient's face at the same time determines the positioning of the microphone 600 in the same direction, thus allowing to acquire sounds coming from the patient, while excluding the possible noise and/or sounds surrounding him/her, which might alter acquisition and diagnosis. A possible position of the microphone 600 is schematically shown in the detail view of Figure 3.

[0077] The bioelectric signals acquired from the electrodes 200, as well as the audio-video signals simultaneously obtained through the camera 500 and the microphone 600 are received by the electronic control unit 300. A microprocessor of the electronic control unit 300 is configured for the acquisition of bioelectric signals detected by the electrodes 200, simultaneously and in parallel, and is also configured to synchronize these signals with the video signals recorded by the camera 500, as well as any audio signal recorded by the microphone 600, thus offering the advantage of having data sets which together represent the brain's electrical activity at the same time and at all the contact points chosen by the physician and used to correlate this electrical activity to specific images and possibly also to sounds, which allows to carry out particularly effective diagnoses in patients with epilepsy and in some cases even allows to identify and predict a seizure.

[0078] The electronic control unit 300 may be advantageously provided with a removable storage medium such as an SD card (Secure Digital) for the recording and processing of video-EEG data on a separate processing device, such as a remote electronic unit such as an electronic calculator. In addition or alternatively to this, the data received may for example be transmitted to the remote electronic unit by resorting to the wireless technology.

[0079] The device of the invention may also be provided with further electronic components, such as a triaxial accelerometer useful to detect seizures, and a Hall effect sensor that can be used to power the device 100 in combination with a support wearable by a patient, a physician or, more generally, by medical personnel, such as a bracelet provided with a magnet. The Hall effect sensor may be also used to mark particular events during the monitoring period, thus allowing to identify specific parts of the EEG record and its related audio-video synchronous signals.

[0080] The electronic control unit 300 is powered by a battery, preferably of the rechargeable type in a wireless mode or, alternatively, through an electric cable, for example provided with a USB connector.

[0081] The present invention has hereto been described with reference to preferred embodiments thereof.

It will be appreciated that there may be other embodiments relating to the same inventive idea as defined by the scope of protection of the claims set forth below.

[0082] As far as the electrodes of the portable device Video-EEG are concerned, separate protection may be requested regardless of the presence of a patient video recording system, and in particular also independently of the features of the independent claim 1.

Claims

1. A portable device for video electroencephalography (100), said device (100) comprising a central portion (110) to which a plurality of arcuate arms (120, 130, 140, 150, 160, 170, 180, 190) are directly or indirectly connected in a movable manner, wherein said arms together define a helmet structure adapted to be worn on the head of a patient, wherein each of said arms (120, 130, 140, 150, 160, 170, 180, 190) is configured to allow mounting of one or more electrodes (200) of the device (100) and wherein said electrodes (200) are connected to an electronic central unit (300) mounted on said helmet structure, the device further comprising at least one supporting member (400) and at least one video camera (500) mounted on said supporting member (400) so as to face the helmet structure, said video camera (500) being connected to said electronic central unit (300), **characterized in that** said arms comprise a first arm (120) and a second arm (130) which extend away from each other in a longitudinal direction (L), as well as a third arm (140) and a fourth arm (150) which extend away from each other in a front direction (F), said first and second arms (120, 130) being pivoted on said central portion (110) about respective axes parallel to said front direction (F), and said third and fourth arms (140, 150) being pivoted about respective axes parallel to said longitudinal direction (L).

2. A device (100) according to claim 1, further comprising a microphone (600) connected to the electronic central unit (300).

3. A device (100) according to claim 2, wherein said microphone (600) is integrated in the casing enclosing the video camera optics components (500).

4. A device (100) according to any one of claims 1 to 3, further comprising biasing means associated to the axes around which the first, second, third and fourth arms (120, 130, 140, 150) pivoted on the central portion (110) rotate, said biasing means being configured so as to urge toward one another the arms that are arranged opposite to each other relative to the central portion (110).

5. A device (100) according to any one of claims 1 to 4, wherein said arms further comprise a fifth arm (160) and a sixth arm (170), which are respectively restrained at the ends of said third arm (140) and extend therefrom away from each other in the longitudinal direction (L), as well as a seventh arm (180) and an eighth arm (190), which are respectively restrained at the ends of said fourth arm (150) and extend therefrom away from each other in the longitudinal direction (L).

6. A device (100) according to claim 5, wherein said fifth, sixth, seventh and eighth arm (160, 170, 180, 190) are pivoted on the respective third and fourth arms (140, 150) about axes that are parallel to the front direction (F).

7. A device (100) according to claim 6, wherein the fifth, sixth, seventh and eighth arm (160, 170, 180, 190) are pivotally mounted on the third arm (140) and the fourth arm (150) through respective clutch mechanisms.

8. A device (100) according to any one of claims 1 to 7, wherein the supporting member (400) is restrained to the central portion (110) and extends therefrom in the longitudinal direction (L).

9. A device (100) according to any one of claims 1 to 8, further comprising panning means operably connected with the video camera (500) and the supporting member (400), said panning means being configured to adjust the position of the video camera (500) relative to the supporting member (400).

10. A device (100) according to any one of claims 1 to 9, wherein said electrodes (200) are dry electrodes and are slidably restrained to the arms (120, 130, 140, 150, 160, 170, 180, 190) along slots (121) formed therein, and wherein each slot (121) comprises a plurality of openings (122) having a size larger than the width of the slot (121) and defining a plurality of predefined locations for the positioning of the electrodes (200) along the arms (120, 130, 140, 150, 160, 170, 180, 190).

11. A device (100) according to claim 10, wherein each electrode (200) comprises a mount (210) made of a conductive metal material and a plurality of arms (220) extending therefrom radially outwards, said arms being made of a conductive metal material, the arms (220) being partially embedded in a matrix (230) having an annular shape and made of a resilient polymeric material, said matrix (230) surrounding said mount (210).

12. A device (100) according to claim 11, wherein each arm (220) made of a conductive metal material includes a resilient portion (221) restrained to said

mount (210) and a rigid portion (222) restrained to said resilient portion (221), as well as a rounded portion (223) arranged at the free end of said rigid portion (222).

13. A device (100) according to claim 12, wherein the resilient portion (221) is completely embedded in the matrix (230), while the rigid portion (222) and the rounded portion (223) protrude therefrom.

14. A device (100) according to claim 12 or 13, wherein the mount (210) and the resilient portions (221) of the arms (220) restrained thereto are formed on a flexible plastic substrate.

15. A device (100) according to any one of claims 11 to 14, wherein the mount (210) of the electrode (200) is connected to a printed circuit board (240) on which a plurality electronic components configured for the acquisition of bioelectrical signals and a transmission cable (241) connected to the electronic central unit (300) are mounted.

16. A device (100) according to claim 15, wherein said printed circuit board (240) and said transmission cable (241) are housed in a casing (260) made of an insulating, resilient material and are configured to be slidably fitted into slots (121) formed in the arms (120, 130, 140, 150, 160, 170, 180, 190).

17. A device (100) according to claim 16, wherein said casing (260) has a substantially cylindrical shape and comprises an intermediate portion (261) of reduced cross-section configured to allow to fit the electrode (200) into the slots (121) formed in the arms (120, 130, 140, 150, 160, 170, 180, 190), and wherein the printed circuit board (240) is housed in a first portion (262) of the casing (260), while the transmission cable (241) protrudes therefrom through a second portion (263) of the casing (260) opposite to the first portion (262) with respect to said intermediate portion (261).

18. A device (100) according to claim 17, wherein the size of the reduced cross-section of the intermediate portion (261) is larger than the width of the slots (121) formed in the arms (120, 130, 140, 150, 160, 170, 180, 190).

19. A device (100) according to claim 18, wherein each of the slots (121) formed in the arms (120, 130, 140, 150, 160, 170, 180, 190) comprises a plurality of openings (122) the surface area of which substantially corresponds to the surface area of the cross-section of the intermediate portion (261) of the casing (260).

Patentansprüche

1. Eine tragbare Video-Elektroenzephalographie-Vorrichtung (100), wobei die besagte Vorrichtung (100) einen zentralen Bereich (110) umfasst, an welchem eine Mehrzahl von gebogenen Armen (120, 130, 140, 150, 160, 170, 180, 190) in beweglicher Weise direkt oder indirekt angeschlossen ist, wobei die besagten Arme zusammengenommen eine Helmstruktur definieren, die dazu geeignet ist, auf dem Kopf eines Patienten getragen zu werden, wobei jeder der besagten Arme (120, 130, 140, 150, 160, 170, 180, 190) dazu ausgelegt ist, die Montage einer oder mehrerer Elektroden (200) der Vorrichtung (100) zu erlauben, und wobei die besagten Elektroden (200) an einer elektronischen Zentraleinheit (300) angeschlossen sind, die an der besagten Helmstruktur befestigt ist, wobei die Vorrichtung ferner wenigstens ein Tragelement (400) umfasst sowie wenigstens eine Videokamera (500), die an dem besagten Tragelement (400) derart befestigt ist, dass sie der Helmstruktur zugewandt ist, wobei die besagte Videokamera (500) an der besagten elektronischen Zentraleinheit (300) angeschlossen ist, **dadurch gekennzeichnet, dass** die besagten Arme einen ersten Arm (120) umfassen und einen zweiten Arm (130), welche sich in einer longitudinalen Richtung (L) voneinander weg erstrecken, sowie einen dritten Arm (140) und einen vierten Arm (150), welche sich in einer frontalen Richtung (F) voneinander weg erstrecken, wobei die besagten ersten und zweiten Arme (120, 130) an dem zentralen Bereich (110) um jeweils zu der frontalen Richtung (F) parallele Achsen verschwenkbar sind, und die besagten dritten und vierten Arme (140, 150) sind um jeweils zu der longitudinalen Richtung (L) parallele Achsen verschwenkbar.

2. Eine Vorrichtung (100) gemäß Anspruch 1, ferner umfassend ein an die elektronische Zentraleinheit (300) angeschlossenes Mikrofon (600).

3. Eine Vorrichtung (100) gemäß Anspruch 2, wobei das besagte Mikrofon (600) in dem Gehäuse integriert ist, das die optischen Komponenten (500) der Videokamera umschließt.

4. Eine Vorrichtung (100) gemäß einem der Ansprüche 1 bis 3, ferner umfassend denjenigen Achsen zugeordnete Vorspannmittel, um welche die an dem zentralen Bereich (110) angelenkten ersten, zweiten, dritten und vierten Arme (120, 130, 140, 150) rotieren, wobei die besagten Vorspannmittel dazu ausgelegt sind, diejenigen Arme, welche im Hinblick auf den zentralen Bereich (110) einander gegenüber liegend angeordnet sind, aufeinander zu zu drängen.

5. Eine Vorrichtung (100) gemäß einem der Ansprüche

1 bis 4, wobei die besagten Arme ferner einen fünften Arm (160) umfassen und einen sechsten Arm (170), welche jeweils an den Enden des besagten dritten Arms (140) gehalten sind und sich von dort aus in der longitudinalen Richtung (L) voneinander weg erstrecken, sowie einen siebten Arm (180) und einen achten Arm (190), welche jeweils an den Enden des besagten vierten Arms (140) gehalten sind und sich von dort aus in der longitudinalen Richtung (L) voneinander weg erstrecken.

6. Eine Vorrichtung (100) gemäß Anspruch 5, wobei die besagten fünften, sechsten, siebten und achten Arme (160, 170, 180, 190) an dem jeweiligen dritten oder vierten Arm (140, 150) um zu der frontalen Richtung (F) parallele Achsen schwenkbar angelenkt sind.

7. Eine Vorrichtung (100) gemäß Anspruch 6, wobei die besagten fünften, sechsten, siebten und achten Arme (160, 170, 180, 190) über zugeordnete Kupplungsmechanismen an dem jeweiligen dritten oder vierten Arm (140, 150) schwenkbar angelenkt sind.

8. Eine Vorrichtung (100) gemäß einem der Ansprüche 1 bis 7, wobei das besagte Tragelement (400) an dem zentralen Bereich (110) festgehalten ist und sich von dort aus in der longitudinalen Richtung (L) erstreckt.

9. Eine Vorrichtung (100) gemäß einem der Ansprüche 1 bis 8, ferner umfassend ein Schwenkmittel, das mit der Videokamera (500) und dem Tragelement (400) wirkungsmäßig verbunden ist, wobei das besagte Schwenkmittel dazu ausgelegt ist, die Position der Videokamera (500) gegenüber dem Tragelement (400) einzustellen.

10. Eine Vorrichtung (100) gemäß einem der Ansprüche 1 bis 9, wobei die besagten Elektroden (200) Trockenelektroden sind und an den Armen (120, 130, 140, 150, 160, 170, 180, 190) entlang von darin eingeformten Schlitzen (121) verschiebbar festgehalten sind, und wobei jeder Schlitz (121) eine Mehrzahl von Öffnungen (122) aufweist, deren Größe die Weite des Schlitzes (121) übertrifft, und welche eine Mehrzahl von vordefinierten Orten für die Positionierung der Elektroden (200) entlang der Arme (120, 130, 140, 150, 160, 170, 180, 190) festlegen.

11. Eine Vorrichtung (100) gemäß Anspruch 10, wobei jede Elektrode (200) eine Halterung (210) aus einem leitenden Metallmaterial aufweist und eine Mehrzahl von sich davon radial nach außen erstreckenden Armen (220), wobei die besagten Arme aus einem leitenden Metallmaterial hergestellt sind, und wobei die Arme (220) teilweise in eine Matrix (230) von ringförmiger Gestalt und aus einem elastischen Polymermaterial eingebettet sind, wobei die besagte Matrix (230) die besagte Halterung (210) umgibt.

12. Eine Vorrichtung (100) gemäß Anspruch 11, wobei jeder aus einem leitenden Metallmaterial bestehende Arm (220) einen elastischen Bereich (221) aufweist, der an der besagten Halterung (210) gehalten ist, und einen an dem elastischen Bereich (221) gehaltenen festen Bereich (222), sowie einen gerundeten Bereich (223), der an dem freien Ende des besagten festen Bereichs (222) angeordnet ist.

13. Eine Vorrichtung (100) gemäß Anspruch 12, wobei der elastische Bereich (221) vollständig in der Matrix (230) eingebettet ist, während der feste Bereich (222) und der gerundete Bereich (223) davon abstehen.

14. Eine Vorrichtung (100) gemäß Anspruch 12 oder 13, wobei die Halterung (210) und die elastischen Bereiche (221) der daran festgehaltenen Arme (220) an einem elastischen Kunststoffsubstrat ausgebildet sind.

15. Eine Vorrichtung (100) gemäß einem der Ansprüche 11 bis 14, wobei die Halterung (210) der Elektrode (200) an einer gedruckten Leiterplatte (240) angeschlossen ist, an welcher eine Mehrzahl von elektronischen Komponenten für die Beschaffung bioelektrischer Signale festgelegt ist sowie ein an der elektronischen Zentraleinheit (300) angeschlossenes Übertragungskabel (241).

16. Eine Vorrichtung (100) gemäß Anspruch 15, wobei die besagte gedruckte Leiterplatte (240) und das besagte Übertragungskabel (241) in einem Gehäuse (260) aufgenommen sind, das aus einem isolierenden, elastischen Material hergestellt und dazu ausgelegt ist, um in die in den Armen (120, 130, 140, 150, 160, 170, 180, 190) ausgebildeten Schlitze (121) gleitend eingepasst zu werden.

17. Eine Vorrichtung (100) gemäß Anspruch 16, wobei das besagte Gehäuse (260) eine substantiell zylinderförmige Gestalt aufweist und einen Zwischenbereich (261) von reduziertem Querschnitt umfasst, welcher dazu ausgelegt ist, um es zu ermöglichen, die Elektroden (200) in die in den Armen (120, 130, 140, 150, 160, 170, 180, 190) ausgebildeten Schlitze (121) einzusetzen, und wobei die gedruckte Leiterplatte (240) in einem ersten Bereich (262) des Gehäuses (260) aufgenommen ist, während sich das Übertragungskabel (241) von dort aus durch einen zweiten, dem ersten Bereich (262) hinsichtlich des besagten Zwischenbereichs (261) gegenüber liegenden Bereich (263) des Gehäuses (260) erstreckt.

18. Eine Vorrichtung (100) gemäß Anspruch 17, wobei

die Größe des reduzierten Querschnitts des Zwischenbereichs (261) größer ist als die Weite der in die Arme (120, 130, 140, 150, 160, 170, 180. 190) eingeformten Schlitze (121).

19. Eine Vorrichtung (100) gemäß Anspruch 18, wobei jeder der in den Armen (120, 130, 140, 150, 160, 170, 180. 190) eingeformten Schlitze (121) eine Mehrzahl von Öffnungen (122) umfasst, deren Oberfläche substantiell mit der Oberfläche des Querschnitts des Zwischenbereichs (261) des Gehäuses (260) korrespondiert.

Revendications

1. Dispositif portable pour électroencéphalographie vidéo (100), ledit dispositif (100) comprenant une partie centrale (110) à laquelle est directement ou indirectement reliée de manière amovible une pluralité de bras arqués (120, 130, 140, 150, 160, 170, 180, 190), dans lequel lesdits bras définissent ensemble une structure de casque destinée à être portée sur la tête d'un patient, dans lequel chacun desdits bras (120, 130, 140, 150, 160, 170, 180, 190) est conçu pour permettre le montage d'une ou de plusieurs électrode(s) (200) du dispositif (100) et dans lequel lesdites électrodes (200) sont connectées à une unité centrale électronique (300) montée sur ladite structure de casque, le dispositif comprenant en outre au moins un élément de support (400) et au moins une caméra vidéo (500) montée sur l'élément de support (400) de manière à faire face à la structure de casque, ladite caméra vidéo (500) étant connectée à ladite unité centrale électronique (300), **caractérisé en ce que** lesdits bras comprennent un premier bras (120) et un deuxième bras (130) qui s'étendent à l'opposé l'un de l'autre dans une direction longitudinale (L), ainsi qu'un troisième bras (140) et un quatrième bras (150) qui s'étendent à l'opposé l'un de l'autre dans une direction avant (F), lesdits premier et deuxième bras (120, 130) pivotant sur ladite partie centrale (110) autour d'axes respectifs parallèles à ladite direction avant (F), et lesdits troisième et quatrième bras (140, 150) pivotant autour d'axes respectifs parallèles à ladite direction longitudinale (L).

2. Dispositif (100) selon la revendication 1, comprenant en outre un microphone (600) connecté à l'unité centrale électronique (300).

3. Dispositif (100) selon la revendication 2, dans lequel ledit microphone (600) est intégré au boîtier renfermant les composants d'optique de caméra vidéo (500).

4. Dispositif (100) selon l'une quelconque des revendications 1 à 3, comprenant en outre des moyens de sollicitation associés aux axes autour desquels tournent les premier, deuxième, troisième et quatrième bras (120, 130, 140, 150) pivotant sur la partie centrale (110), lesdits moyens de sollicitation étant conçus de manière à pousser l'un vers l'autre les bras qui sont disposés à l'opposé l'un de l'autre par rapport à la partie centrale (110).

5. Dispositif (100) selon l'une quelconque des revendications 1 à 4, dans lequel lesdits bras comprennent en outre un cinquième bras (160) et un sixième bras (170) qui sont respectivement assujettis aux extrémités dudit troisième bras (140) et qui s'étendent à partir de celles-ci, à l'opposé l'un de l'autre dans la direction longitudinale (L), ainsi qu'un septième bras (180) et un huitième bras (190) qui sont respectivement assujettis aux extrémités dudit quatrième bras (150) et qui s'étendent à partir de celles-ci, à l'opposé l'un de l'autre dans la direction longitudinale (L).

6. Dispositif (100) selon la revendication 5, dans lequel lesdits cinquième, sixième, septième et huitième bras (160, 170, 180, 190) pivotent sur les troisième et quatrième bras respectifs (140, 150) autour d'axes qui sont parallèles à la direction avant (F).

7. Dispositif (100) selon la revendication 6, dans lequel les cinquième, sixième, septième et huitième bras (160, 170, 180, 190) sont montés pivotants sur le troisième bras (140) et le quatrième bras (150) au moyen de mécanismes d'embrayage respectifs.

8. Dispositif (100) selon l'une quelconque des revendications 1 à 7, dans lequel l'élément de support (400) est assujetti à la partie centrale (110) et s'étend à partir de celle-ci dans la direction longitudinale (L).

9. Dispositif (100) selon l'une quelconque des revendications 1 à 8, comprenant en outre des moyens de translation panoramique fonctionnellement reliés à la caméra vidéo (500) et à l'élément de support (400), lesdits moyens de translation panoramique étant conçus pour ajuster la position de la caméra vidéo (500) par rapport à l'élément de support (400).

10. Dispositif (100) selon l'une quelconque des revendications 1 à 9, dans lequel lesdites électrodes (200) sont des électrodes sèches et sont assujetties aux bras (120, 130, 140, 150, 160, 170, 180, 190) de manière à pouvoir coulisser le long de fentes (121) qui y sont formées, et dans lequel chaque fente (121) comprend une pluralité d'ouvertures (122) ayant une taille supérieure à la largeur de la fente (121) et définissant une pluralité d'emplacements prédéfinis pour le positionnement des électrodes (200) le long des bras (120, 130, 140, 150, 160, 170, 180, 190).

11. Dispositif (100) selon la revendication 10, dans lequel chaque électrode (200) comprend un support (210) constitué d'un matériau métallique conducteur et une pluralité de bras (220) s'étendant à partir de celui-ci radialement vers l'extérieur, lesdits bras étant constitués d'un matériau métallique conducteur, les bras (220) étant partiellement noyés dans une matrice (230) présentant une forme annulaire et constituée d'un matériau polymère élastique, ladite matrice (230) entourant ledit support (210).

12. Dispositif (100) selon la revendication 11, dans lequel chaque bras (220) constitué d'un matériau métallique conducteur comporte une partie élastique (221) assujettie audit support (210) et une partie rigide (222) assujettie à ladite partie élastique (221), ainsi qu'une partie arrondie (223) disposée à l'extrémité libre de ladite partie rigide (222).

13. Dispositif (100) selon la revendication 12, dans lequel la partie élastique (221) est complètement noyée dans la matrice (230), tandis que la partie rigide (222) et la partie arrondie (223) dépassent de celle-ci.

14. Dispositif (100) selon la revendication 12 ou 13, dans lequel le support (210) et les parties élastiques (221) des bras (220) assujettis à ceux-ci et sont formés sur un substrat en matière plastique flexible.

15. Dispositif (100) selon l'une quelconque des revendications 11 à 14, dans lequel le support (210) de l'électrode (200) est relié à une carte de circuit imprimé (240) sur laquelle sont montés une pluralité de composants électroniques conçus pour l'acquisition de signaux bioélectriques et un câble de transmission (241) connecté à l'unité centrale électronique (300).

16. Dispositif (100) selon la revendication 15, dans lequel ladite carte de circuit imprimé (240) et ledit câble de transmission (241) sont logés dans un boîtier (260) constitué d'un matériau isolant, élastique et sont conçus pour être installés de manière à pouvoir coulisser dans des fentes (121) formées dans les bras (120, 130, 140, 150, 160, 170, 180, 190).

17. Dispositif (100) selon la revendication 16, dans lequel ledit boîtier (260) est de forme sensiblement cylindrique et comprend une partie intermédiaire (261) de section transversale réduite conçue pour permettre l'installation de l'électrode (200) dans les fentes (121) formées dans les bras (120, 130, 140, 150, 160, 170, 180, 190), et dans lequel la carte de circuit imprimé (240) est logée dans une première partie (262) du boîtier (260), tandis que le câble de transmission (241) dépasse de celui-ci à travers une seconde partie (263) du boîtier (260), opposée de la première partie (262) par rapport à ladite partie intermédiaire (261).

18. Dispositif (100) selon la revendication 17, dans lequel la taille de la section transversale réduite de la partie intermédiaire (261) est supérieure à la largeur des fentes (121) formées dans les bras (120, 130, 140, 150, 160, 170, 180, 190).

19. Dispositif (100) selon la revendication 18, dans lequel chacune des fentes (121) formées dans les bras (120, 130, 140, 150, 160, 170, 180, 190) comprend une pluralité d'ouvertures (122) dont l'aire correspond sensiblement à l'aire de la section transversale de la partie intermédiaire (261) du boîtier (260).

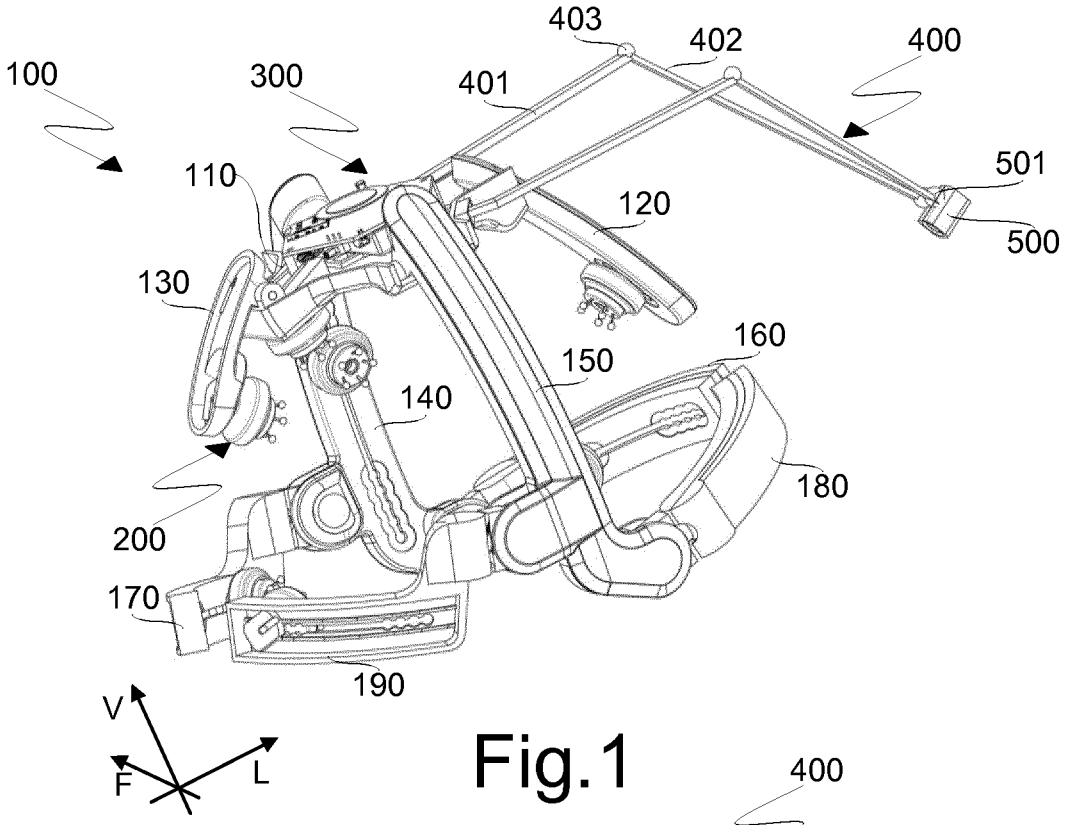
403
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Fig.1

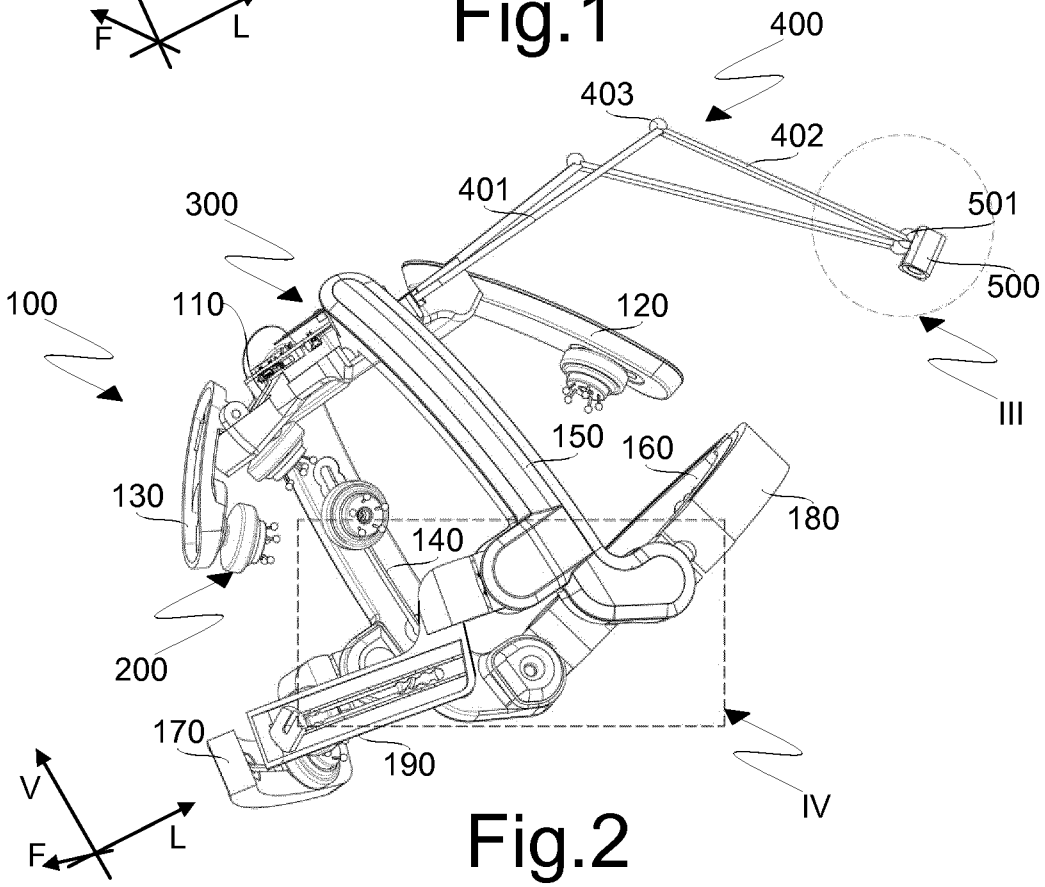
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Fig.2

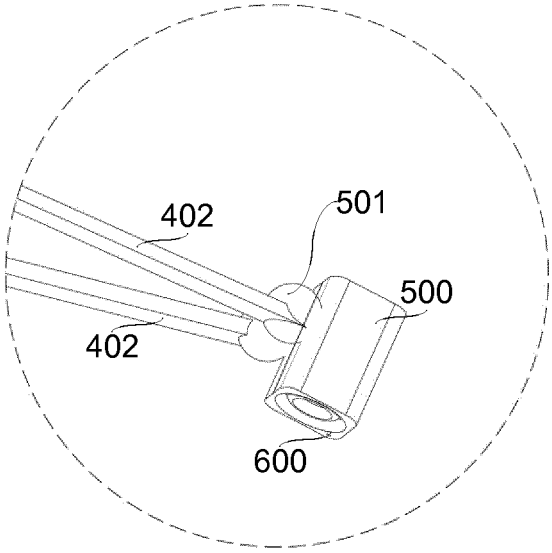


Fig.3

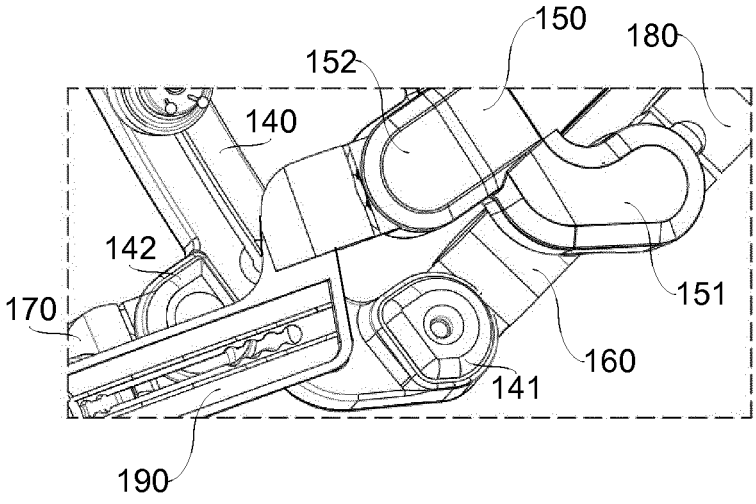


Fig.4

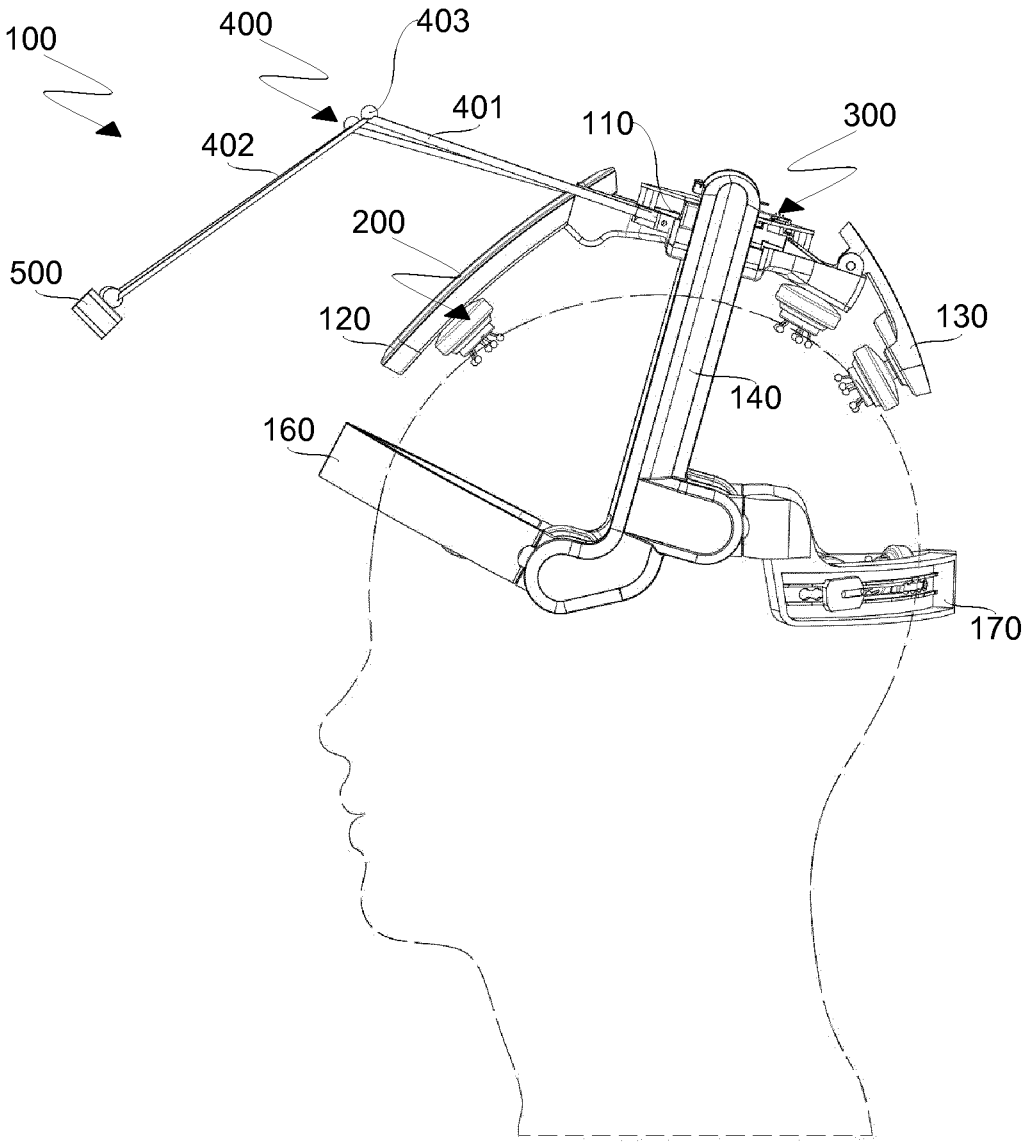
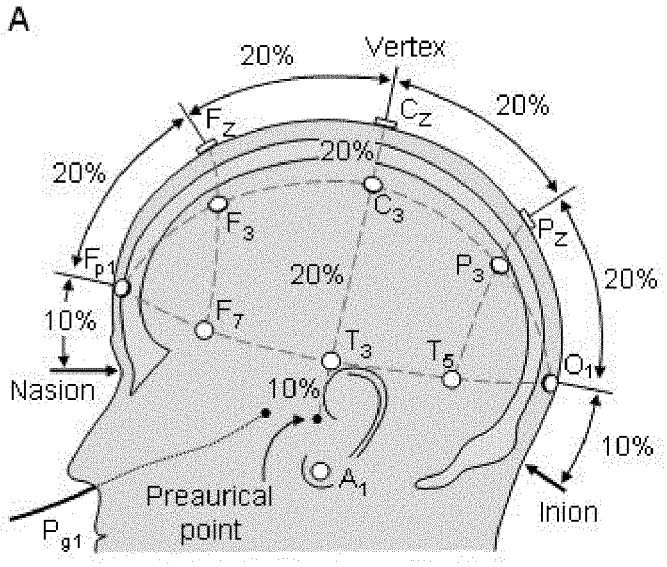


Fig.5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C_Z
P_Z
F_3
C_3
F_{p1}
P_3
F_7
T_3
T_5
O_1
A_1
P_{g1}

Fig.6

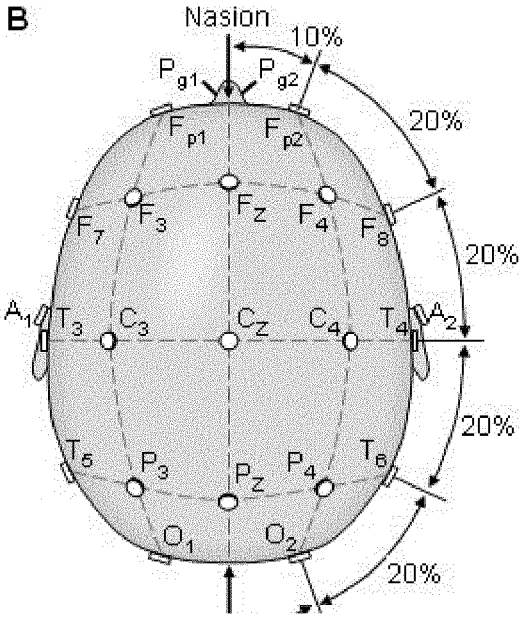
B
Nasion
10%
20%
20%
20%
P_{g1}
P_{g2}
F_{p1}
F_{p2}
F_7
F_3
F_Z
F_4
F_8
A_1
T_3
C_3
C_Z
C_4
T_4
A_2
T_5
P_3
P_Z
P_4
T_6
O_1
O_2

Fig.7

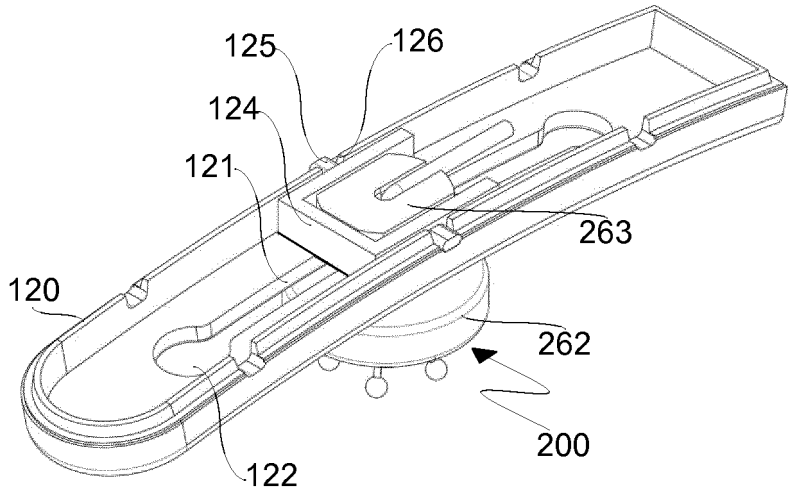

Fig.8

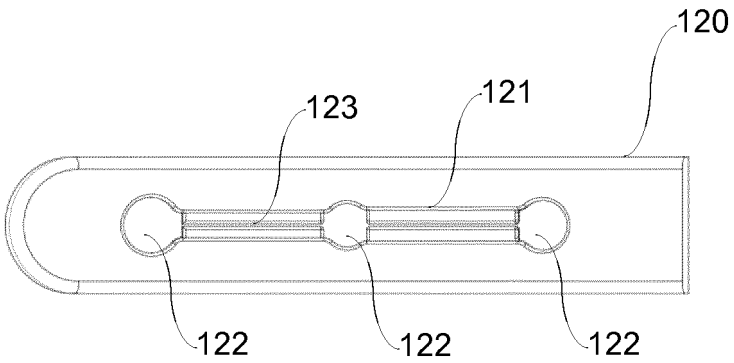

Fig.9

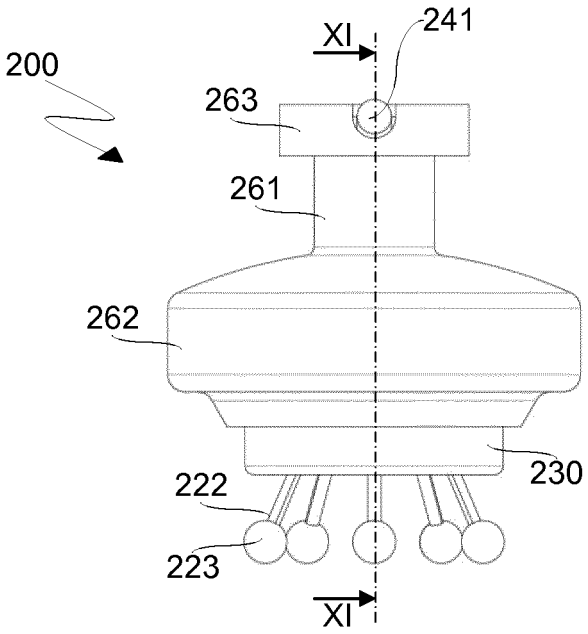
200
XI
241
263
261
262
230
222
223
XI

Fig.10

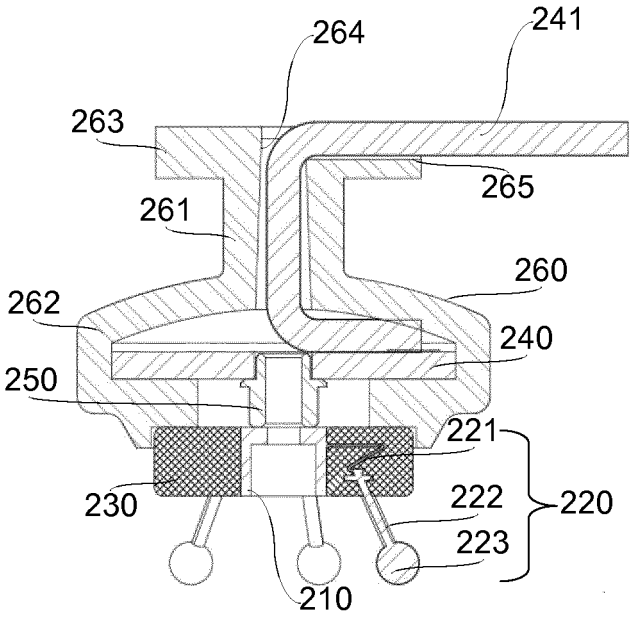
264
241
263
265
261
260
262
240
250
221
230
222
220
223
210

Fig.11

REFERENCES CITED IN THE DESCRIPTION

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专利名称(译)	用于记录视频脑电图的装置		
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IPC分类号	A61B5/00 A61B5/0476		
CPC分类号	A61B5/0077 A61B5/0476 A61B5/4094 A61B5/6803 A61B5/6835 A61B2562/04		
优先权	UB2015A004029 2015-09-30 IT		
其他公开文献	EP3355766A1		
外部链接	Espacenet		

摘要(译)

本发明涉及一种用于视频脑电图的便携式装置。该装置具有中央部分，多个弧形臂以可移动的方式直接或间接地连接到该中央部分。臂一起限定适于佩戴在患者头部上的头盔结构，臂被配置为允许安装一个或多个电极，所述一个或多个电极连接到安装在头盔结构上的电子中央单元。该装置还具有支撑构件和安装在支撑构件上的摄像机，以便面对头盔结构，所述摄像机。臂具有在纵向方向（L）上彼此远离地延伸的第一臂和第二臂，以及在前方（F）上彼此远离地延伸的第三臂和第四臂。第一和第二臂围绕平行于前方（F）的相应轴线在中心部分上枢转，并且第三和第四臂围绕平行于纵向方向（L）的相应轴线枢转。

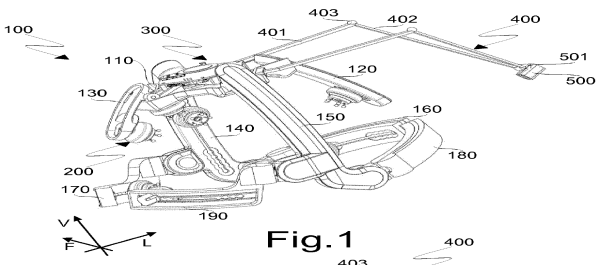

Fig.1

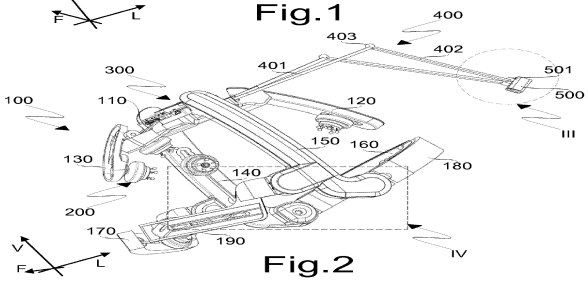

Fig.2