

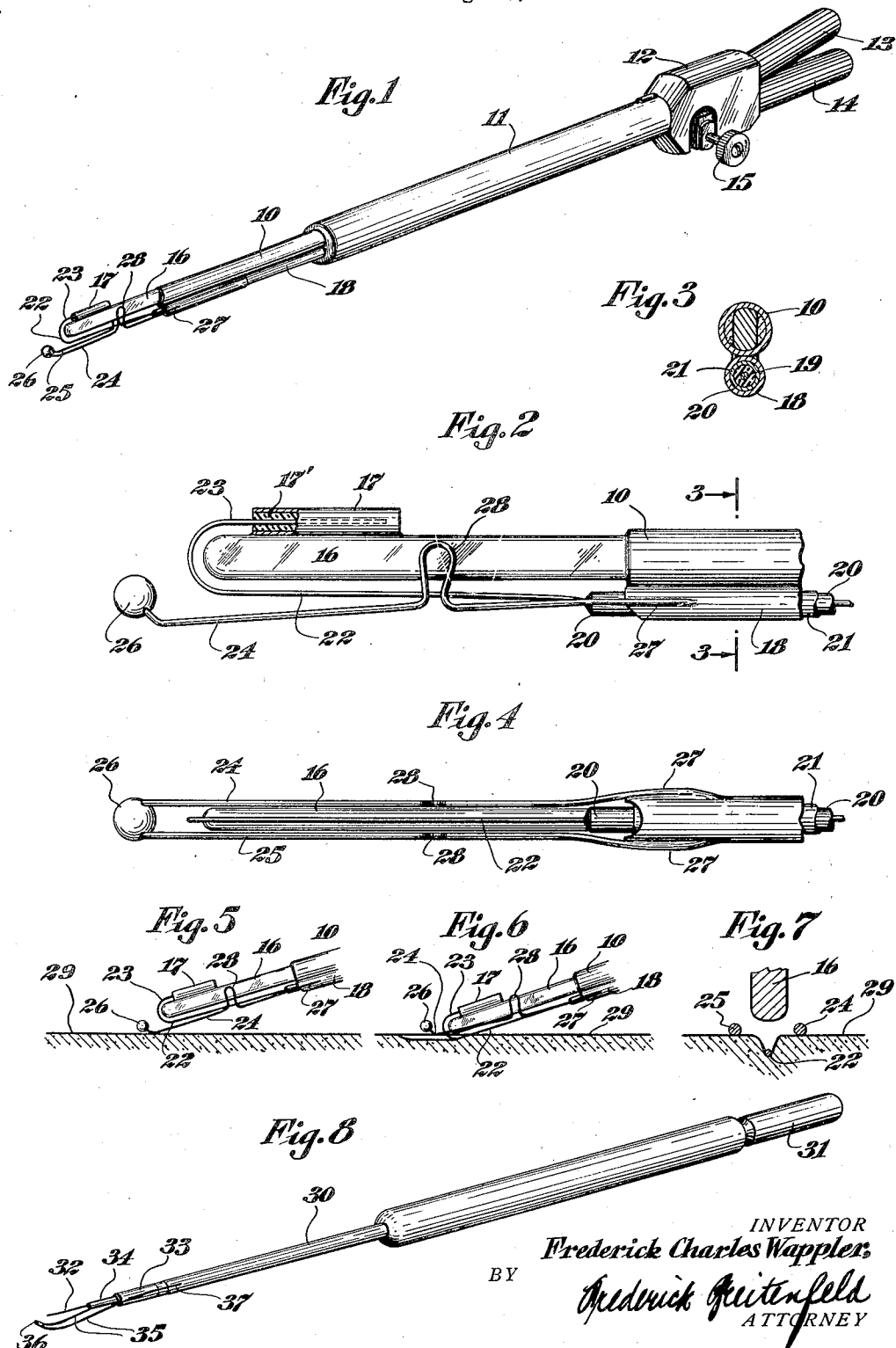
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ELECTRODIC INSTRUMENT

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ELECTRODIC INSTRUMENT

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My present invention relates generally to surgical instruments, and has particular reference to an improved type of electrodic instrument.

It is a general object of my invention to provide an improved device of the character which is used for supplying high-frequency current to the human body for surgical purposes, and, more particularly, for the purpose of passing a suitable cutting current through tissue. The novel characteristics of the present instrument render it more compact, more simple in structural nature, and of improved characteristics in effecting a practically hemostatic excision or cut through the portion of the body that is under treatment.

It is usual practice to connect an active cutting electrode to one terminal of a suitable source of high-frequency current, and to establish a suitable connection between another terminal of said source and a relatively indifferent electrode, the latter being usually of relatively large size and being connected to the patient at any convenient remote area. The passage of current from the generator through these electrodes, and through the body, causes a concentration of the current at the relatively attenuated point or area of contact of the active electrode, thereby effecting the desired cut.

It is one of the main objects of my invention to provide an instrument in which the passage of current through the body is limited in travel, and, more particularly, in which an indifferent electrode is mounted in relatively close association with an active electrode. With an arrangement of this character, and by employing a proper type of indifferent electrode, a cutting effect of improved characteristics may be achieved, and the indifferent electrode may itself be caused to produce a sort of coagulating effect which enhances the hemostatic character of the entire operation.

Briefly, my invention resides in the provision of an instrument in which a pair of mutually insulated electrodes are mounted in relatively close association at the forward end of a suitable elongated stem, means being provided for connecting the electrodes, respectively, to opposite terminals of a source of high-frequency current. One of the electrodes serve as an active electrode, and is so constructed and arranged that its contact with the body will produce a cutting effect; the other electrode is so constructed and arranged that it serves as an indifferent electrode with respect to the other one, and at the same time produces a coagulating or cooking effect which helps to improve the hemostatic nature of the operative procedure.

In the provision of an instrument of this general type, I have found it necessary and desirable to devise a means for assuring firm contact, with the body, of both electrodes simultaneously; because, if the indifferent electrode (whether it be arranged close to the active electrode or not) fails to maintain a firm contact with the body, the electric circuit is interrupted and the smooth continuous operation of the active electrode is impaired. With this objective in view, it is a feature of my present invention to provide a pair of electrodes which are so mounted in association with each other and in relationship to an elongated supporting stem, that the use of the active electrode is assuredly accompanied, at all times, by a firmly maintained contact between the indifferent electrode and the body of the patient.

A more particular feature of my invention lies in mounting one electrode in relatively rigid association with the stem, and in providing a relatively resilient, yieldable means for securing the other electrode to the stem, the electrodes being normally disposed in a divergent relationship, whereby the application of the rigid electrode to the body is necessarily coupled with a yieldable, sustained pressure of the other electrode against a closely adjacent portion of the body.

A further feature of my invention lies in constructing the yieldable electrode in a manner which permits it to accomplish a highly desirable coagulating effect upon the area which is cut by the rigid or active electrode. More particularly, the yieldable electrode is constructed in the form of a wire which lies alongside of the rigid electrode, so that the cutting action of the rigid or active electrode is accompanied, automatically, by a coagulative treatment of the area bordering the cut. In a preferred construction, the indifferent or yieldable electrode is composed of a pair of spaced wires arranged on opposite sides of the plane of the other electrode, so that the aforementioned coagulative treatment takes place along both marginal edges of the cut.

Other features of my invention will be more fully pointed out hereinafter, and lie in the particular arrangement and manner of association of the elements of the device. For example, in a preferred construction, the active electrode is mounted in a removable manner with respect to the instrument as a whole.

I achieve the foregoing objects, and such other objects as may hereinafter appear or be pointed out, in the manner illustratively exemplified in the accompanying drawing, wherein—

Figure 1 is a perspective view of an instrument

embodying the features of my present invention;

Figure 2 is an enlarged side elevation of the forward end of the instrument of Figure 1;

Figure 3 is a cross-sectional view taken substantially along the line 3—3 of Figure 2;

Figure 4 is a view of Figure 2, taken from the bottom;

Figure 5 is a view showing the manner of initially applying the operative end of the device to an area to be treated thereby;

Figure 6 is a view similar to Figure 5, showing the relationships of the parts during a cutting operation;

Figure 7 is a diagrammatic cross-sectional view showing the relationship of the electrodes during a cutting procedure; and

Figure 8 is a perspective view of a slightly modified type of instrument.

In Figure 1, I have illustratively shown an instrument in which an elongated stem 10 is composed of conducting material and has a body portion 11, adapted to be grasped by the operator, and a rear end 12 which carries a pair of binding posts 13 and 14 and a clamping arrangement 15. The binding post 13 is preferably in uninsulated relationship to the stem 10, but the binding post 14 is mounted in a manner whereby it is insulated from the stem 10.

At the forward end of the stem 10, I prefer to provide a rigid extension 16 with a longitudinal bearing portion 17 carried at the forward end thereof. This bearing portion, shown most clearly in Figure 2, is lined with insulating material 17'.

Extending along the stem 10 is a channel or tube 18 having its forward end positioned adjacent to the rear end of the extension 16, and having its body portion extending through the body 11 of the stem and terminating adjacent to the clamp 15 and in alignment with the interior of the binding post 14. This channel slidably yet snugly accommodates an elongated conductive member 19 (see Figure 3) which is ensheathed throughout most of its length with insulation 20 and with an outer sheathing 21 of metal. At its rear end, the conductive member 19 is bare of sheathing and is adapted to engage with the interior conductive portion of the binding post 14. When this association has been effected, the clamp 15, which includes a pair of complementary jaws, is adapted to engage the member 19 forwardly of its bare rear end so as to hold it in firm association with the stem of the instrument.

At its forward end, the conductive member 19 merges with the active electrode wire 22 which is substantially parallel to the extension 16 and is spaced from the latter. At the forward end of the electrode wire 22, the latter doubles back upon itself to form a rearwardly directed portion 23 adapted to be snugly accommodated within the insulation 17' of the bearing portion 17.

The electrode wire 22, and the conductive member 19 carried thereby, are thus removably applicable to the instrument as a unit. Its removal is accomplished by unloosening the clamp 15 and withdrawing the electrode forwardly, thus drawing the ensheathed conductive member 19 forwardly out of the tube 18. Its application to the instrument is accomplished in the reverse manner. It is to be observed that the electrode wire 22 is thus mounted in association with the stem in a relatively rigid manner. It is further to be noted that the electrode wire 22 is insulated from every portion of the stem but is nevertheless

in electrical connection with the interior of the binding post 14.

In the instrument illustrated, the electrode wire 22 is designed to serve as the active cutting electrode, and it will be understood that a suitable connection may readily be established between the binding post 14 and an active terminal of a suitable source of high-frequency current.

In accordance with my present invention, I mount at the forward end of the stem 10 a second electrode which I have illustrated in the form of two parallel spaced wires 24 and 25 united or joined at their forward ends, as, for example, by means of the ball 26. The rear portions of the wires 24 are springy and are soldered or similarly connected, as at 27, to the forward portion of the stem 10, or, more accurately, to the forward portion of the tube 18 which forms part of the stem assembly. Preferably, though not necessarily, the rear portions of the wires 24 and 25 are each provided with a loop portion 28 extending upwardly into slidable engagement with opposite sides, respectively, of the extension 16.

The electrode constituted of the wires 24 and 25 is, in the illustrated instrument, designed to serve as an indifferent electrode with respect to the active cutting electrode 22. This indifferent electrode, it is to be noted, is mounted in association with the stem in a relatively resilient and yieldable manner, as distinguished from the relatively rigid mounting of the cutting electrode 22. Normally, the indifferent electrode projects forwardly from the stem in a direction which forms a divergence with respect to the active electrode 22, this divergent forward relationship of the two electrodes being most clearly illustrated in Figure 2.

The indifferent electrode is not insulated from the stem 10, and is thus in electrical connection with the binding post 13, from which a suitable connection may be made, in any desired manner, with a corresponding indifferent terminal of the source of high-frequency current. The fact that the operator, in wielding the instrument, establishes a connection with the indifferent terminal of the current source, is immaterial.

The manner of using the present instrument, and the advantages achieved thereby, are most clearly illustrated in Figures 5-7. Assuming that a piece of tissue 29 is to be cut, the operative end of the instrument is first applied to the desired area in the manner illustrated in Figure 5. It will be observed that the divergent relationship of the electrodes causes the indifferent yieldable electrode to contact with the tissue 29, as shown in Figure 5. As yet, the active electrode is not in contact with the tissue. By pressing laterally upon the indifferent electrode, the parts are brought into the relationship of Figures 6 and 7. It is to be observed that the active electrode 22 travels downwardly through the space between the wires 24 and 25, and establishes contact with the tissue 29 as the indifferent electrode is yieldably pressed into the position shown in Figure 6. Further pressure upon the instrument permits the active electrode to enter right into the tissue, as a cut is effected. The desired cut may then be completed by simply moving the instrument in a longitudinal direction, preferably rearwardly; and when pressure against the tissue is released, the active electrode is withdrawn from the tissue first; and after the parts again assume the relationship of Figure 5, the indifferent electrode finally breaks contact with the tissue.

During the cutting procedure, a firm contact is necessarily maintained between the indifferent electrode and the body of the patient, and there is therefore a maintained assurance of smooth, continuous functioning of the active electrode. The current, as will be readily understood, passes through the cutting electrode, and through the adjacent tissue to the indifferent electrode, and thence back to the source of current.

By properly designing the indifferent electrode, a coagulating effect may be produced thereby, simultaneously with the cutting effect of the active electrode. Where the indifferent electrode is composed of two spaced wires, as shown, this coagulation takes place along the margins of the cut which is being produced by the active electrode. The coagulation of the borders of the cut is thus accomplished simultaneously with the making of the cut itself, and a highly efficient, thoroughly hemostatic, operative procedure is thereby capable of accomplishment.

It is further to be noted that the indifferent, yieldable electrode serves as a sort of guard which prevents the operator from inadvertently cutting too deeply into the tissue with the active electrode. In many instances, a guard of this character is highly desirable, since the cutting effect of the active electrode is so rapid that, without some sort of guard, an incision of too great depth might very readily be made, without realizing it. The guarding effect of the yieldable electrode is of further advantage in that it permits an extended cut to be made, of substantially uniform depth throughout, because the indifferent electrode necessarily slides along the surface of the tissue, and thereby constrains the active electrode to follow along a line which is substantially parallel to the contours of this surface.

During the operative procedure, the loops hereinbefore referred to, serve as efficient guides for the yielding retractive movement of the indifferent electrode.

In Figure 8, I have illustrated a slightly modified construction in which the stem is in the form of a tube adapted snugly to accommodate a rearwardly extending conductive member which connects at the rear of the stem with a binding post and which terminates at its forward end in the active electrode. It will be understood that the conductive member is suitably ensheathed in insulation, through the major portion of its length, and that the rear end of the conductive member is bare and is in direct electrical connection with the interior of the binding post. Preferably, near the forward electrode end the conductive member is ensheathed in a small, tubular element of quartz or the like which serves to add rigidity.

The indifferent electrode, in this embodiment, is again composed of two spaced wires connected at their forward ends, as at 36; and the rear portions of these wires are relatively springy and are connected, as at 37, to the forward end of the tube. The yieldable electrode constituted of the wires is normally in the forwardly divergent relationship to the active electrode 32, and, as in the previous embodiment, the two spaced wires lie on opposite sides of the plane of the active electrode. As in the previous embodiment, the wires are uninsulated from the stem, but the active electrode 32 is thoroughly insulated by virtue of the sheaths 33 and 34. The active electrode is, however, in electrical connection with the binding post 31.

The use of the instrument of Figure 8 involves

no separate connection between an indifferent terminal of the current source and the indifferent electrode wires 35, the circuit being sufficiently completed through the body of the operator who establishes a connection with the indifferent electrode whenever he wields the instrument, it being understood, of course that, as hereinbefore mentioned, the body of the stem is of conductive material.

While the electrode 32 of Figure 8 may be removably associated with the instrument, such removability is not essential; and in the embodiment of Figure 8, both electrodes are preferably associated in permanent relationship with the stem. However, the active electrode is, as before, secured to the stem in relatively rigid relationship, while the indifferent electrode is secured by means of a relatively resilient, yieldable mounting.

The manner of using the instrument of Figure 8 is substantially the same as hereinbefore described in connection with Figures 5-7, the indifferent electrode first contacting with the tissue, and then yielding to allow the active electrode 32 to travel downwardly through the space between the wires 35, and thence into operative contact with the tissue.

While I have consistently referred to the relatively rigid electrode as the "active" electrode, it is to be understood that the terms "active" and "indifferent" are merely relative, and that under certain circumstances it might be desirable to render the yieldable electrode effective in an "active" sense. I do not mean to limit myself to a manner of use whereby the relatively rigid electrode is necessarily the active electrode of the instrument.

Furthermore, it will be understood that the yieldable electrode is not necessarily constituted of two spaced wires, lying on opposite sides of the plane of the active electrode. Under certain circumstances, only one wire may be employed, the essential characteristic being that one of the electrodes is mounted in relatively yieldable and resilient relation to the stem, while the other one is relatively rigid, whereby the effects hereinbefore discussed may be accomplished.

It will also be understood that the entire instrument will probably be associated in some suitable manner with an outer endoscopic tube, and with an illuminating telescope or the like.

In general, it will be understood that the details herein described and illustrated, for the purpose of explaining the nature of my invention, may be made by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is, therefore, intended that these details be interpreted as illustrative, and not in a limiting sense.

Having thus described my invention, and illustrated its use, what I claim as new and desire to secure by Letters Patent is—

1. In an instrument of the character described, an elongated stem, an active electrode and an indifferent electrode diverging forwardly from said stem, means for insulating said electrodes from each other, relatively rigid means for securing the active electrode to said stem, and resilient, yieldable means for securing the indifferent electrode to said stem, the indifferent electrode comprising a pair of parallel wires arranged on opposite sides, respectively, of the plane of said active electrode, the forward ends of said wires being connected to each other, the rear ends of said wires being springy and being connected to

said stem, said yieldable means permitting a reduction in the degree of divergence when the indifferent electrode is pressed against the tissue to be treated.

2. In an instrument of the character described, an elongated conductive stem, a pair of electric binding posts mounted at the rear end of said stem, one of said posts connecting electrically with the stem, the other post being insulated from the stem, a pair of electrodes diverging forwardly from the front end of said stem, relatively rigid means for securing one electrode to said stem, resilient, yieldable means for securing the other electrode to said stem, and means for establishing an insulated electrical connection between one electrode and the insulated binding post, the other electrode being uninsulated from said stem and hence from said uninsulated binding post, said yieldable means permitting a reduction in the degree of divergence when the yieldable electrode is pressed against the tissue to be treated.

3. In an instrument of the character described, an elongated conductive stem, a pair of electric binding posts mounted at the rear end of said stem, one of said posts connecting electrically with the stem, the other post being insulated from the stem, a pair of electrodes diverging forwardly from the front end of said stem, relatively rigid means for securing one electrode to said stem, resilient, yieldable means for securing the other electrode to said stem, and means for establishing an insulated electrical connection between the rigid electrode and the insulated binding post, the yieldable electrode being uninsulated from said stem and hence from said uninsulated binding post, said yieldable means permitting a reduction in the degree of divergence when the yieldable electrode is pressed against the tissue to be treated.

4. In an instrument of the character described, an elongated conductive stem, an electric binding post mounted at the rear end of said stem in insulated relation to the latter, a pair of electrodes diverging forwardly from the front end of said stem, means for securing one electrode in relatively rigid and insulated relation to said stem, resilient, yieldable means for securing the other electrode in uninsulated relation to said stem, and means for establishing an insulated electrical connection between the rigid electrode and said binding post, said yieldable means permitting a reduction in the degree of divergence when the yieldable electrode is pressed against the tissue to be treated.

5. In an instrument of the character described, an elongated conductive stem, an electric binding post mounted at the rear end of said stem in insulated relation to the latter, a pair of electrodes diverging forwardly from the front end of said stem, means for securing one electrode in relatively rigid and insulated relation to said stem, resilient, yieldable means for securing the other electrode in uninsulated relation to said stem, and means for establishing an insulated electrical connection between the rigid electrode and said binding post, said last-named means comprising a conductive member connecting at the front with the rigid electrode and at the rear with said binding post, an insulating sheath around said conductive member, and means associated with the stem for accommodating said

ensheathed member, said yieldable means permitting a reduction in the degree of divergence when the yieldable electrode is pressed against the tissue to be treated.

6. In an instrument of the character described, an elongated stem, a pair of mutually insulated electrodes diverging forwardly from said stem, resilient, yieldable means for securing one electrode to said stem, said electrode constituting an indifferent electrode, the other electrode constituting an active electrode and comprising an uninsulated forward end and a rearward insulated extension projecting through the stem to the rear thereof, and means for removably securing the active electrode in relatively rigid association with said stem, said yieldable means permitting a reduction in the degree of divergence when the indifferent electrode is pressed against the tissue to be treated.

7. In an instrument of the character described, an elongated stem, a pair of mutually insulated electrodes diverging forwardly from said stem, resilient, yieldable means for securing one electrode to said stem, said electrode constituting an indifferent electrode, the other electrode constituting an active electrode and comprising an uninsulated forward end and a rearward insulated extension projecting through the stem to the rear thereof, and means for removably securing the active electrode in relatively rigid association with said stem, said means comprising a clamp secured to the stem at the rear thereof and adapted to engage the rear portion of said extension, said yieldable means permitting a reduction in the degree of divergence when the indifferent electrode is pressed against the tissue to be treated.

8. In an instrument of the character described, an elongated stem, a rigid extension on the front end thereof, a pair of mutually insulated electrodes diverging forwardly from said stem, one of said electrodes comprising a pair of spaced parallel wires connected at the front, the other electrode comprising a single wire arranged in a plane between said spaced wires, means for securing the two-wire electrode in resiliently yieldable relation to the stem, and means for securing the single-wire electrode in relatively rigid relation to said stem, said last-named means including an element carried by said extension and engaging the forward end of said wire, said yieldable means permitting a reduction in the degree of divergence when the two-wire electrode is pressed against the tissue to be treated.

9. In an instrument of the character described, an elongated stem, a rigid extension on the front end thereof, a pair of mutually insulated electrodes diverging forwardly from said stem, one of said electrodes comprising a pair of spaced parallel wires connected at the front, the other electrode comprising a single wire arranged in a plane between said spaced wires, means for securing the single-wire electrode in relatively rigid relation to said stem, a pair of springy arms for securing the other electrode in resiliently yieldable relation to the stem, and guiding means carried by said arms and engaging said extension on opposite sides of the latter, respectively, said yieldable means permitting a reduction in the degree of divergence when the yieldable electrode is pressed against the tissue to be treated.

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