

1

3,658,726

ELECTROLYTICALLY CONDUCTIVE PASTE
Gerhard Mühl, Freiburg im Breisgau, Germany, assignor
to Fritz Hellige & Co. GmbH, Breisgau, Germany
No Drawing. Filed Dec. 19, 1967, Ser. No. 691,704
Claims priority, application Germany, Dec. 31, 1966,
P 15 64 103.9

Int. Cl. H01b 1/06; B01g 1/00
U.S. Cl. 252—518

6 Claims

ABSTRACT OF THE DISCLOSURE

An electrolytically conductive paste or jelly is disclosed, for facilitating low resistance contact between a metal electrode and a biological body. The paste comprises an aqueous solution of an ionized salt as the conducting agent with a thickening agent, and includes a chelating agent to complex heavy metal ions and thereby reduce polarization effects.

The present invention relates to electrolytically conducting pastes or jellies used to decrease the contact resistance between a metallic electrode and a biological body.

There are numerous instances where it is desired to establish a low resistance contact between a biological body, such as a human body, and a metallic electrode. Such contacts are used to derive voltage signals from the body indicative of the biological functions thereof, as for example in electrocardiography or electroencephalography. They are also used to apply stimulating voltages or currents to the body. The electrodes utilized for this purpose are usually formed of heavy metals, such as iron or copper, or alloys thereof.

In order to reduce the contact resistance between these electrodes and the biological body, it is customary to utilize an electrolytically conductive paste or jelly between the electrode contact surface and the body surface. These pastes or jellies conventionally comprise an aqueous solution of a highly ionized salt, such as sodium chloride or sodium carbonate, as the electrolyte, and a stiffening or thickening agent, such as a starch. These electrolytically conductive materials are well known in the art, and may be in the form of an emulsion, jelly, or paste, and may contain numerous additive ingredients for various purposes, such as antiseptics, skin emollients, or cleaning or removal aids. Such compositions are set forth in U.S. Pat. 3,027,333 and German Pat. 943,610.

These metal electrode and paste contact systems are, however, subject to the detrimental effect of polarization potentials at the interface of the metal electrode with the electrolytically conductive paste or jelly, and the interface of the skin or surface of the biological body with the paste or jelly. The polarization potentials may be caused by metal ions entering the paste from the electrode or from the biological body, or by impurities present in the paste itself, resulting in the development of gaseous layers at said interfaces. In accordance with the present invention, polarization from these sources is decreased or essentially eliminated by incorporating a heavy metal ion complexing agent in the conductive paste or jelly, and thereby effectively removing such ions from the electrolytic system.

It is therefore one object of the present invention to provide for the application of electrical voltages or currents to a biological body, or the derivation of voltage signals from the body, utilizing a metal electrode contact with the body and an electrolytically conductive paste between the body and the electrode, with a minimal development of electrolytic polarization potentials.

Another object of the present invention is substantially to eliminate such polarization potentials as would result from heavy metal ions in or entering the paste or jelly.

2

And still another object of the present invention is to provide for the foregoing objects by incorporating a complexing agent for said heavy metal ions in the electrolytically conductive paste or jelly.

Many electrolytically conductive jellies or pastes of the type hereinabove described are known and used for the purpose of facilitating a low resistance contact between a biological body and a metal electrode. It has been observed, however, that these contact systems develop significant polarization potentials at the electrode and body interfaces with the jelly or paste. It has been found that this effect results in large measure from the presence of heavy metal ions entering into the electrolytic process. The heavy metal ions come primarily from diffusion of the electrode metal into the paste or jelly, although such ions also can come from the surface or skin of the biological body, as well as being initially present as an impurity in the paste itself.

Pursuant to the present invention, polarization from this source is essentially eliminated by the incorporation of a small percentage of a heavy metal ion complexing agent in the conductive paste or jelly. Any known heavy metal ion complexing agent may be used for this purpose, provided the material is not antagonistic to the biological body. It has been found that ethylene diamine tetra-acetic acid, and its usual salts are particularly useful for the purposes of this invention, although it should be understood that the invention is not considered to be limited thereto. Among the salts of EDTA found particularly useful are the disodium salts, the calcium disodium salts, etc. Also nitrilo tri-acetic acid and its salts are found particularly suitable for the purposes of the present invention. The complexing agent is found to be effective when present in the conductive jelly in amounts as low as about 0.05% by weight; and the preferred concentration is between about 0.05% and about 2%, preferably about 0.1% to 1%.

To further illustrate the present invention, the following illustrative specific example is provided, the percentages being by weight:

	Percent
Sodium lauryl sulfate	1.0
Glyceryl monostearate (free from soap)	11.0
Cetyl alcohol	1.0
Sodium nitrite	0.1
Sodium chloride	5.0
Glycerin	5.0
Di-sodium EDTA	1.0
Water (distilled or deionized)	75.9

It is understood, of course, that this example is only illustrative of the invention, and that the invention is applicable to other electrolytically conductive contact pastes or jellies. Likewise, the benefits of the invention can be realized with other known heavy metal ion complexing agents.

What is claimed is:

1. An electrolytically conductive paste or jelly material for use in establishing a low resistance contact between a metal electrode and a biological body, comprising an aqueous solution of highly ionizable salt providing the electrolytic conductivity of the material, a thickening agent in sufficient quantity to impart a paste-like body to the material, and a small percentage of a heavy metal ion complexing agent dissolved in said solution, whereby polarization potentials arising from the presence of heavy metal ions in the material are substantially eliminated, said complexing agent is present in an amount of from about 0.1% to about 2% by weight of the material, and said complexing agent is EDTA, nitrilo tri-acetic acid, a salt thereof, or a mixture thereof.

3

2. A material as set forth in claim 1, wherein said highly ionizable salt is either sodium chloride or sodium carbonate.

3. An electrolytically conductive paste or jelly material for use in establishing a low resistance contact between a metal electrode and a biological body, comprising an aqueous solution of a highly ionizable salt providing the electrolytic conductivity of the material, a thickening agent in sufficient quantity to impart a paste-like body to the material, and a small percentage of a heavy metal ion complexing agent dissolved in said solution, whereby polarization potentials arising from the presence of heavy metal ions in the material are substantially eliminated, said complexing agent being EDTA, nitrilo tri-acetic acid, a salt thereof, or a mixture thereof.

4. A method of making low resistance electrical contact between a metal electrode and a biological body comprising applying between the electrode and the body an electrolytically conductive paste or jelly material, said material comprising an aqueous solution of a highly ionizable salt providing the electrolytic conductivity for the material, a thickening agent in sufficient quantity to impart a paste-like consistency to said material, and a small percentage of a heavy metal ion complexing agent dissolved in said solution, whereby polarization potentials arising from the presence of heavy metal ions in the material are substantially eliminated; said complexing agent being present in an amount of from about 0.1% to about 2% by weight of the material, and said complexing agent being EDTA, nitrilo tri-acetic acid, a salt thereof, or a mixture thereof.

5. A method as set forth in claim 4, wherein said highly ionizable salt is sodium chloride or sodium carbonate.

4

6. A method of making low resistance electrical contact between a metal electrode and a biological body comprising applying between the electrode and the body an electrolytically conductive paste or jelly material, said material comprising an aqueous solution of a highly ionizable salt providing the electrolytic conductivity for the material, a thickening agent in sufficient quantity to impart a paste-like consistency to said material, and a small percentage of a heavy metal ion complexing agent dissolved in said solution, whereby polarization potentials arising from the presence of heavy metal ions in the material are substantially eliminated, said complexing agent being EDTA, nitrilo tri-acetic acid, a salt thereof or a mixture thereof.

References Cited

UNITED STATES PATENTS

3,027,333	3/1962	Friedman	252—518
3,048,549	8/1962	Adams	252—518
3,265,638	8/1966	Goodman	252—518
3,210,248	10/1965	Feldmann	252—316

OTHER REFERENCES

Martell and Calvin, Chemistry of the Metal Chelate Compounds, Prentice-Hall Inc., Englewood Cliffs, N.J., 1952. Copy in U.S. Patent Office Library QD411M38 pages 511, 512.

Lewis, Electrode Jelly in Electrocardiography, British Heart J., 1965, vol. 27, pp. 107-109.

DOUGLAS J. DRUMMOND, Primary Examiner

U.S. Cl. X.R.

252—316