

Feb. 26, 1957

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2,782,786

ELECTROCARDIOGRAPH ELECTRODE WITH ABSORBENT CONTACT SURFACE

Filed Oct. 10, 1955

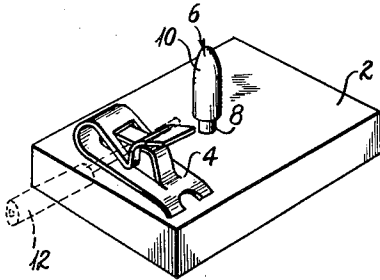


Fig. 1.

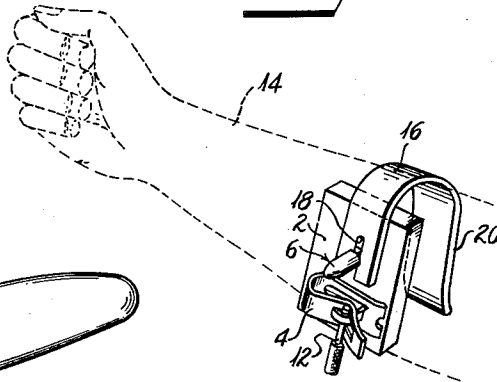


Fig. 2.

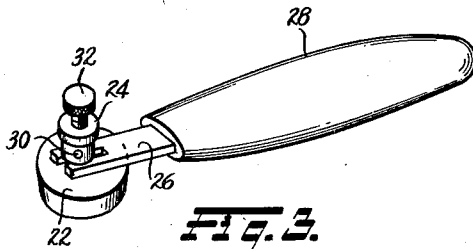


Fig. 3.

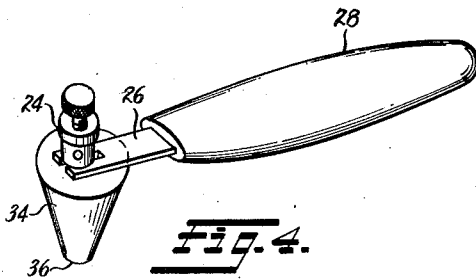


Fig. 4.

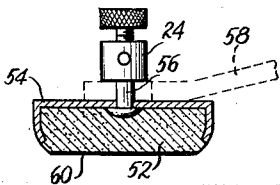
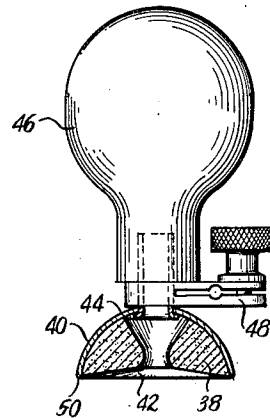


Fig. 5.



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ELECTROCARDIOGRAPH ELECTRODE WITH ABSORBENT CONTACT SURFACE

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Application October 10, 1955, Serial No. 539,444

4 Claims. (Cl. 128—417)

This invention relates to electrode structures and particularly to electrodes for establishing electrical contact with the skin of a patient's body for electrocardiographic tests.

Heretofore it has been common practice to provide a rigid metal electrode for electrocardiographic purposes, to establish electrical contact with the skin of a patient. A metal surface placed against dry skin does not establish a satisfactory electrical contact and so it is the practice to coat the contact surface of the electrode with a suitable conductive paste and to secure the electrode to the patient's body in a suitable manner. In many instances the chemical content of the paste and/or concentrated pressure between the metal electrode and the patient's skin causes irritation and in some cases actual damage. Also, unless the metal electrode is securely held in place, the paste used acts as a lubricant and the electrode tends to slide about. It has been proposed to establish electrical contact with a patient's skin, for the purpose of electrotherapy by moistening a pad of fibrous material to be placed against the skin to establish electrical contact. Such pads of fibrous material, however, were not uniformly absorbent and are so readily distortable that the conductivity between the pad and the patient's skin is not reliable or uniform.

According to the present invention electrical contact is established with a patient's skin through a body of absorbent material, which body is substantially rigid. A highly satisfactory electrode has been constructed by forming a body of molded calcium sulphate. Calcium sulphate is commonly known as plaster of Paris. This material may be readily molded to any desired shape without special equipment and when the material "sets" it forms a substantially rigid body highly absorbent and self sustaining. Such a body may have a suitable clip or terminal post imbedded therein or otherwise electrically connected thereto and constitute an electrode for engaging the patient's skin. A supply of such electrodes may be made up in advance and allowed to dry completely. For use it is only necessary that the electrode be dipped in water whereupon the absorbent body of plaster absorbs a sufficient quantity of water to make it readily conductive to electricity without causing the electrode to disintegrate. Commercially available plaster of Paris (calcium sulphate) is usually provided with a minor proportion of sodium chloride (table salt) mixed therewith. The proportion of sodium chloride may be varied to produce a slow setting or fast setting plaster. When such a mixture is used for molding electrodes according to the present invention, the dipping of the electrode in water causes ionization of at least some calcium sulphate and thus renders the electrode conductive, in addition, some

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of the sodium chloride goes into solution and thus aids in rendering the absorbed moisture highly conductive. It is not necessary, however, that the electrode contain sodium chloride since the ionization of the calcium sulphate alone is sufficient to make the water suitably conductive. In any event, the electrode could be moistened in a saline solution if necessary. It is not necessary that water be used as the moistening agent. Any suitable conductive liquid, not irritating or harmful to the skin, may be used.

It is not necessary that calcium sulphate specifically be employed for the electrode since any suitable absorbent solid body may be used.

Among the advantages of the present electrode is the fact that it may be produced by unskilled persons without special equipment, and furthermore that the contact surface may be scraped, carved or molded to any desired surface configuration to snugly embrace any desired portion of the patient's body in snug surface contact throughout the area of the electrode without enforcing distortion of the electrode body and without applying undue pressure at any portion thereof. Furthermore, the contact surface is sufficiently rough to prevent slipping on the patient's skin even when held in place with very light pressure while not being rough enough to cause abrasion if slippage does occur.

It is therefore an object of this invention to provide a novel electrocardiograph electrode which requires no electrode paste when used.

Another object of this invention is to provide an electrode for the purpose described which is of extreme simplicity in construction, and highly economical to produce.

Still another object of this invention is to provide an electrocardiograph electrode having a contact surface and connecting means readily adaptable to many diverse types of electrical apparatus.

It is a further object of this invention to provide an electrode having uniform and dependable conductivity.

A still further object of this invention is to provide an electrode having a rigid contact portion readily modified to conform to different body contours.

Additional objects and advantages will appear to those skilled in the art as the description proceeds in connection with the accompanying drawings wherein:

Fig. 1 is a perspective view of an electrode embodying the present invention;

Fig. 2 is a view of the electrode of Fig. 1 shown applied to the arm of a patient;

Figs. 3 and 4 are similar perspective views of modified forms of electrode illustrating the use thereof with handles for manually holding the electrodes in place;

Fig. 5 is a partial sectional view of a still further form of electrode embodying the present invention; and,

Fig. 6 is a vertical sectional view, with certain parts shown in elevation illustrating a still further embodiment of the invention.

Referring first to Fig. 1, the electrode body 2 comprises a molded rectangular body of suitable absorbent material such as plaster of Paris having an electrical connector clip 4 secured thereto by having a portion thereof imbedded in the material of the body 2. The body 2 is further provided with an attachment member 6 located substantially centrally thereof and comprising a peg imbedded in the body of the electrode and having a reduced shank portion 8 and an enlarged head 10. The attachment member 6 is preferably of nonconductive material

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whereby it may be held by any suitable instrumentality against the body of a patient without affecting the electrical characteristics thereof. As stated, the body 2 may be of molded plaster of Paris, which is highly absorbent. When it is desired to use the electrode for electrocardiographic purposes the body 2 is dipped into any suitable supply of water (or other suitable liquid conductor) whereupon the body absorbs a considerable quantity of the water throughout. With the saturated plaster body placed against the skin of a patient, very good electrical contact is made with the patient's skin and the electrode may be connected, by means of conductor 12, to the desired indicating or recording apparatus in the usual manner.

Fig. 1 shows a rectangular block of absorbent material and a large supply of such blocks may be made up in advance. When it is desired to apply the electrode to a portion of the patient's body that does not present a substantially flat surface for contact, the contact surface of the electrode (that surface at the bottom of the block shown in Fig. 1) may be scraped or carved to a shape complementary to the desired portion of the patient's anatomy and placed thereon to make good surface contact throughout a substantial area without unduly distorting the patient's flesh or applying high localized pressure at any point.

Fig. 2 merely illustrates the adaptability of the electrode of Fig. 1 for application to any portion of the patient's body. As shown in that figure the electrode 2 is held against the patient's forearm 14 by means of the resilient clip 16. The clip 16, which is preferably of nonconducting material, is of generally bowed shape having a slot 18 in one end thereof and a resilient arm 20 at the other end. The slot 18 may be positioned to embrace the shank portion 8 of the attachment 6 with the resilient arm 20 extending around the patient's forearm to engage the opposite side thereof and thus securely hold the electrode 2 against the patient's skin. Clearly, a clip like that of Fig. 2 may be made of any size necessary to hold the electrode against any selected portion of the patient's body.

Figs. 3 and 4 illustrate alternative forms of electrode wherein, in Fig. 3 the absorbent body 22 has imbedded therein a portion of a binding post 24. The binding post 24 is provided with a reduced shank portion adapted to frictionally receive a slot in the shank 26 of a handle 28. Preferably the shank 26 and/or handle 28 are of non-conductive material. The terminal post 24 is further provided with a transverse opening 30 to receive a conductor, such as the conductor 12 of Fig. 2, and a clamping screw 32 for securely clamping the conductor in the binding post. In the form of Fig. 3 the electrode may be held against the patient's skin by means of the handle 28 or it may be held in the manner indicated in Fig. 2. It is to be understood that any suitable clip or other holding means may be provided to hold the electrode of the present invention against the patient's body since the invention is not limited to any specific type of securing or holding means.

Fig. 4 shows a further form the electrode may take wherein the absorbent body 34 is of frustoconical shape whereby the contact surface 36 may be very small and in fact may even approach a contact "point" where it is desired to perform tests over a very small area of the patient's skin. The binding post 24 and the handle 26-28 of this form may be identical to those shown in Fig. 3.

Fig. 5 shows a still further adaptation of the invention wherein an annular body 38 of absorbent material is carried by a suction cup 40 on the inner side thereof and presents a concave contact face 42 to the patient's skin when in place thereon. The suction cup 40 is preferably of metal and provided with a connecting tube 44 communicating with the interior thereof and upon which a rubber or the like bulb 46 is telescopically mounted.

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The metal tube 44 may also support a conductor clamp 48, as shown, in electrically conductive contact with the tube 44 and cup 40. The electrode of Fig. 5 is held against the patient's skin by suction. In use, the suction cup 40 is first dipped in water so that the absorbent body 38 becomes moist and conductive and then the bulb 46 is collapsed to expel a large portion of the air therefrom. While the bulb is held in collapsed condition the periphery of the suction cup 40 is placed against the patient's skin and while being held there, the bulb 46 is released to expand and establish a partial vacuum within cup 40. The partial vacuum in the cup 40 and bulb 46 serves to hold the electrode securely against the patient's skin as long as desired. Since the porous or absorbent body 38 is not impervious to air, it is necessary that the peripheral edge of the suction cup 40 be in actual contact with the patient's skin to provide a suitable hermetic seal therewith. For that reason the outer periphery of the concave contact surface 42 substantially coincides with the peripheral edge 50. It is desirable that no abrupt change in direction exist at the juncture of the edge 50 and surface 42 which abrupt changes in direction would result in undue distortion of the patient's skin and possible damage thereto. By providing the concave surface 42, the patient's skin and flesh may be drawn slightly inwardly of the cup 40 into firm surfaced contact with the moist absorbent body 38 and thus establish good electrical contact therewith.

Fig. 6 shows a still further embodiment wherein an absorbent body 52 is supported by a supporting cup 54. The supporting cup 54 has a binding post 24 permanently mounted thereon and provided with a reduced shank 56 adapted to frictionally receive the slotted portion of a suitable holding means 58 (shown in dotted lines). The absorbent body 52 may be placed in the supporting cup 54 while in a plastic state and molded therein to define a contact surface 60 of any desired configuration. After the material is set the electrode is ready for use in the described manner. The form shown in Fig. 6 offers some advantages in that the absorbent body 52 may be molded in place therein without the necessity of providing any mold, such as would be necessary for the forms of Figs. 1 through 5. The provision of the absorbent body 52 of Fig. 6 may be accomplished at any place without molds or tools by merely forming the usual plaster of Paris mixture with water, placing it in the supporting cup 54 and molding the contact surface by hand.

While a limited number of embodiments of the invention have been shown and described herein it is to be understood that these embodiments are merely illustrative and that the invention is not limited thereto. It is contemplated that the invention encompass all modifications falling fairly within the scope of the appended claims.

I claim:

1. An electrocardiograph electrode comprising; a substantially rigid, porous and self-sustaining body of calcium sulphate, and an electrically conductive connector secured to said body, said body having an exposed face for contact with a test surface.

2. An electrocardiograph electrode comprising; an electrically conductive rigid supporting body having means thereon for connection to an electrical conductor, said electrode having a contact surface thereon for engagement with a surface to be electrically connected thereto, said contact surface being defined by a substantially rigid body of calcium sulphate secured to said conductive supporting body.

3. An electrode as defined in claim 2, wherein said supporting body comprises a metal suction cup with means for creating a partial vacuum therein, said body of material being an annular body inside said suction cup and having a concave contact surface with its outer periphery substantially coincident with the open peripheral edge of said suction cup.

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4. An electrocardiograph electrode comprising; a hollow rigid casing of electrically conductive material and having an open side, means carried by said casing for electrically connecting said casing to an electrical conductor, a rigid body of calcium sulphate secured in said casing in electrical contact with the inner face thereof, said body having an exposed surface at the open side of said casing for contact with a test surface.

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