

[54] **ELECTRIC CONTACTOR WITH VENTURI-SUCTION MEANS FOR ORGANIC TISSUE**

[72] Inventor: **Heiner Hoffmann, Herrlingen, Germany**
 [73] Assignee: **Ingeborg Niess, Elektromedizinische, Herrlingen, Germany**
 [22] Filed: **July 29, 1970**
 [21] Appl. No.: **59,283**

[30] **Foreign Application Priority Data**
 Aug. 2, 1969 GermanyP 19 39 523.4
 [52] U.S. Cl.128/2.1 E, 128/418, 128/DIG. 4
 [51] Int. Cl.A61b 5/04
 [58] Field of Search128/2.06 E, 2.06 R, 2.1 E, 128/2.1 R, 404, 410, 411, 417, 418, DIG. 4

[56] **References Cited**
 UNITED STATES PATENTS
 3,568,663 3/1971 Phipps.....128/2.06 E

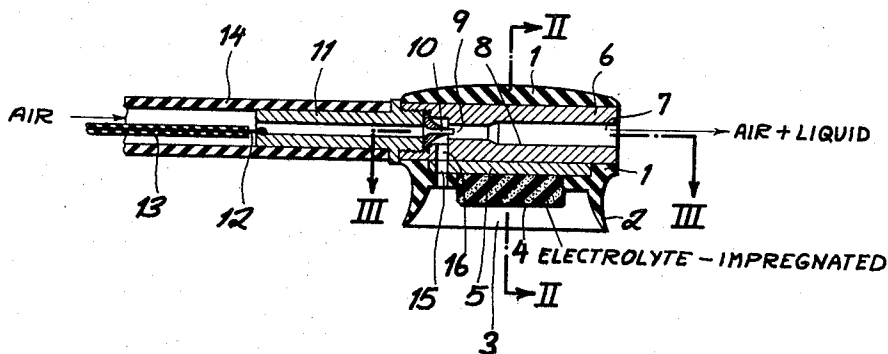
3,534,733	10/1970	Phipps.....	128/2.1 E
3,505,993	4/1970	Lewes et al.....	128/2.06 E
2,660,175	11/1953	Thrasher et al.....	128/404
3,170,459	2/1965	Phipps et al.....	128/2.06 E

Primary Examiner—William E. Kamm
Attorney—Karl F. Ross

[57] **ABSTRACT**

A contactor for diagnostic or therapeutic use on human or animal tissue comprises a suction cup of elastomeric material containing an electrolyte-impregnated sponge near the mouth of the cup supported on an electrode plate from which a conductor extends insulatedly outwardly inside a tube leading to a source of air under pressure. This tube, traversing the cup inwardly of the electrode plate, forms a Venturi nozzle for aspirating air from the interior of the cup and terminates in an outlet which opens into the atmosphere for dispersing entrained liquid.

7 Claims, 3 Drawing Figures



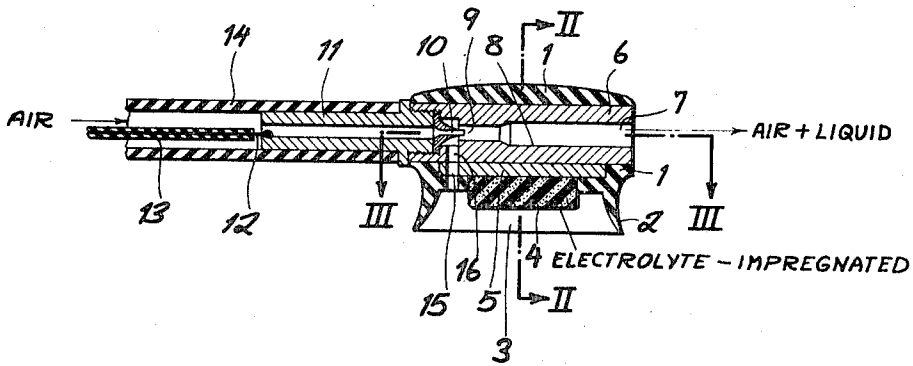


FIG. 1

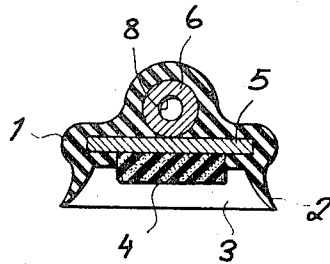


FIG. 2

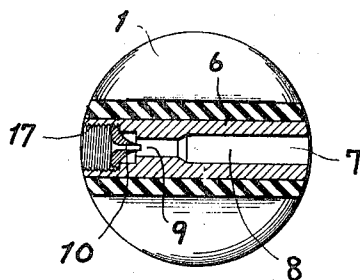


FIG. 3

Heiner Hoffmann
INVENTOR.

BY

Karl G. Ross
Attorney

ELECTRIC CONTACTOR WITH VENTURI-SUCTION MEANS FOR ORGANIC TISSUE

The present invention relates to a contactor for establishing electric communication with organic tissue, such as the skin of a human or animal body, for diagnostic or therapeutic purposes. More particularly, it relates to a contactor utilizing a partial vacuum for holding an electrode onto the skin or other body tissue, in the presence of a liquid electrolyte to facilitate the transition of ions between the electrode and the tissue.

In simple cases a contactor of this type can be equipped with a hand pump, such as a rubber ball, to create the necessary pressure differential. In view of an unavoidable leakage between the tissue and the rim of the cup-shaped electrode housing, however, such a partial vacuum cannot be long maintained so that the contact time between the electrode and the tissue is limited. For prolonged contact, therefore, a suction pump must be used thereby the pressure differential can be maintained indefinitely.

The application of such suction to the interior of the cup tends to extract some of the electrolyte present therein with formation of housing, bridges between the electrode and the normally grounded pump housing these bridges shunting the usually high-ohmic input independence of a voltage source connected between that electrode and ground. Such shunts are particularly objectionable in the case of diagnostic instruments whose readings may be falsified by the resulting leakage current. The use of liquid separators or traps in the suction line, in order to break up these electrolytic bridges, is cumbersome and expensive, especially where a single pump serves several contactors of the aforesaid type which must remain electrically insulated not only from the pump housing but also from one another. The maintenance of a specified pressure differential with the aid of a suction pump operating through interposed liquid separators is also difficult.

It is, therefore, the object of my present invention to provide a contactor of the general character referred to, serving as an attachment for therapeutic or diagnostic apparatus including a source of electric current, in which the aforesaid drawbacks are avoided.

The object is realized, pursuant to the invention, by the substitution of a source of high-pressure gas for the conventional suction pump, the gas traversing a conduit with a Venturi-type nozzle to create an underpressure communicated to the interior of the suction cup via a branch from that conduit. Any liquid aspirated through that branch and entrained by the gas passing through the main conduit is dispersed into the open air through an outlet discharging freely into the atmosphere, thereby positively preventing the formation of any electrolyte bridge.

Advantageously, according to a more specific feature of my invention, the conduit is a preferably metallic tube rigid with the cup-shaped housing. In this case a branch leading from the Venturi nozzle to the interior of the cup may be a short passage formed by a hole in an electrode plate within a housing and an adjoining hole in the tube wall. The metallic tube, together with a metallic nipple extending outwardly therefrom for connection to an air hose, may then form part of an external power supply, this conductor advantageously including a wire extending from the nipple toward the power supply within the gas line itself.

Since the only medium traveling between the pump and the suction cup is air or some other dry and nonconductive gas, the insertion of liquid separators in that path becomes unnecessary.

The invention will be described in greater detail hereinafter with reference to the accompanying drawing in which:

FIG. 1 is a sectional side view of a contactor embodying the invention;

FIG. 2 is a cross-sectional view taken on the line II—II of FIG. 1; and

FIG. 3 is a top view partly in section on the line III—III of FIG. 1.

The device shown in the drawing, attached to a diagnostic or therapeutic apparatus not further illustrated, comprises a housing 1 of rubber or other elastomeric material formed with a mouth 3 which is bounded by an elastically deformable rim 2. The lower part of this housing as viewed in FIGS. 1 and 2 has the shape of an inverted cup whose bottom includes an electrode plate 5 embedded in the elastomeric material. Also embedded in that material, but projecting downwardly toward the mouth 3, is a sponge 4 permeated by liquid electrolyte; upon firm application of the rim 2 to the skin of a human or animal body, the sponge 4 contacts the skin and establishes an ionic path between the latter and the electrode 5 upon which it bears. This electrode, in turn, is in contact with a metal tube 6 overlying same, tube 6 having a bore 8 with an outlet 7 opening into the atmosphere from the body of elastomeric material in which it is embedded. A constriction 9 near the opposite end of the tube receives a nozzle-shaped tip of a restrictive insert 10 held in place by a metallic nipple 11 threaded at 17 (FIG. 3) into the inlet end of the tube. The Venturi effect created at the junction of nozzle 10 with the restricted bore portion 9 of tube 6 generates suction which is communicated to the interior of the housing above mouth 3 by way of a passage including a lateral hole 16 in tube 6, a hole 15 in plate 5 aligned therewith and a corresponding hole in the layer of elastomeric material underlying the electrode plate. The length of the wider part of bore 8 is designed to attenuate the noise of the gas rushing through the tube 6. A wire 12, bearing insulation 13, extends from the free end of nipple 11 to a source of operating voltage, not shown, by way of a microammeter or equivalent means for testing the bioelectric resistance of the body if the apparatus is to be used for diagnostic purposes. A preferably flexible and electrically nonconductive hose 14 is fitted onto nipple 11 (omitted in FIG. 3) and extends to the discharge part of a compressor, storage tank or other source of gas (e.g., air) under a sufficient pressure to generate (e.g., desired suction within the cup-shaped lower part of housing 1. The gas pressure may be adjusted to a desired level by conventional regulating means likewise not illustrated.

Once the necessary suction has been created and the rim 2 of the cup is firmly seated on the skin of the body under test, the volume of air traversing the passage 15, 16 will be just sufficient to balance leakage losses. A small amount of electrolyte entrained with this air by the main flow through the tube 6 will be dispersed into the atmosphere at outlet 7 without creating any low-resistance current bridges between ground and the conductive housing part represented by electrode 5.

In practice, the rate of gas flow through the Venturi nozzle 9, 10 needed to maintain the desired subatmospheric pressure will be quite low. The orifice of insert 10 may have a diameter of about 0.25 mm.

It will be appreciated that parts of housing 1, other than electrode plate 5, could also be made of metal or other conductive material and that the sponge 4 is merely representative of a variety of means (such as, for example, reservoirs with restricted outlets) for storing a liquid electrolyte within the cup housing to provide the desired ionic contact.

I claim:

1. A contactor for establishing electric communication with organic tissue, comprising a generally cup-shaped housing consisting at least partly of conductive material, said housing having a mouth bounded by a tissue-engaging rim; storage means in said housing accessible through said mouth for maintaining a supply of liquid electrolyte in contact with the conductive part of said housing; conduit means leading from a source of high-pressure gas to the atmosphere, said conduit means forming a Venturi nozzle and being provided with a branch leading from said nozzle to the interior of said housing for creating in the latter a partial vacuum to hold said rim in contact with tissue engaged thereby while dispersing entrained liquid from said storage means into the open air, and conductor means extending outwardly from said conductive part for connection to an external circuit.

3

4

2. A contactor as defined in claim 1 wherein said conduit means comprises a tube rigid with said housing.

3. A contactor as defined in claim 2 wherein said conductive part comprises an electrode plate in said housing spaced inwardly from said rim, said plate having a hole forming part of said branch.

4. A contactor as defined in claim 3 wherein said tube is metallic and contacts said electrode plate on the side thereof opposite said mouth.

5. A contactor as defined in claim 4 wherein said conduit means includes a metallic nipple integral with said tube and

said conductor means comprises a lead tied to said nipple, said conduit means further including a hose fitted around said nipple and enveloping at least part of said lead.

6. A contactor as defined in claim 4 wherein said housing comprises an elastomeric shell surrounding said electrode plate and said tube.

7. A contactor as defined in claim 3 wherein said storage means comprises a sponge carried on a surface of said electrode plate confronting said rim.

* * * * *

15

20

25

30

35

40

45

50

55

60

65

70

75