July 14, 1931. F. M. ENDE 1,814,791

DIATHERMY

Filed May 4, 1928

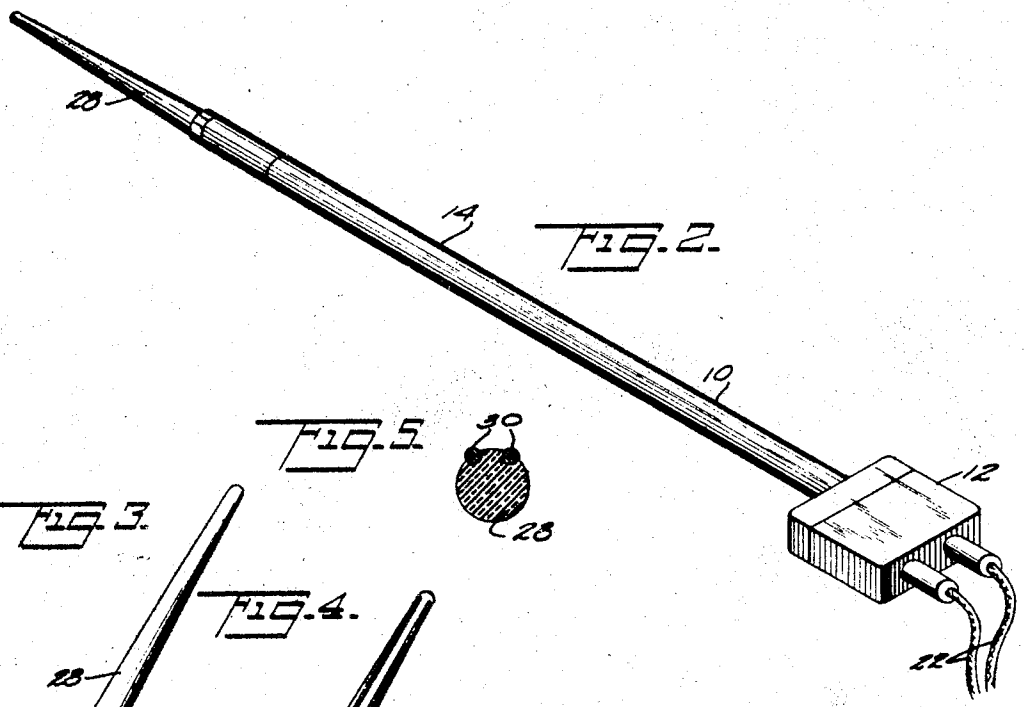


FIG. 2.

FIG. 5.

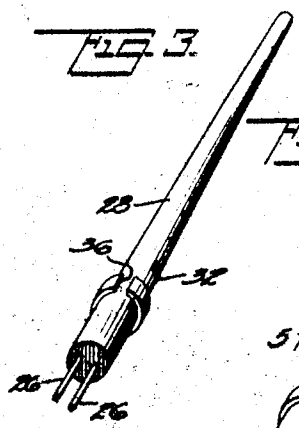


FIG. 3.

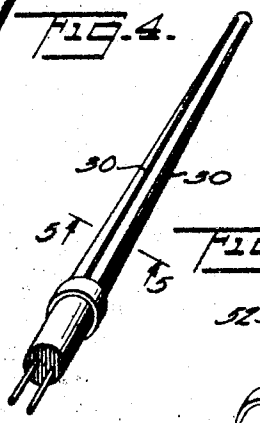


FIG. 4.

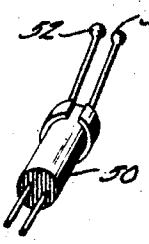


FIG. 6.

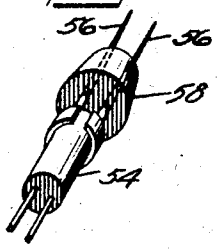


FIG. 7.

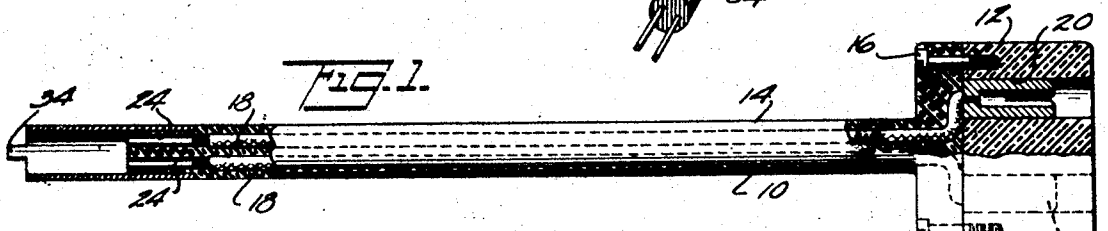


FIG. 1.

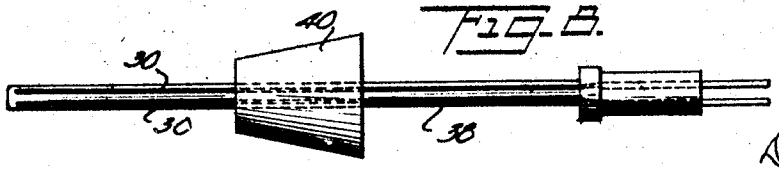


FIG. 8.

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Patented July 14, 1931 1,814,791

UNITED STATES PATENT OFFICE

FRANK M. ENDE, OF NEW YORK, N. Y.

DIATHERMY

Application filed May 4, 1928. Serial No. 275,154.

My invention relates to diathermy, and especially to an improved electrode and for producing localized coagulation of tissue.

In applying diathermy using the usual indifferent and active electrodes, the latter in contact with the part to be treated, and the former applied to the patient's buttocks or elsewhere, the degree of tissue destruction and the area actually destroyed is difficult to control with the certainty required to keep within the narrow limits permissible.

Causes for this are numerous. The electrical resistance between the inactive and active electrodes varies in different individuals and in different locations with a single individual. Changes and variations in the area of contact between the active electrode and the tissue to which it is applied produce corresponding variations in current density and cause the degree of tissue destruction to vary. Where the active work on tissue is out of sight, as, for example, in the cervical canal, the degree of destruction is beyond the control of the operator, because of his inability to see the area of coagulation as it forms, and application of diathermy treatment may result in areas of excessive destruction and resulting excessive scar tissue formation, and even in circular scar formation and resultant narrowing of the lumen of the canal (stricture).

I have discovered that very greatly improved and closely regulable results in respect of depth, extent, and uniformity of destruction of tissue can be obtained by making the application of the high frequency diathermy current to the tissue through a pair of active electrode elements of known size and known spacing, whereby the path of current from one to the other is confined to the strip of tissue between these electrodes, and use of an indifferent electrode is eliminated.

When the high frequency current is supplied by means of such electrodes connected to the poles of the diathermy machine, tissue destruction can be regulated over a definite area and in such closely controlled fashion as to obtain the best results for localized tissue destruction and for subsequent healing.

In the accompanying drawings, I have shown apparatus by which my invention can be carried into effect, but it is to be understood that same is only for the purpose of affording an understanding of the invention and not for imposing limitations thereon.

In said drawings, Fig. 1 is a longitudinal cross-sectional view of a handle for receiving a removable electrode tip. Fig. 2 is a perspective showing the handle of Fig. 1 with a cervical electrode tip in place therein. Figs. 3 and 4 are enlarged views of the cervical tip of Fig. 2. Fig. 5 is a section on approximately the line 5—5, Fig. 4. Figs. 6 and 7 are views of some of the numerous modified forms of tips that can be used; and Fig. 8 is a side view of a dummy tip.

Reference character 10 designates a handle comprising a plug 12 having a pencil or rod 14 connected thereto as by means of screws 16, and the spaced-apart insulated wires 18, 18 extending therethrough, and terminating at each end in jacks, the jacks 20, 20 at the plug end being adapted for connection of lead wires 22, 22 from the two poles of the standard diathermy machine, and the jacks 24, 24 at the other end adapted to receive wires 26, 26 projecting from removable tips, as the cervical tip 28, preferably made of molded insulating material which will not deteriorate when washed or immersed in antiseptic solution. The projecting wires 26, 26 communicate with the electrodes 30, 30 which are preferably partially imbedded in the lateral surface of the tip 28 so as to be spaced a uniform distance apart, preferably about 1/8". When tips containing these active electrodes are made of molded insulating material, the electrodes can be partially imbedded therein, except for the relatively small protruding portions, in the course of molding. The cervical tip 28 is preferably of tapered substantially pencil-like formation and is graduated, preferably in units of 1/4 inch, as indicated at 32, enabling the depth of the cervical canal to be measured by the graduations on the tip. The rod 14 can be provided with a spline 34 to enter a splineway 36 on the several tips adapted to

guide the projecting wires 26 into their jacks 24.

The electrical characteristics of current output from high frequency machines vary, and it is desirable with each machine to secure accurate data of its capacity for albumin coagulation inasmuch as the reading of the milliammeter with which all diathermy machines are equipped is merely a rough indication of the output and cannot be used as a basis of diathermy dosage.

From extended experimentation and observation, I have found that when the current of a machine is applied to the albuminous trial material hereinafter referred to for a sufficient length of time to show a white strip of coagulated material against the black background of the dummy tip (the dummy tip is black for this purpose), the application of the cervical tip to the cervical tissue for a like length of time will produce tissue destruction to the depth of about one millimeter, which is a desirable depth in practice.

In Fig. 8 of the drawings, I have shown what I prefer to call a "dummy tip" 38, which is like the tip already described except that it is substantially cylindrical throughout its length and is provided with an adjustable stop, which in the form shown consists of a perforated rubber stopper 40. The dummy tip 38 is preferably of dark colored or black molded insulating material and is graduated, preferably in quarter inches, like the tip 28, for convenient noting of the extent of protrusion beyond the stop 34.

With the depth of the cervical canal measured preliminarily by insertion therein of the cervical tip 28, same is removed from the handle 10 and replaced by the dummy tip 38, and the stop 40 adjusted to a position on the dummy tip to expose a length of active electrode equal to the length of the canal which has been measured. The measured protruding portion of such dummy tip is then preferably immersed in egg albumen to which has been added sufficient chloritone, or equivalent thereof, so that it will be preserved from decomposition and at the same time its electrical resistance is lowered to approximate the resistance of the cervical tissue.

The diathermy current is turned on and continued a sufficient length of time to coagulate a strip of albumin coming in contact with the dummy tip and lying between the two active electrodes to an extent to show white and entirely opaque against the black background of the dummy tip material. The time period of current flow for the accomplishment of this coagulation is gauged, preferably, by counting seconds. The output of the machine is then properly adjusted so that sufficient power is used to coagulate a one-inch strip in four seconds, so that other cases may be treated on a basis of one second exposure per quarter-inch length of time strip treated.

By making this test of a diathermy machine, I am enabled to determine the time factor for producing a given extent of coagulation of cervical tissue by the application of the machine output by means of the active electrodes of my cervical tip having the same exposed electrode area and spacing as in the dummy tip.

The cervical tip 28 with the electrodes parallel and spaced with relation to one another at a predetermined distance apart as described, which distance remains unchanged during use for tissue coagulation, is adapted for producing the destruction of the tissue along a strip line, the strip being of the length of the exposed portion of the electrodes that are in contact with tissue and of a width corresponding to their distance apart. The complete uniform application to the cervical canal, for example, may be made by producing a series of strip destructions of tissue or diffusely by rotation of the tip over a period of time which has been gauged in advance in the manner above described. It will of course be understood that when this gauging has been done for a given machine it is unnecessary to be repeated in its operation thereafter, if the ammeter is read with the tip short-circuited, though check gauging may, of course, be resorted to from time to time if deemed necessary. By short-circuiting for reading the shorted output on the ammeter, I am able to say that the machine in question will coagulate cervical canal one millimeter deep when exposed one second per quarter-inch of introduction if the machine is first shorted and the output adjusted so that the meter reading is identical with that obtained by shortening the machine immediately after its successful operation on albumin.

The spaced active electrodes for application of diathermy may be constructed or arranged in various ways according to the results desired to be accomplished. For example, in Fig. 6 I have shown a tip 50 with two ball-shaped electrodes 52, 52 projecting beyond its end, and these ball-shaped electrodes, which are preferably about $\frac{1}{8}$ inch in diameter, can be a somewhat greater distance apart than in case of the elongated electrodes of the cervical tip 28. This arrangement of electrodes is adapted for destruction of tissue on an exposed surface, such as the surface around the mouth of the cervical canal, for example.

Numerous other forms of active spaced electrodes may be made use of in accordance with my invention. In Fig. 7 I have shown the tip 54 having electrodes 56, 56 of needle form. These sharp-pointed needle electrodes are designed to perforate the tissue and may have a slidable collar back of their points,

as indicated at 58, so as to provide a stop to limit the extent of penetration. Electrodes of this type are of utility, for example, in connection with the step-by-step destruction of a ring of tissue surrounding a part or a neoplasm which is to be removed.

I claim:

1. Therapeutical apparatus for destruction of tissue by high frequency current comprising bipolar electrodes, means for supporting same at a predetermined distance from each other, which is a small fractional part of an inch, so that such distance remains fixed during use, means for connecting up said electrodes to complete the output circuit of a source of high frequency electrical current through tissue intervening between and in contact with the electrodes, and a non-conducting handle.

2. Apparatus as in the preceding claim, in which the electrode supporting means comprises a substantially pencil-like non-conductor, and the electrodes are arranged to extend substantially parallel along substantially the surface of said non-conductor.

3. Apparatus as claimed in claim 1 in which the bipolar electrodes are carried in a separable jack member whereby desired predetermined spacing and conformation of electrodes can be secured by jack replacement.

In testimony whereof, I have signed my name hereto.

FRANK M. ENDE.