

[54] **METHOD FOR PROVIDING AN IMPROVED BODY ELECTRODE ELECTRICAL CONNECTION**

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[22] Filed: Dec. 16, 1971

[21] Appl. No.: 208,586

[52] U.S. Cl. .... 128/2.1 E, 128/DIG. 4

[51] Int. Cl. .... A61b 5/04

[58] Field of Search ..... 128/2.1 E, 2.06 E, 128/416, 417, 418, 404, 410, 411, DIG. 4, 405; 128/2.1 R, 2.06 R, 416-418

[56] **References Cited**

**UNITED STATES PATENTS**

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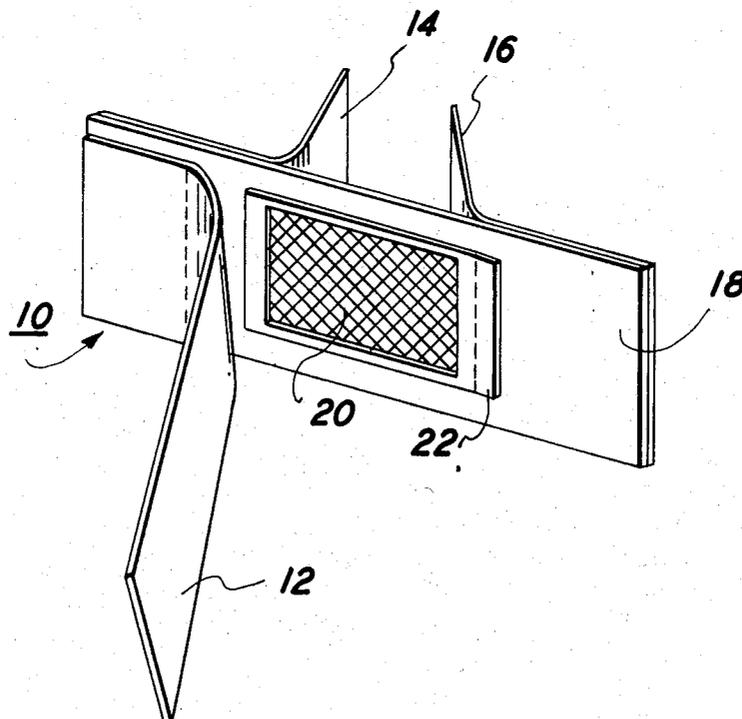
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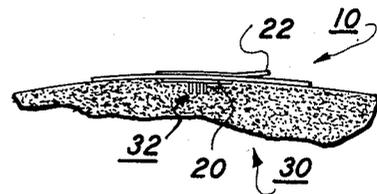
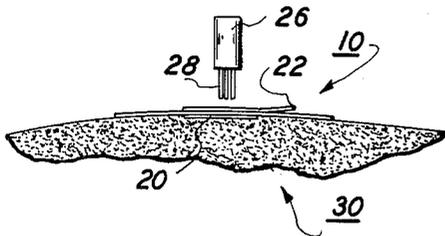
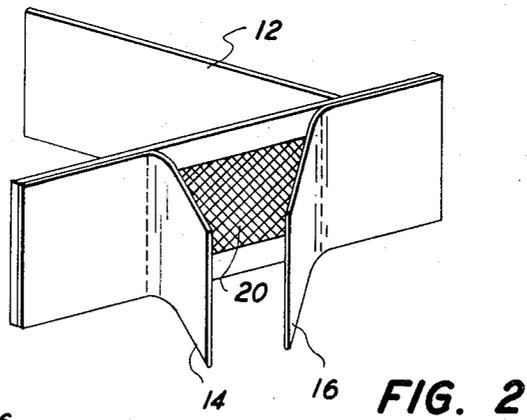
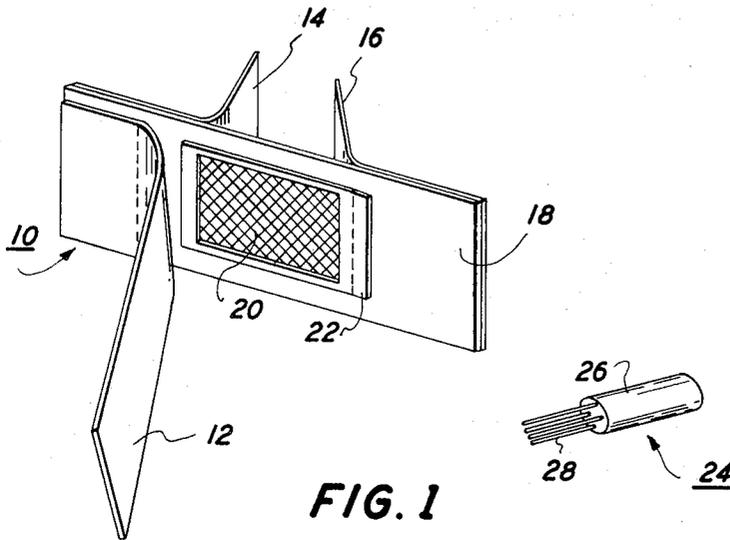
Attorney—James J. Ralabate et al.

[57] **ABSTRACT**

Method and apparatus for providing an improved electrical connection between an electrode placed on the surface of the body and the underlying tissue. The electrode, including an absorbent pad saturated with a conductive material, is adhesively affixed to the body surface. The elongated fibers of a brush are brought into contact with the absorbent pad and, with an appropriate amount of force applied to the brush, the fibers micro-puncture the body surface, forcing the conductive material into microchannels beneath the body surface formed or enlarged by the fibers and into contact with the underlying tissue.

3 Claims, 4 Drawing Figures





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## METHOD FOR PROVIDING AN IMPROVED BODY ELECTRODE ELECTRICAL CONNECTION

### BACKGROUND OF THE INVENTION

Many techniques have been developed in the prior art for transferring electrical signals to and from a patient through the use of body electrodes electrically connected to monitoring apparatus by means of electrical wires or through radio telemetry. The prior art body electrodes have been held in place on the patient by various means, such as by hand, suction cups, straps, adhesives, or the like.

For one reason or the other, these prior art techniques for maintaining the electrodes in place on the patient have not been satisfactory. For example, in those situations wherein the patient is mobile and not confined to a limited area, a portable electrode which is immediately active, preferably disposable, and easily affixed to the body would be preferable to the prior art electrodes. In addition, it is desired that the body electrode be small, not noticeable, and cause no immediate or long term discomfort to the patient.

In the area of electroencephalography, the prior art techniques for detecting and recording brain waves have not been satisfactory. The voltages found in the human scalp region are minute, typically about 10-80 microvolts. In order to get reliable readings, a good connection is necessary. However, a surface layer of dead cells, dirt, etc. usually prevents a good electrical connection to the ionic fluids of the underlying living tissue. Various methods are presently used to establish good connection from the body electrode to the living tissue, a good connection typically being less than 10,000 ohms resistance between points four inches or greater apart. Typically, the surface layer is abraded off after cleansing with a solution, such as acetone. The rubbing is vigorous, with abrasives added to some solutions to assist the abrading. All solutions are heavily conductive, so that when an electrode is placed over the abraded area, the conductive gel or solution then provides the ohmic connection between metallic electrodes and living tissue. To keep the electrode in place, a common practice is to glue the electrode in the desired area with, for example, water-soluble cement. Obviously, this procedure is not particularly comfortable for the patient. An alternately used technique is that in which a sterilized microneedle is buried in the scalp tissue which provides a good ohmic connection but which is obviously uncomfortable to the patient.

It is therefore desired that a body electrode be provided which is easily affixed to a patient, which provides a good electrical connection to the living tissue underlying the surface layer of skin and which is preferable disposable.

U. S. Pat. No. 3,085,577 issued to R. M. Berman et al, is an example of a prior art body electrode which is small, inexpensive, disposable and portable. The electrode comprises a flexible tape having an adhesive material on its underside and an absorbant pad and screening material affixed to the underside by a small rigid annular member. The pad is saturated with a conductive paste and the assembly is placed in contact with the body part. The inflexibility of the screening, however, as pointed out in the patent, produces a low electrical resistance contact between the skin and the electrode, the swelling and associated redness obviously will produce discomfort to the patient. Since the body

electrode of Berman et al measures the electrical activity on the surface of the skin, the connection necessary to read the extremely small voltages produced by the body is not completely satisfactory due to the surface layer of dead cells, dirt, etc. Again, the usual practice with the type of electrode shown in Berman et al is to pre-abrade or utilize solvent chemicals which slowly dissolve the dead cell layer.

### SUMMARY OF THE PRESENT INVENTION

The present invention provides an improved method of employing a body electrode for transferring electrical signals to and from the living tissues underlying the surface of a body part. In particular, the body electrode of the present invention comprises a flexible tape having an adhesive material on its underside. An absorbent pad, saturated with a conductive material, is located substantially in the center of the tape. A conductive electrode is affixed in contact with the absorbent pad on the upper side of the tape. The body electrode is then positioned on the body part and a stiff bristle brush is dabbed against the absorbent pad which is saturated with a conductive gel. The bristles are forced through the pad and through the non-conductive surface layer of the skin. It is found that a good connection is made and that apparently microchannels are established through the non-conductive skin layer with sufficient gel penetration to get excellent conduction, i.e. 5,000 - 7,000 ohms. This dabbing action of the stiff bristles has been found not to be painful and for practical purposes the attendant can dab at the back of his hand to perceive what dabbing force should be used which would not cause discomfort to the patient. Several uses have shown that a good, reliable contact is immediately made, viable over several hours.

It is a object of the present invention to provide a novel method for providing a low electrical resistance contact between the living tissue underlying the surface of a body part and an electrode positioned on the body surface.

It is still a further object of the present invention to provide a disposable body electrode and applicator pack for applying the body electrode to a body part in a manner whereby excellent electrical contact is achieved between the living tissue underlying the surface of a body part and an electrode positioned on the body surface.

### DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention as well as other objects and features thereof, reference is made to the following description which is to be read in conjunction with the accompanying drawing wherein:

FIG. 1 is a perspective view of a preferred body electrode showing a top view thereof;

FIG. 2 is a perspective view of the preferred body electrode of FIG. 1 showing a bottom view thereof; and

FIG. 3(a) illustrates the body electrode as applied to the surface of the body part and FIG. 3(b) is a general representation of the microchannels formed in the body part with the conductive material therein by the dabbing action of the brush member.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a perspective top view of the body electrode 10 is shown with peel off covers 12, 14

and 16 partially removed to illustrate the components of the body electrode. A flexible tape 18 has an absorbent pad located substantially in the center of the tape 18. The absorbent pad 20 is saturated with a conductive gel or paste, such as sodium chloride containing mixtures known as electrode paste or gel containing sodium chloride. A conductive electrode 22, either the foil as shown or a wire mesh, is affixed to the upper side of the tape 18 over the absorbent pad 20 with adhesive, cement or other material. The electrode 22 provides an electrode clip point whereby the body electrode is electrically connected to electromedical apparatus (not shown).

A brush member 24, comprising a handle portion 26 and a plurality of bristles 28, is associated with the body electrode 10 and preferably is packaged therewith in an unitary, disposable pack.

The bristles are preferably of a uniform length and are of a medically-suitable stiff material such as stainless steel.

FIG. 2 is a perspective bottom view of the body electrode 10 with peel off covers 14 and 16 partially open, the covers being affixed to adhesive zones on the margins of the bottom of absorbent pad 20.

As shown schematically in FIG. 3(a), the present invention is utilized in the following manner.

The attendant first places the gel saturated absorbent pad 20 in the desired location on a body part, such as scalp 30. The attendant then dabs the brush 24 against the gel saturated absorbent pad 20, driving the bristles through the pad and through the nonconductive portion of the upper scalp. It is believed that microchannels 32, shown in FIG. 3(b), through the nonconductive scalp layer are established with sufficient gel penetration to get excellent conduction, i.e. typically 5,000-7,000 ohms. The dabbing action of the stiff bristles is generally not painful and, in practice, the attendant may dab at the back of the hand to determine what force can be used without causing discomfort to the patient. Numerous tests have shown that a good, reliable contact is made, viable over several hours.

The bottom side of tape 18 is provided with a pressure sensitive adhesive enabling the body electrode 10 to be attached to the skin and be tightly retained in position despite various changes in body curvature that may serve to flex the tape 10 into conformity with the skin surface. Suitable adhesives for this purpose are now available and commonly employed in self retaining bandages.

The pad material is of the class of material which provides a thin porous absorbent pad such as cotton, gauze, or the like. The characteristic of the selected material is such as to absorb and retain an electrically conductive paste or gel that is applied thereto.

The advantage of the present invention is that it is inexpensive and that its construction makes it adaptable for disposable use. The package contemplated by the present invention includes the body electrode assembly 10 and the brush 24 since the brush is needed to force the gel material into contact with the living tissue underlying the surface layer of skin. The adhesive layer enables body electrode 10, with the associated peel-off covers, to be easily applied to the skin without sticking to other items during its handling. Before application to the skin, these layers are easily removed to expose the adhesive surface therebeneath. The conductive gel may be added to the pad 20 prior to the sealing of the body electrode 10 and its associated brush 20 within its individual wrappers or, alternately, it can be applied to the pad 20 after the peel-off layers are removed.

While the invention has been described with reference to its preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents substituted for elements thereof without departing from the true spirit and scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from its essential teachings.

What is claimed is:

1. A method of providing an electrical connection between a body electrode and the tissue beneath the surface of the human anatomy comprising the steps of:
  - a. placing the body electrode in contact with the body surface, said body electrode comprising a flexible tape having an adhesive on the underside thereof, a layer of a porous, absorbent material affixed to the flexible tape, and a conductive electrode in overlying relationship with said layer, said layer being saturated with an electrolytic solution, and
  - b. puncturing said layer and said body surface through the upper surface of said flexible tape by a sharp object such that a portion of said electrolytic solution is forced through the body surface into contact with the tissue therebeneath, whereby an electrical connection is made between the tissue and the conductive electrode.
2. The method of claim 1 wherein said absorbent layer is saturated with said electrolytic solution prior to said layer being placed in contact with said body surface.
3. The method of claim 1 wherein said absorbent layer is saturated with said electrolytic solution after said layer is placed in contact with said body surface.

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