Sept. 2, 1947. G. A. ULETT, JR., ET AL 2,426,958

ELECTRODE HOLDER FOR USE IN ELECTROENCEPHALOGRAPHY

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Fig.1.

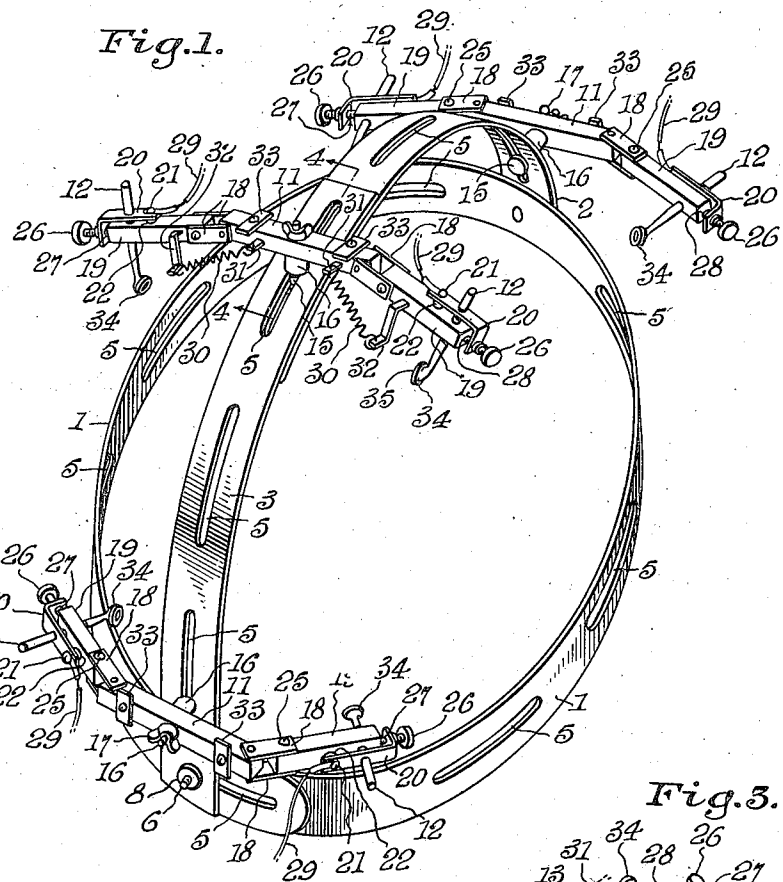


Fig.5.

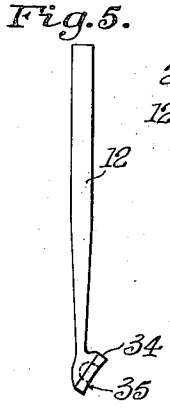
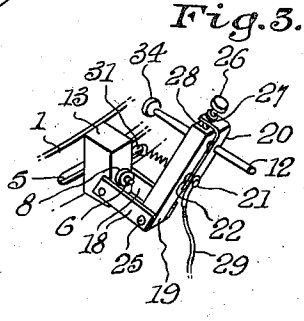




Fig.3.



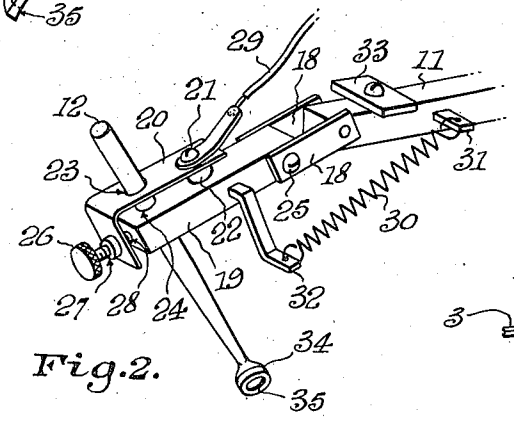


Fig.2.

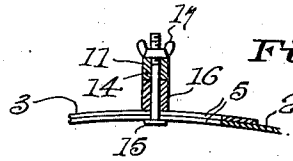


Fig.4.

Inventors

George A. Ulett, Jr.

Fred B. Claussen

By Francis H. Sandmeyer and Joseph M. Crowe

Attorneys

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## ELECTRODE HOLDER FOR USE IN ELECTROENCEPHALOGRAPHY

George A. Ulett, Jr., and Fred B. Claussen, Portland, Oreg., assignors to the United States of America, as represented by the Secretary of War

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5 Claims. (Cl. 128—2.1)

1

This invention relates to electroencephalography, and particularly it is directed toward a device for applying and holding electrodes in electrical contact with the scalp for recording electrical potentials of cortical areas.

Since Caton reported electrical activity of the brain in 1874, considerable research and investigation has been conducted in an effort to efficiently utilize this electrical activity in clinical diagnosis of cortical areas. The first investigator to record the electrical potentials from the brain was Berger, who, in 1924, inserted a silver wire into the anesthetized scalp. For several years thereafter he continued his studies and became the first to apply electroencephalography to a clinical diagnostic use. The research in this field has developed several recording instruments that are adequate and satisfactory in operation, some of which are disclosed in "Atlas of Electroencephalography" by F. A. and E. L. Gibbs. Considerable advancement likewise has been achieved in the electrode placement since Berger first used the silver wire in the anesthetized scalp. Among the various electrodes and methods of placement contributed to the art, there may be mentioned liquid electrodes and serrated circular metallic electrodes which are held in place by clamps applied to the hair and by adhesive compounds binding the electrodes to the scalp. The electrode and method of application most commonly used, however, is an electrode paste coated flat solder pellet secured to a copper wire and held to the scalp by collodion, as described by Gibbs. Satisfactory placement of these electrodes requires a high degree of skilled technique acquired only by lengthy practice, and then they consume considerable time in placement. With the widespread use of the electroencephalograph to survey large populations in both military and civilian medicine and with an increased difficulty in obtaining technicians for this work, it has become necessary to devise a fast, simple technique of electrode application. It is this problem of electrode placement that has been confronting electroencephalographers and which is solved by this invention.

The electrode and placement technique associated therewith should be such that the electrode produces no artifacts; is easy to apply, keep on, and remove; and, it is relatively cheap in production and painless in its application and use. Any metal capable of establishing electrical contact with the scalp through a saline solution or paste, such as Sanborn electrode paste, may be

2

used for an electrode. The ideal placement of the electrode is such that the independent recordings of the activity from each distinct cortical area may be obtained, unmixed with muscle potentials, movement artifacts or potentials from other cortical areas. Actually, however, the activity immediately under each electrode is so strong in the recording and the activity at slightly distant points are so very weak that only the activity under the electrode is apparent in the recording. The electrode, therefore, should be adaptable to placement adjustment and be operable with both monopolar and bipolar leads to the recorder.

Accordingly, the method of spring-pressure contact electrode placement of this invention substantially lessens the time required for electrode application; obviates the necessity for long practice in electrode application; dispenses with the use of collodion which is often objectionable to the patient; aids in the comparison of electroencephalographic records from patient to patient by permitting a more uniform electrode placement; and is adjustable and adaptable to monopolar and bipolar leads.

It is therefore an object of this invention to provide a device for supporting electrodes employed in electroencephalography that is adjustable to fit various sizes and shapes of craniums.

It is another object of this invention to provide a device of the class herein described, equipped with adjustable electrodes which are resiliently urged in electrical contact with the scalp of a patient wearing the device.

A further object of this invention is to provide a head gear supporting adjustable electrodes employed in the electroencephalography whereby said electrodes are resiliently held in operative and inoperative positions.

A still further object of this invention is to provide a device of the class herein described which is economical, efficient, and durable.

The foregoing and other objects will be more apparent from reading the specification in conjunction with the drawings forming a part thereof, wherein:

Fig. 1 is a perspective of the head gear with pairs of symmetrical placed electrodes movable over the frontal, parietal and occipital regions of the scalp;

Fig. 2 is a cutaway perspective of the electrode supporting and holding assembly pivotally connected with the electrode rotated 90° from normal to show the slanting contact surface;

Fig. 3 is a perspective view of the electrode assembly secured to the head band of the head gear;

Fig. 4 is a cross-sectional view taken along line 4—4 of Fig. 1; and

Fig. 5 is a side elevation of the electrode.

In the drawings where like members are given the same reference numeral, an adjustable head gear and electrode holder is adapted to be worn by a patient while undergoing electroencephalographic diagnosis. This head gear is composed of a fiber band 1 adapted to pass around the patient's head, a posterior band 2 and an anterior band 3 secured to the head band 1 and adjustably fastened together to form a single adjustable band. The head band 1 has elongated slots 5, longitudinally provided in its end members, adapted to receive a flat, cushioned headed bolt 6. The anterior band 3 is provided with an aperture adapted to receive this bolt 6. The threaded engagement of a nut 8 and the bolt 6 secures the anterior band 3 to the head band 1 and fastens the ends of the head band at a predetermined circumferential size. The posterior band 2 is fastened to the center of the head band 1 in a suitable manner such as stitching or brading. The posterior band 2 and the anterior band 3 are likewise provided with elongated slots 5 longitudinally provided in their respective free ends so as to be fastened together to form an adjustable center band with a bolt assembly securing an electrode support thereto, as will be discussed more fully hereinafter. The head band 1, posterior band 2 and anterior band 3 are provided with a plurality of longitudinal slots 5 adapted to receive bolts longitudinally movable therein for adjustably mounting electrode supports thereon.

Each of the electrode supports and holders is basically the same, the supports mounted on the head band differ from those mounted on the center band in the adjustable supporting bar or block only. The electrode supports mounted to the center band formed by the anterior 3 and posterior 2 bands have an elongated cross bar 11 for supporting pairs of symmetrically placed electrodes 12; whereas, those mounted on the head band 1 may be viewed as a half of the assembly mounted on the center band with a shorter supporting bar or block 13 supporting a single electrode 12. The supporting cross bars 11 may be any suitable rigid material such as brass, bronze fiber, plastic and the like, and the shorter bar or block 13 is preferably a plastic or fiber material. A hole 14 is centrally provided in the cross bar 11 to receive a bolt 15 which is inserted through the longitudinal slot 5 in the bands 2 and 3. Intermediate the supporting bar 11 and the bands 2 and 3 and surrounding the bolt 15 is a spacer 16 having a diameter greater than the width of the slot 5. A nut 17 is threadedly engaged with the bolt 15, thereby rigidly securing the supporting bar 11 to the head gear at a predetermined position of the band. Pivotally connected to each end of the supporting cross bar 11 are a pair of parallel pivot plates 18 which are fastened to an electrode holding bar 19 in such a manner that the angular relationship between the two may be adjusted and the two members rigidly secured together in the adjusted position. A set screw 25 and friction washer adequately serve the purpose of fastening the members.

This electrode holding bar 19, preferably composed of an insulation material such as the resin generally known as "Bakelite," holds the electrode 12 and electrical continuity devices associated therewith. A substantially L-shaped spring clip 20 of a suitable electrical conductive material such as bronze, brass and the like, is mounted on and in insulated spaced relationship with the electrode holding bar 19 by a screw 21 surrounded by an insulation spacer 22 disposed intermediate the clip and the supporting bar. The spring clip 20 is thus secured to the holding bar 19 in a manner such that the shorter leg extends downwardly over the end of the supporting bar and is in spaced relationship therewith. Aligned apertures 23 and 24 are provided in the spring clip 20 and supporting bar 19, respectively, and adapted to receive an electrode 12 which is held therein by a set screw 26 inserted through an aperture 27 provided in the downwardly extending flange of the spring clip 20 and engaging a threaded aperture 28 perpendicular to and registering with the aperture 24 in the electrode holding bar 19. The continuity of the electrical circuit is through the electrode 12, set screw 26, spring clip 20, and a lead wire 29 fastening screw 21. The spring action of the clip 20 urges it in contact with the set screw 26 which is contacting the electrode 12.

The single electrode holder and support used on the head band 1 is similar to the twin mount described above. The difference between the two mounts being that the single mount does not have a supporting cross bar 11 but instead has a supporting insulation bar 13 surrounding the fastening bolt 6 with parallel pivotally mounted bars 18 secured thereto.

Resilient means is provided for holding the electrode in operative and inoperative positions. This resilient means comprises a coil spring 30 secured at one end to a stud 31 attached to the cross bar 11, or the supporting insulation bar 13 as the case may be, and secured at the other end to a downwardly extending stud or projection 32 rigidly attached to the electrode holding bar 19. Since the electrode holding bar 19 is pivotally connected to the supporting bar 11 the tensioned coil spring 30 connecting the two will urge the electrode into contact with the scalp and hold it in such position while recording. When the holding bar is pivoted upwardly above the axis of the supporting bar, the spring will hold the electrode upward away from the scalp. A cross bar 33 is disposed across the top of the supporting bar 11 to stop the movement of the electrode holding bar 19 when selectively positioned in this inoperable state and held by the action of the spring.

The adjustment of the device is relatively simple and easy. The head gear is adjusted to the desired size by loosening the nuts 8 and 17 on the bolt 6 and the electrode holding bolt 15 securing the center band together, respectively, adjusting the three bands to the required size, and again tightening the aforementioned nuts on the bolts. The various electrode supporting bars of convenient lengths may be adjusted by loosening the nut 17 on each bolt 15 assembly and sliding in an antero-posterior movement in the elongated slots 5 and fastened in the desired position. In the routine six electrode device, three cross bars 11 supporting pairs of symmetrically placed electrodes 12 are secured to the center band and movable over the frontal, parietal and occipital regions of the scalp. In the sixteen electrode device, useful for localization of intracranial lesions, five of these movable supporting cross bars 11 are mounted on the center band and supplemented by 6 individually mounted single electrodes

which are adjustably mounted along the sides of the head band 1 to permit recordings from lateral regions of the head.

The electrode is preferably a brass rod 12 tapered at one end for attaching a cup-shaped solder pellet 34 thereto. The solder pellet is provided with a slanting or arcuate contour 35 adapted to accurately engage the scalp of a patient. The electrode is freely adjustable by releasing the tension of the set screw 26.

In using this device, the electrodes are positioned over the cortical areas and electrode paste applied to the scalp engaging surface of the solder pellet, care being taken that the brass rod, solder pellet and electrode paste do not contact as an artifact would be produced. The hair is then parted, the electrode paste applied to the exposed scalp, and the paste coated electrode pivoted to the operable position.

Recordings are most conveniently taken with the patient in a sitting position. Recording in the supine position is possible with the use of a block pillow placed beneath the neck and base of the occiput of the patient.

This device has been particularly useful in rapidly and easily applying electrodes for electroencephalographic diagnosis and differential diagnosis of epilepsies; location of neoplasms; presence and location of cerebral diseases; diagnosis and differential diagnosis of psychoses; and, qualitative and quantitative studies of emotional states.

Having thus described our invention, what we claim as new and wish to secure by Letters Patent is:

1. A device for electrode placement in electroencephalographic diagnosis comprising a head gear, electrode supports secured to said head gear, electrode holders pivotally connected to said supports, electrodes fastened to said holders, and spring means connected to said electrode supports and holders, said spring means adapted to actuate said holders about their pivotal connection with said supports for holding said electrodes in operative position during recording and in an inoperative position when not in use.

2. A device for electrode placement in electroencephalographic diagnosis comprising an adjustable head gear, electrode supports adjustably secured to said head gear, electrode holders mounted to said supports and movable in relationship therewith to operative and inoperative positions, and spring means connected to said electrode supports and holders, said spring means adapted to actuate said holders on said supports for selectively holding said electrodes in operative and inoperative positions.

3. A device for electrode placement in electroencephalographic diagnosis comprising an adjustable head band adapted to pass around a patient's head, an adjustable center band secured to said head band and adapted to pass over the patient's head, longitudinal slots in the aforesaid bands, bolts longitudinally movable in said slots, supporting bars associated with said bolts and movable therewith, means fastening said bars to said bolts and rigidly securing said bars and bolts at predetermined positions in said slots, electrode holders pivotally mounted to said bars, electrodes fastened to said holders, and spring means connected to said bars and electrode holders, said spring means adapted to actuate said holders about their pivotal connection with said bars for selectively holding said holders in operative and inoperative positions.



4. A device for electrode placement in electroencephalographic diagnosis comprising an adjustable head band adapted to pass around a patient's head, an adjustable center band secured to said head band and adapted to pass over the patient's head, longitudinal slots in the aforesaid bands, bolts longitudinally movable in said slots, supporting bars associated with said bolts and movable therewith, means fastening said bars to said bolts and rigidly securing said bars and bolts at predetermined positions in said slots, electrode holders pivotally mounted to said bars, electrodes fastened to said holder, and resilient means connecting each said supporting bar and respective holding bar whereby said electrode is selectively held in operative and inoperative positions.

5. A device for electrode placement in electroencephalographic diagnosis comprising an adjustable head gear, electrode supports adjustably secured to said head gear, electrode holders mounted to said supports and movable therewith to assume operative and inoperative positions, electrodes removably secured to said holders, means establishing electrical continuity through said electrodes, and spring means connected to said electrode supports and holders, said spring means adapted to actuate said holders on said supports for selectively holding said electrodes in operative and inoperative positions.

GEORGE A. ULETT, JR.
FRED B. CLAUSSEN.


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