

# A Surface Electrode Design for Myoelectric Control

by

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There is need for a simple, rugged, and versatile surface electrode to operate myoelectrically controlled hand splints or similar devices from innervated muscles. This type of equipment has been provided for six C4 and C5 quadriplegics who are fitted with Highland View Hospital Flexor Hinge Hand Splints. Our myoelectric control, provided with rechargeable batteries, drives the splint by means of an electric motor and flexible cable. This kind of electrode is easily applied by a parent

or attendant, and requires only some alcohol, adhesive tape, and electrode jelly.

The muscle sites available for obtaining useful signals in such patients are usually limited to those of the head, neck, or trapezius. We have had good results using either the right or left upper trapezius muscles, while Dr. James L. Cockrell of the University of Michigan, Ann Arbor, Michigan, has successfully used the platysma. The electrode must be located in such a position that normal head movements, eating, talking, etc., will not inadvertently actuate the device. It must also be flexible so it will conform to curved body surfaces.

Our electrodes are made up of three stainless steel buttons meas-

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uring 8 mm in diameter and 6 mm high, with small tips for soldering to the wires. The buttons are spaced 20 mm apart. These are

placed in a metal mold and encapsulated with Dow Corning Silastic No. 588, as shown in Figures 1, 2, and 3. To prevent the cable from

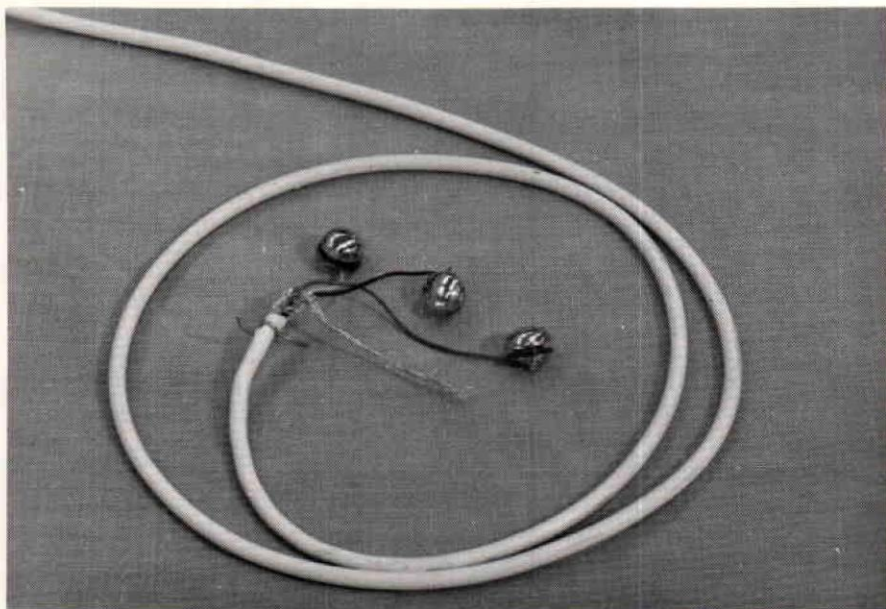


FIGURE 1.

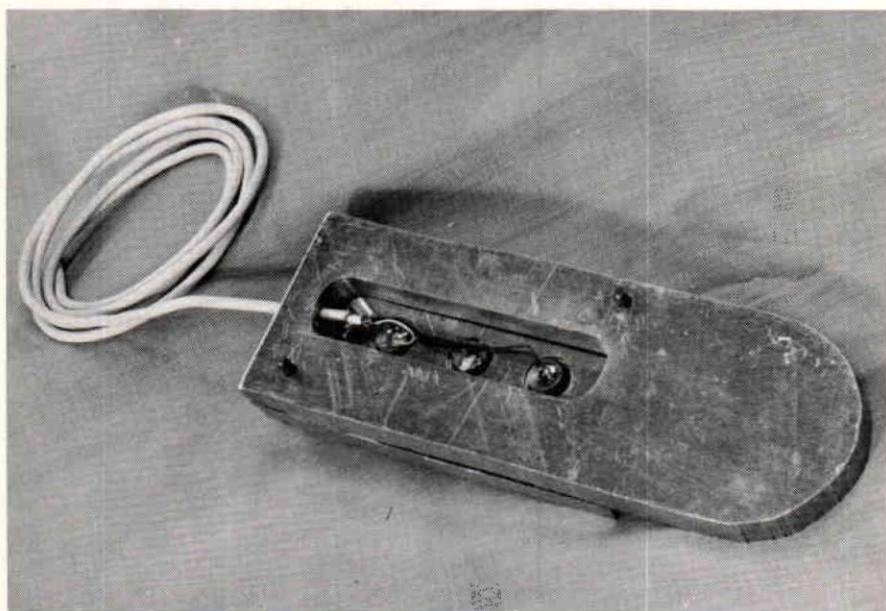


FIGURE 2.

pulling out, a loose knot is tied in the wire and the Silastic forms around this knot providing strain relief. A suitable cable plug, such as the Amphenol #126-217, is attached and securely fastened with the cable clamp.

In this form, the electrode can be taped to the shoulder, using Johnson & Johnson Elastikon Ad-

hesive, 1" wide. In addition, the ends of this tape are fastened to the skin with Johnson & Johnson Band-Aid Clear Tape.

At the suggestion of Dr. Cockrell, a collar was designed to adapt the same electrode to the platysma muscle. This is seen in Figures 4, 5, and 6. It is made of 1" webbing with a Velcro closure and an elas-

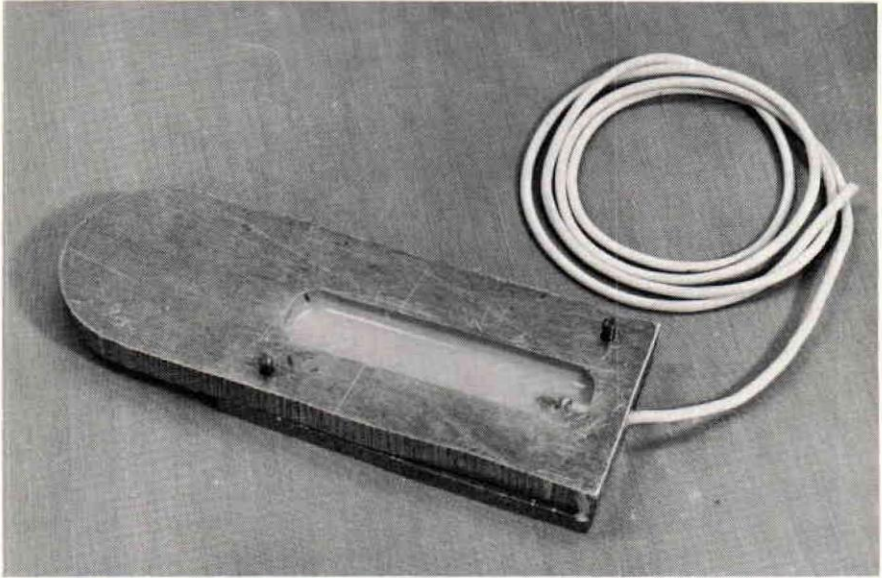


FIGURE 3.

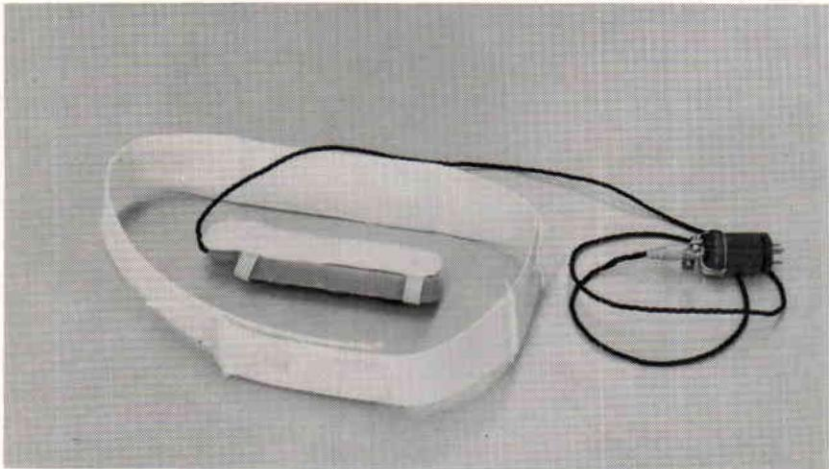


FIGURE 4.

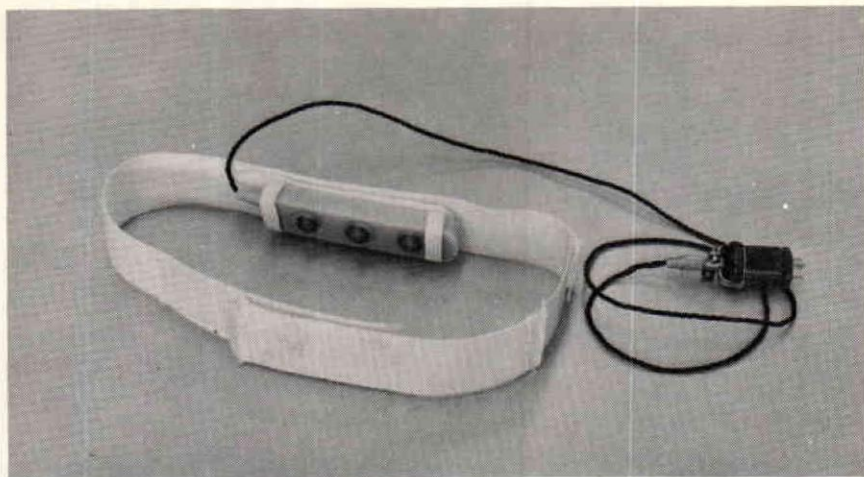


FIGURE 5.



FIGURE 6.

tic section. The Velcro strip that holds the electrode may be removed when the collar needs laundering.

Preparation of the skin surface and application of either of the two kinds of electrodes requires

only about three minutes. Signals are produced by the trapezius muscle by a slight shrugging of the shoulder; while the platysma is contracted by a motion similar to yawning, that is, an almost isometric contraction.

Various cables were tested, both shielded and unshielded, as shown in the photographs. Since no problems occurred with electrical interference using unshielded wire, 3-conductor tinsel hearing aid cord, type 14D70, made by Gavitt Wire and Cable Company is now used as shown in Figure 5. It is thin and inconspicuous, yet strong and very flexible.

Before applying an electrode, the skin site should be rubbed with alcohol and dried. A very good electrode jelly is Aquasonic 100 from Parker Laboratories, Inc., Irvington, New Jersey. This may be applied thinly to the skin and the dry electrode taped on quickly; or a drop of the jelly can be put on each of the buttons, instead. For use on the shoulder, stretch

three lengths of Elastikon tape, equally spaced, over the electrode and skin. The ends of the tape can be made to stick even better if they are taped down with the clear tape.

For use with the platysma, the same procedure is followed, except that the electrode is held against the neck with the collar and no tape is used.

Activities performed by patients at Highland View Hospital, using myoelectric control and surface electrodes, include eating, drinking from a glass, playing cards, us-

ing electric typewriter, operating telephone dials or push buttons, tape recording, brushing teeth, shaving, writing their name, removing objects from drawers or low shelves, underlining in school books, picking up small objects from a foam pad, and running a modified electric wheelchair. Of course, C4 patients cannot do all of these tasks.

These electrodes have been found to be effective, easy to apply, acceptable by both patient and family, and have caused no skin irritation.