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A MULTIPLE SUCTION ELECTRODE SYSTEM[1]

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Systems utilizing suction as a means of applying surface electrodes have been described by Blinn (1955) and by Tulley (1953).

The system to be described combines three valuable properties: it can be adapted to a large number of electrodes; it uses active rather than passive suction, so that the electrode will continue to hold, even when the vacuum is broken; and the electrodes will adhere to either skin or mucosa.

The system consists of electrodes and manifold.

An electrode is shown in Fig. 1. The two ends of this electrode are relatively permanent, and are made in a machine shop. The suction cup is made from a sterling silver jewelry bead[4], sawed in half (the edge carefully filed smooth), with a short piece of brass tubing inserted in the side. The tube-to-cup joint is sealed with silver solder. The inside of the cup acts as the end of the electrode. If the electrode is to be applied to a very moist flexible surface, such as the velum, a small stainless steel spring may be soldered into the electrode. This prevents the soft tissue from being sucked into the base of the cup, blocking the tube and breaking the suction. The electrode cup could be chlorided or gold-plated if it were necessary in a particular application.

The other end of the electrode is a lathe-made brass

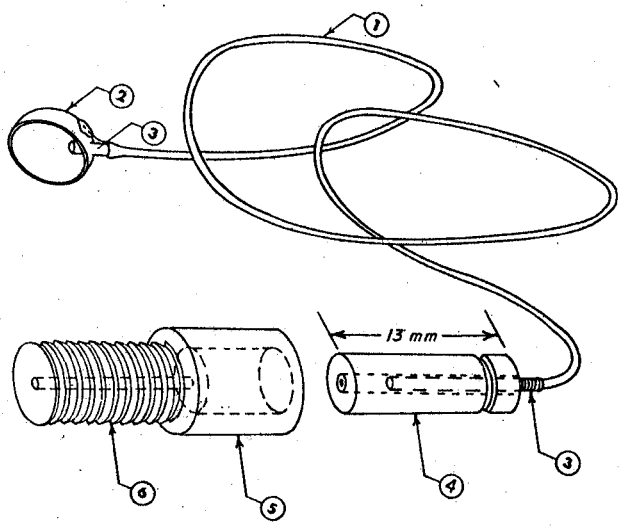

Fig. 1

Electrode and electrode plug receptacle. 1: 1 mm ID silicone tubing; 2: Half silver jewelry bead, 7 mm diameter (see footnote 4); 3: 1.5 mm OD brass tubing; 4: 4.5 mm OD brass plug; 5: 1 cm OD brass plug receptacle; 6: Fine-thread shank, to be screwed into manifold top plate, which should be drilled and tapped to match.

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[4] These are obtainable from Krieger and Dranoff, 44 West 47th Street, New York 36, N.Y. The type we use are 7 mm in diameter. A wide range of other bead sizes is available.

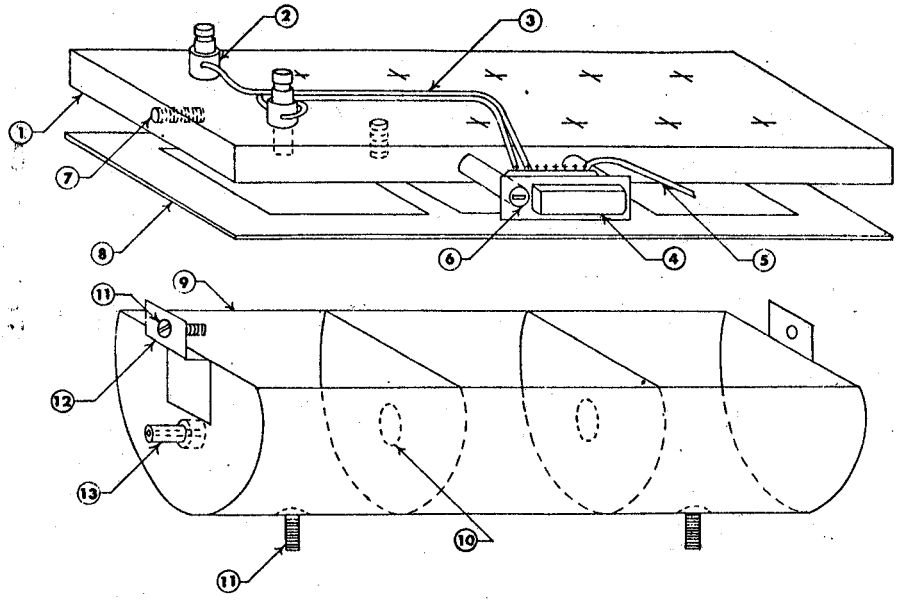

Fig. 2

Manifold top plate, gasket and trough. 1: Lucite top plate; 2: Electrode plug receptacles; 3: Lead wires to miniature connector; 4: Miniature connector; 5: Ground wire connected to trough ground; 6: Mounting for miniature connector; 7: Holes for top plate support; 8: Neoprene gasket, 1.5 mm thick; 9: Manifold trough, made of 1.5 mm gauge stainless steel; 10: Air passage holes; 11: Manifold mounting screws; 12: Top plate support; 13: Exhaust tube.

plug drilled to receive a piece of brass tubing, which is soldered into place. Extra "blank" plugs should be made, without a suction hole, to fill the plug receptacles in the manifold, when they are not in use. The tubing which connects the plug and the cup is silicone[1], threaded with conductive soft stainless steel wire[2]. A piece of silicone tubing of the desired length and a piece of stainless steel wire several inches longer are cut. One end of the wire is soldered to the outside of the electrode cup. The other end is threaded onto a blunted darning needle and fed through the tubing. This process is aided by feeding a little glycerine into the tubing with a hypodermic before threading. After the wiring, the end of the tubing is fitted over the protruding shank of the plug. The extra wire is then wound around the shank. Both the outside of the cup and the wire-wound shank are coated with nail polish to insulate them. This coating requires periodic renewal.

The manifold, shown in Fig. 2, contains on its top plate the electrode plug receptacles (a large view of an electrode plug receptacle is shown with the electrode in Fig. 1). The electrode plugs are sanded to fit the receptacles with a slip fit. If a leak develops between plug and receptacle, it can be remedied with a little vacuum grease.

The manifold may be fitted with any number of electrode plug receptacles and this number will determine the dimensions of the manifold.

The top of the manifold is made from a piece of 1 cm thick Lucite. It is drilled and tapped for the desired number of electrode plug receptacles, the top plate supports, and for the brass spacers which hold an Amphenol miniature connector. After tapping, the plugs are screwed in with a little vacuum grease to prevent leakage, and a covered stranded wire is soldered from each receptacle to the corresponding pin of the connector.

The manifold trough, shown in the lower part of Fig. 2, is made from stainless steel sheet. The ends and the supports are circles, truncated at the top. All joints are sweat-soldered to prevent leakage of the vacuum. Holes cut in the two center supports assure a continuous vacuum chamber inside the trough. A small piece of brass tubing is inserted into one end of the trough for the tube of the exhaust hose. Mounting screws in the bottom of the trough permit attachment to any convenient surface. There are also mounting brackets at the ends to accommodate the overhanging top plate. The top plate of the manifold is ground flat and fitted with a Neoprene gasket. The top plate is then screwed on.

To provide a vacuum, the manifold assembly is attached to a laboratory pump with thick-walled poly-

[1] We use "Vivosil" silicone tubing (0.030 in. ID) (Becton–Dickinson and Co.) obtainable through a medical supply house.

[2] Obtainable from International Wire Products Corp., 300 Greenwood Avenue, Midland Park, New Jersey. The description is 3 strand 0.003 in. type 304 soft stainless, very tight twist.

ethylene tubing. A five gallon laboratory flask, wood-encased for safety, provides a reservoir. A Bourdon gauge is attached to the system for convenience, although it is by no means necessary. The pump used should be one with a large pumping capacity, capable of providing a vacuum of close to one atmosphere at the electrode so that it will be possible to move one electrode without all the other electrodes falling off.

SUMMARY

A suction electrode system is described with the following properties:

1. It can be adapted to a large number of leads.
2. The electrodes will adhere to skin or mucosa.

We wish to express appreciation to Dr. Patti Grubb and Dr. Keith Hayes for work on the early development of this system.

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