

## Therapy

## Simple Device for Treatment of Hyperhidrosis by Iontophoresis

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A relatively inexpensive and easily constructed device for iontophoresis has at least one good clinical indication. This is in the treatment of palmar and plantar hyperhidrosis. Two or three treatments a week for about two weeks will usually induce an euhydrotic state, which can be maintained by treatment at intervals of one month or longer.

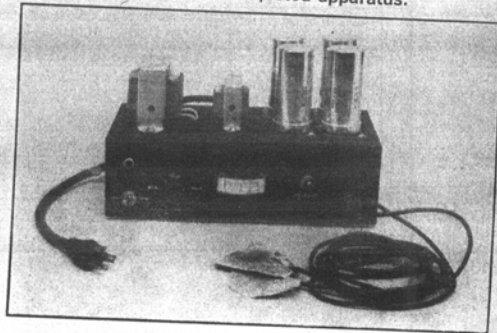
An iontophoresis machine is basically a direct current power supply which is able to pass a current of 15 to 20 ma through the patients extremities. Such a unit can be easily constructed from parts which are readily available from any electronics supply house.

THE TEXTBOOK indications for the use of iontophoresis in the treatment of skin disease have diminished from a dozen in 1946<sup>1</sup> to none in 1965.<sup>2</sup> There are at least two reasons for this attrition. Firstly, the method probably did not work in most of the conditions for which it was touted, and, secondly, the apparatus needed was expensive and not readily available. Research workers solved the apparatus problem for themselves by having special devices de-

signed and made to order. Clinical use of the method would depend on the purchase of a unit of the type used by physical therapists. These produce a variety of electric current forms in addition to the direct current which is used for iontophoresis, and are, consequently, expensive.

A simple and less expensive iontophoresis machine would be valuable if there were at least one good indication for its use. By "good indication" is meant a problem which brings a patient to the physician, which cannot be effectively treated by other methods, and which can be effectively treated by iontophoresis. Palmar, or planter hyperhidrosis is such an indication. Even potent sweat in-

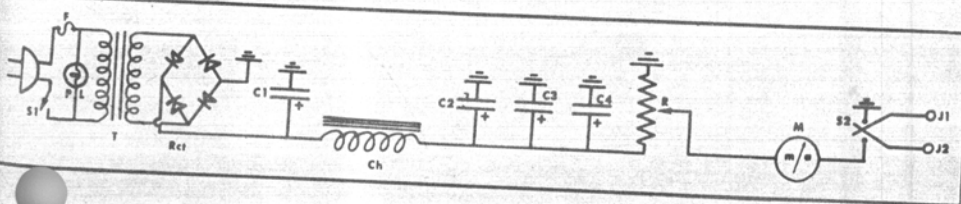
Fig 1.—The completed apparatus.



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Fig 2.—Circuit diagram. Parts required: S1, Single pole, single throw toggle switch. S2, Double pole, double throw toggle switch. C1, C2, C3, C4, Capacitor, electrolytic, 500 mf, 200 v. PL, Pilot lamp, neon, 110 v. T, Transformer, primary 115 v secondary 115 v. Rct, Rectifier, Selenium, full wave, 100 ma 130 v. Ch, Choke, filter, 3.5 Hy. R,

Rheostat, wire wound, 2500 Ohms, 25 watt. M, Milliammeter, 0-20 ma. J1, J2, Banana jacks. F, Fuse holder and fuse, one-half amp. Chassis, 3 X 7 X 5, and bottom plate, 5 X 7. Line cord, three wire type. Banana plugs and limp wire for output leads. Pointer knob and hookup wire.



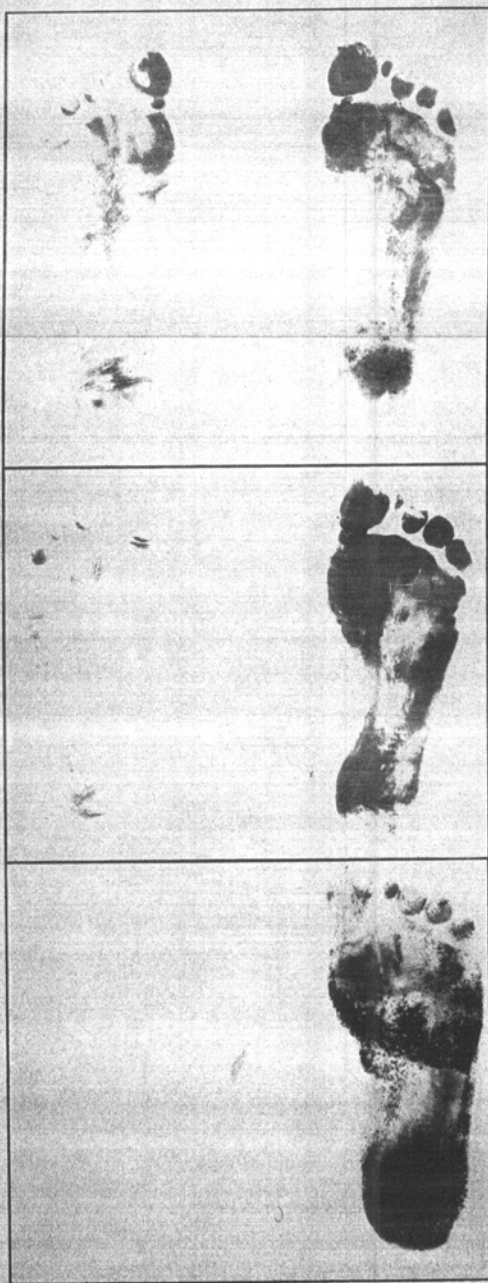


Fig 3.—Sweat prints of the feet of hyperhidrotic patient. Only the left foot was treated. Top row one week after three treatments given on alternate days. Middle row one week after a fourth treatment. Bottom row, one week after a fifth treatment.

hibiting chemicals which work very well on other areas of skin fail on the palms.<sup>3,4</sup> The side effects of orally administered anticholinergics, which may prevent the administra-

tion of doses large enough to produce euhidrosis, are well known.

The production of anhidrosis by iontophoresis with plain water was apparently independently described by Takata<sup>5</sup> and by Shelley.<sup>6</sup> The latter demonstrated that with increasing current density a sequence of effects could be produced ranging from no effect through partial anhidrosis, complete anhidrosis, complete anhidrosis with vesicle formation, to complete anhidrosis with bulla formation. He also noted that increasing the duration of the treatment increased the effect.

The mechanism of production of anhidrosis by iontophoresis has been studied by Dobson<sup>7</sup> and by Papa,<sup>8</sup> and appears to be an obstruction high in the sweat duct. Kuno<sup>9</sup> reports the production of palmar anhidrosis, lasting 30 days or more, following three or four iontophoresis treatments with 10% formalin solution. But, as he points out, Takata produced the same effects using just water. The water serves as a means of conducting the current from the electrode of the machine to the skin surface. Since the main factor limiting current flow is skin resistance, the exact electrolyte content of the water is of no significance. Tap water works well.

#### Construction

The iontophoresis machine (Fig 1) is simply a well filtered direct current power supply. It produces a voltage sufficient to drive a current of from 15 to 20 ma through the hands of most patients. The output of the 115 v isolation transformer is rectified by the full wave selenium rectifier and then filtered by the choke and capacitors. The potentiometer acts as a voltage divider. In the minimum position the moving contact is at ground potential and no voltage is developed at the output terminals. As the moving contact is advanced the voltage applied to the output terminals is increased and, if the circuit is completed by external resistance such as the patient, current flows through the meter and the output circuit. Because the anhidrotic effect is probably greater at the anode,<sup>6,10</sup> a polarity reversing switch is included in the output line so that either lead may be made the anode.

The parts used are all standard items



available from any electronics supply house. The device can be constructed easily from the circuit diagram by anyone who has ever built any kind of electronic device from plans (Fig 2). A three wire line cord must be used, the third wire being grounded to the chassis. The output is taken from the output jacks via a pair of limp wires which terminate in a pair of flat electrodes. A two-inch square of sheet lead soldered to the end of the wire does quite well for an electrode.

### Treatment

When a treatment is to be administered each electrode is placed in a shallow pan containing enough water to just cover the palms or soles. The machine is switched on with the potentiometer turned to the minimum position. The patient's hands or feet are placed in the pans, after any nicks or scratches have been covered with a little petroleum jelly, and the potentiometer slowly advanced. As the potentiometer is rotated, current begins to flow and this is increased until the patient feels some discomfort. Then the current is slightly reduced and permitted to flow for 10 to 15 minutes. Most patients readily tolerate currents of 15 to 20 ma. Too much current or too long a treatment period can produce vesiculation. If this happens a lower current setting or a shorter treatment time should be used.

At the end of the treatment period the current is slowly reduced to zero, and the patient can then remove his hands or feet and take a break. The polarity reversing switch is thrown, the patient reinserts his hands or feet and the current is again raised for a second period of 10-15 minutes. In this way each side is subjected to the action of the anodal current for half of the total treatment time. The current is then slowly reduced to zero and the patient can remove his hands. Current changes are always made slowly to avoid discomfort.

For the treatment of hyperhidrosis tap water iontophoresis is done two or, preferably, three times a week until sufficient diminution in sweating has been obtained. It is usually not necessary to produce total anhidrosis. An approximation of the euhidrotic state is the goal. Treatments can be repeated at whatever intervals are needed to maintain sufficient dryness. This is usually about

once a month, but may be somewhat less often.

The effectiveness of the method can easily be demonstrated by treating only one side. To do this a hand or foot is placed in the pan containing the anode and the diagonally opposite extremity is placed in the other pan. A decrease in the amount of sweating is then easily detected. Figure 3 shows the effect of treating the left foot of a hyperhidrotic patient. The starch paper and iodine method was used to show sweat formation.<sup>11</sup> Although simple soaking in water is known to produce diminution in sweating<sup>12</sup> the anhidrosis produced is of short duration, a 30 minute soak producing diminution in sweating for up to 1½ hours.<sup>13</sup> Anhidrosis lasting 10 to 14 days requires maceration for four to five days.<sup>12</sup>

Dr. Junji Hasegawa, of the Northwestern University Medical School, first suggested the possible clinical applications of this method to the author.

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