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ELECTRODE FOR ELECTROMEDICAL EQUIPMENT

Filed Jan. 24, 1968

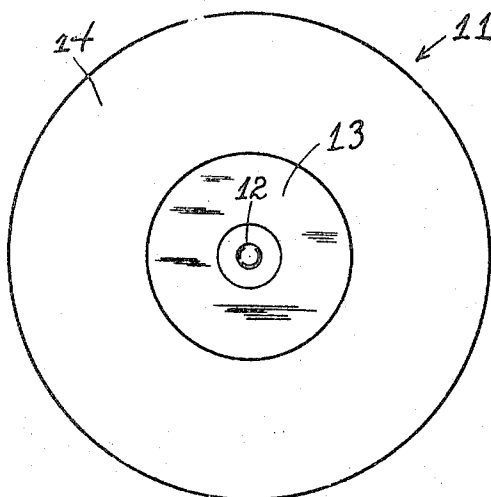


FIG. 1

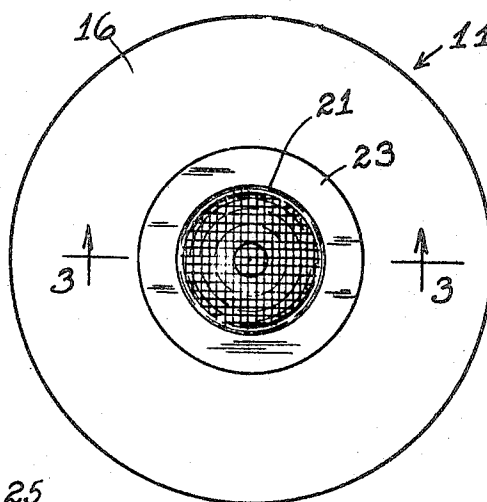


FIG. 2

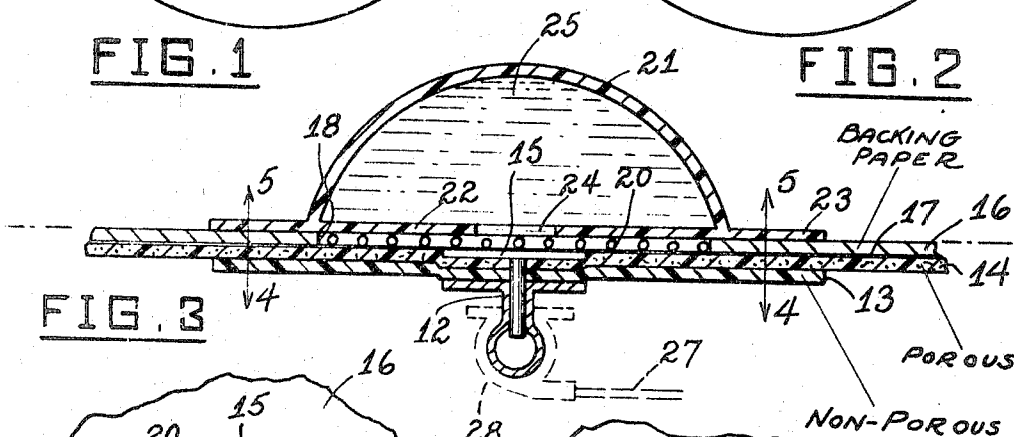


FIG. 3

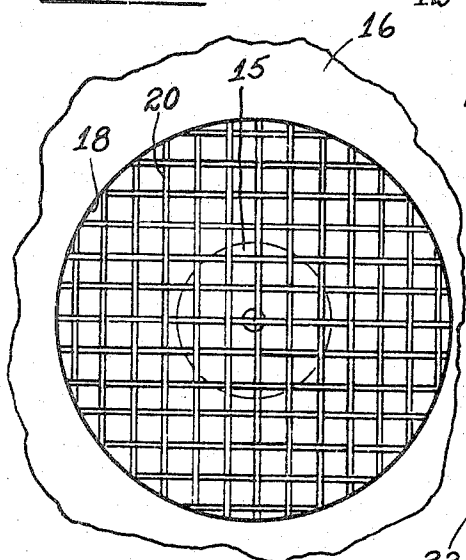


FIG. 4

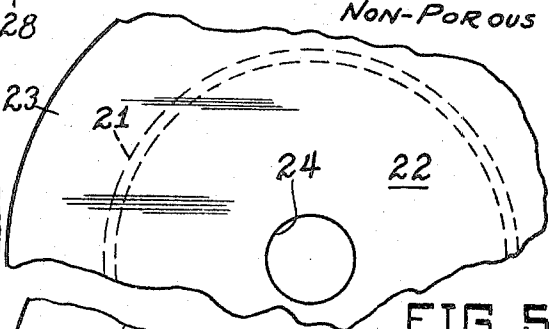


FIG. 5

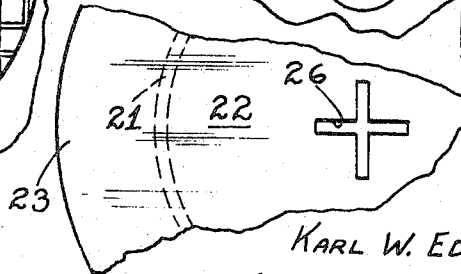


FIG. 6

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1

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ELECTRODE FOR ELECTROMEDICAL
EQUIPMENT

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10 Claims

ABSTRACT OF THE DISCLOSURE

A liquid junction electrode for use with patient-monitoring equipment. The electrode consists of a metal male snap fastener element mounted on a flexible body having adhesive to fasten it to a patient's skin. The inner end portion of the fastener element is covered by a screen of non-conductive mesh material for providing efficient dispersion of conductive jelly. A removable plastic bubble containing the electrode jelly is mounted over the screen, the bubble being aperture so that the jelly is normally in contact with the screen and the electrode is immediately ready for use when the bubble is removed.

This invention relates to electrodes for patient-monitoring equipment, and more particularly to an electrode assembly of the liquid junction type, namely, wherein the patient's skin is not directly contacted by any metallic portion of the assembly.

A main object of the invention is to provide a novel and improved liquid junction electrode assembly for use with patient-monitoring or with similar equipment, the electrode assembly comprising simple parts, providing highly efficient dispersion of its liquid junction material, and being capable of being rapidly installed on a patient's body.

A further object of the invention is to provide an improved liquid junction electrode which is inexpensive to manufacture, which is easy to apply, and which is essentially artifact-free even when used for continuous monitoring over long periods of time.

A still further object of the invention is to provide an improved electrode for medical equipment, said electrode being arranged so that perspiration can readily evaporate therefrom, continuous adherent contact with the body is maintained, pain or discomfort is reduced to a minimum, and effective and reliable electrical contact with the patient's body is provided for detecting bio-electric signals from the body surface.

A still further object of the invention is to provide an improved liquid junction patient-monitoring electrode assembly of the disposable type employing a conductive jelly as its liquid junction material, the assembly employing a non-conductive mesh screen for preventing direct contact between its metal portion and the patient's skin and being arranged for efficient dispersion of the jelly, the jelly being self-contained with the assembly so that the electrode assembly constitutes a complete entity which is always ready for use.

A still further object of the invention is to provide an improved liquid junction electrode assembly which provides an effective wide surface area of contact with a patient's skin, which minimizes irritation of the skin, which insures stable monitoring of electrical signals from the skin even if the electrode is tilted or tipped relative to the skin, and which employs an electrode jelly acting in conjunction with the metal portion of the assembly to in effect create a half-cell having a much higher degree of stability than in the condition which would be present if the metal portion were in direct or intermittent contact with the skin.

2

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

FIGURE 1 is a top plan view of an electrode assembly according to the present invention.

FIGURE 2 is a bottom plan view of the electrode assembly of FIGURE 1.

FIGURE 3 is an enlarged fragmentary vertical cross-sectional view taken substantially on the line 3—3 of FIGURE 2.

FIGURE 4 is a horizontal plan view taken substantially on the line 4—4 of FIGURE 3.

FIGURE 5 is a fragmentary horizontal plan view taken substantially of the line 5—5 of FIGURE 3.

FIGURE 6 is a view similar to FIGURE 5 but showing a modification.

Referring to the drawings, 11 generally designates a typical liquid junction electrode assembly constructed in accordance with the present invention. The assembly 11 comprises a conventional metal male snap fastener element 12 centrally secured to the concentrically superimposed flexible non-porous relatively thin plastic disc member 13 and flexible thin porous relatively large plastic disc member 14, adhesively secured together, with the metal circular inner flange portion 15 of the male snap fastener element exposed at the center of the large porous disc member 14. A strippable backing paper disc 16 is adhesively concentrically secured to porous member 14 by a layer of conventional rubber-composition, or similar adhesive material 17 provided on member 14. Paper disc 16 has a relatively large central aperture 18 several times the diameter of flange portion 15.

Disposed in the aperture 18 and retained therein by the adhesive 17 is a circular mesh member 20 of electrically insulating and non-conducting material, such as plastic fibers, of slightly smaller thickness than the backing paper disc 16. The mesh screen member 20 is of much greater size than the flange 15, for example, is about five times the size of the flange.

Overlying the aperture 18 and concentrically secured on the backing paper disc is a generally hemispheric flexible plastic bubble 21, said bubble having a bottom wall 22 which extends beyond the bubble 21 to define a flat annular peripheral flange 23, which is adhesively secured around the margin of the aperture 18 of the paper disc 16. The diameter of the bubble 21 may be approximately the same as aperture 18.

Bottom wall 22 is formed with a relatively small central aperture 24 which faces, but is preferably substantially smaller than, the metal flange 15, being separated therefrom by the central portion of the insulating screen 20. The bubble 21 is filled with a mass of conductive jelly 25.

The bubble center hole 24 is relatively small in size as compared with the size of the bottom wall 22, to minimize evaporation of the jelly 25 while the electrode assembly is in storage. The shape of the hole may be varied. Thus, the hole may be a small pinhole or may be a cruciform slit, as shown in FIGURE 6 at 26. When pressure is applied to the flexible bubble 21, jelly is forced out through the hole 24 or slit 26 into the interstices of the screen 20. The backing paper 16 normally prevents the adhesive 17 from sticking to other materials. When the backing paper 16 is removed, the bubble 21 comes with it, leaving the electrode with the screen 20 saturated with jelly, ready to be applied to the skin. The size of the center hole 24 or cruciform slit 26 should be as small as possible, namely, only large enough to insure that the jelly will saturate the screen 20 in response to reasonable squeezing pressure applied to the flexible bubble 21.

The backing paper disc 16 approximately the same size as the porous disc 14, so as to adequately protect the adhesive layer 17.

As will be seen from FIGURE 3, the screen 20 is much greater in size than the metal flange 15, so that the jelly-saturated screen greatly expands the area of the conductive path between the metal electrode element 12 and the patient's skin.

When the electrode assembly is in storage, most of the jelly is retained against evaporation in the bubble 21. When the electrode assembly is to be used, the jelly is forced into the screen 20 by merely applying squeezing pressure to the bubble. Thus, after the screen 20 has been thus saturated with jelly, the backing paper 16 with the bubble 21 is removed by stripping it off the porous member 14, and the remaining electrode assembly is applied to the patient's skin. A suitable conducting wire 27, with a metal female snap fastener element 28 may then be connected to the metal male snap fastener element 12, for establishing an electrical connection to the associated external electrical apparatus, such as patient-monitoring equipment, which operates by detecting bio-electric signals from the body surface.

It will be seen that the metal element 15 does not directly contact the body surface, being electrically insulated therefrom by the insulating mesh 20, through which a liquid junction is dispersed, namely, the conducting liquid junction defined by the jelly 25 which saturates the mesh, electrically coupling the metal member 15 to the body surface. As above mentioned, a main advantage thus derived is to greatly expand the effective conductive surface area. In addition, continuous monitoring, which is essentially artifact-free, can be effected for as long as three days because of the additional properties of the electrode assembly. By the use of a non-allergenic porous skin-adhesive anchor element 14, perspiration, which would normally accumulate under a non-porous structure, is allowed to evaporate, permitting the adhesive anchor 14 to maintain continuous adherence to the body. Preservation of the essential liquid junction is provided by the addition of the non-porous seal element 13. The combination of these features permits prolonged, painless monitoring of bio-electric potentials.

The use of the electrically insulating non-conducting mesh member 20 provides an effective distribution of the liquid junction, resulting in as much as a five to one effective area expansion of the liquid junction.

The electrode assembly retains its operative position, with artifact-free monitoring, even under conditions of active movement by the patient of the portion of the body carrying the electrode.

By the provision of large liquid junction area expansion, as above described, it is not necessary to employ a highly conductive hypertonic electrode jelly of the type which rapidly produces irritation. The area expansion of the non-conductive screen 20 permits an isotonic non-irritating electrode jelly to be used. Without the area expansion provided by screen 20, isotonic electrode jelly cannot be successfully utilized.

If the size of the screen is reduced to approximately that of the metal electrode element 15, high resistance develops due to the small resultant liquid junction in contact with the skin. This necessitates the use of a hypertonic electrode jelly of the type causing rapid irritation.

While certain specific embodiments of an improved liquid junction skin electrode have been disclosed in the foregoing description, it will be understood that various

modifications within the spirit of the invention may occur to those skilled in the art. Therefore it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. An electrode assembly for application to a body surface comprising flexible sheet means having a layer of adhesive on its inside surface for engagement with a body surface, a metal electrode element secured to said flexible sheet means and having a flat portion exposed at said inside surface, a flexible layer of backing material removably secured on said inside surface and having an aperture surrounding said electrode element, a mesh member of non-conducting flexible material disposed in said aperture over said electrode element, a flexible bubble member overlying the mesh member and being secured to the peripheral margin of said aperture, and a mass of conductive jelly in said bubble member, said bubble member having a bottom wall overlying the mesh member, said bottom wall being formed with a relatively small aperture adjacent said mesh member allowing conductive jelly to be forced into contact with the mesh member responsive to squeezing force applied to the bubble member.

2. The electrode assembly of claim 1, and wherein said flexible sheet means comprises an inner layer of flexible porous material and an outer layer of flexible non-porous material.

3. The electrode assembly of claim 2, and wherein said outer layer is substantially smaller in size than said inner layer and overlaps the area containing the aperture in the flexible backing member.

4. The electrode assembly of claim 1, and wherein the aperture in said bottom wall is located opposite said metal electrode element.

5. The electrode assembly of claim 4, and wherein the aperture in said bottom wall is substantially smaller in size than said electrode element.

6. The electrode assembly of claim 1, and wherein the mesh member is substantially greater in size than the electrode element.

7. The electrode assembly of claim 6, and wherein the mesh member is approximately five times the size of the electrode element.

8. The electrode assembly of claim 1, and wherein said bubble member has a substantially hemispheric flexible convex top wall and a flat annular peripheral flange attached to the margin of the aperture in the backing material.

9. The electrode assembly of claim 8, and wherein the mesh member substantially fills the aperture in the backing material.

10. The electrode assembly of claim 9, and wherein the aperture in said bottom wall is substantially smaller than and is located opposite said electrode element.

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