United States Patent

Hildebrandt et al.

[15] **3,651,811**

[45] **Mar. 28, 1972**

[54] SURGICAL CUTTING INSTRUMENT

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[22] Filed: **Oct. 10, 1969**

[21] Appl. No.: **865,442**

[52] **U.S. Cl.** **128/303.17**, 128/305

[51] **Int. Cl.** **A61b 17/36**

[58] **Field of Search** 128/303.1, 303.13, 303.14, 128/303.15, 303.16, 303.17, 318, 305

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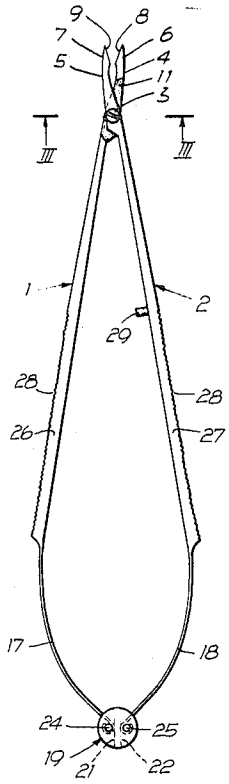
[57] **ABSTRACT**

A surgical cutting instrument that incorporates electrodes capable of coagulating or cauterizing a severed blood vessel at the same time that it is cut.

12 Claims, 10 Drawing Figures



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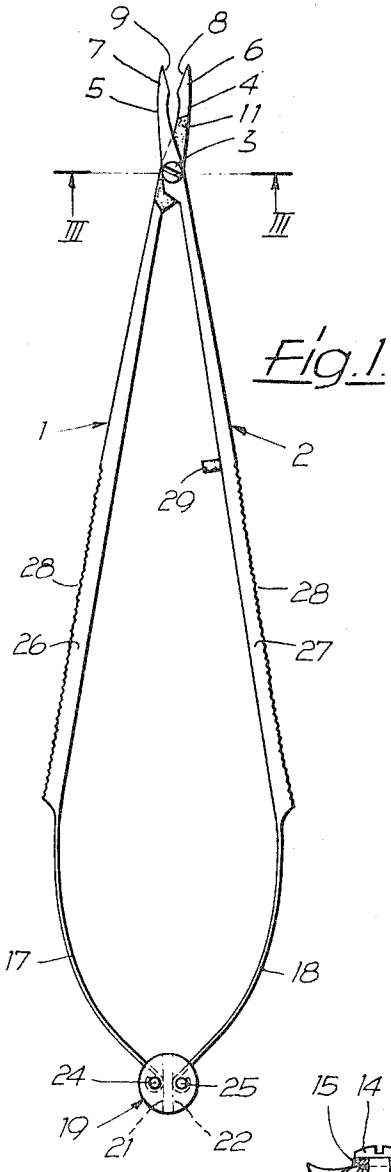

Fig. 1.

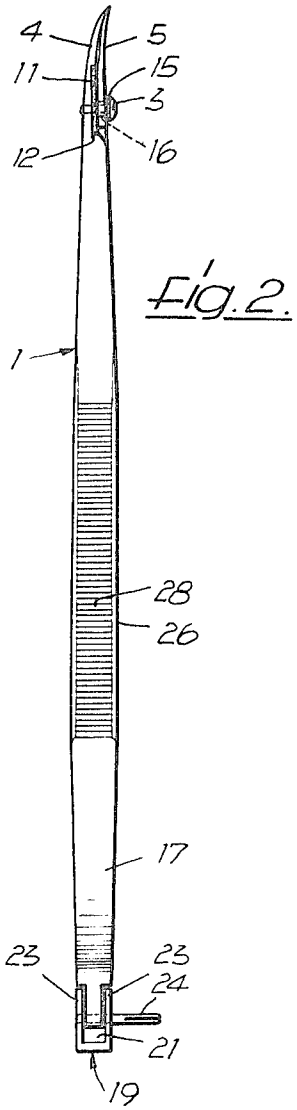

Fig. 2.

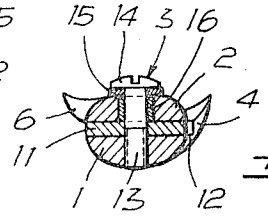

Fig. 3.

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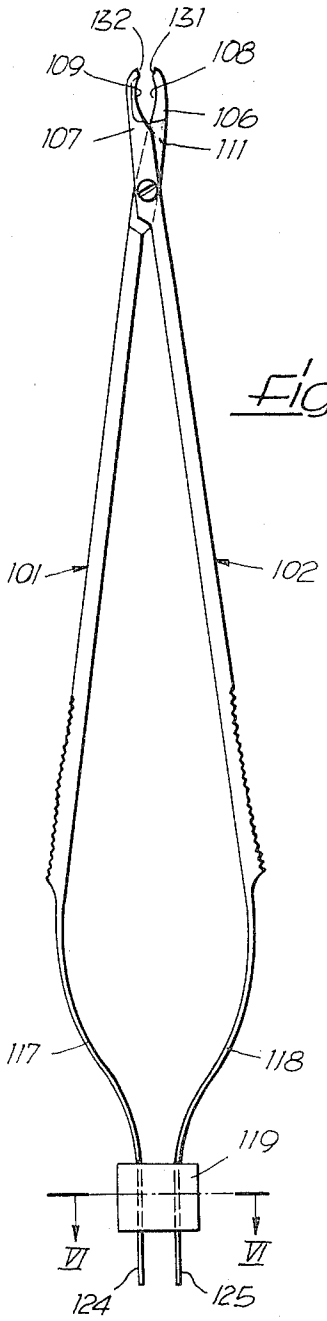

Fig. 4.

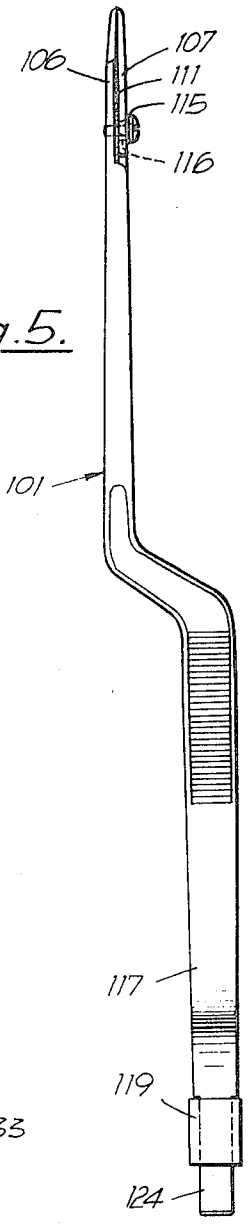

Fig. 5.

Fig. 6.

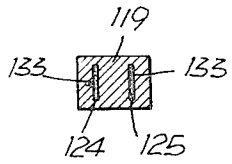

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Fig. 7.

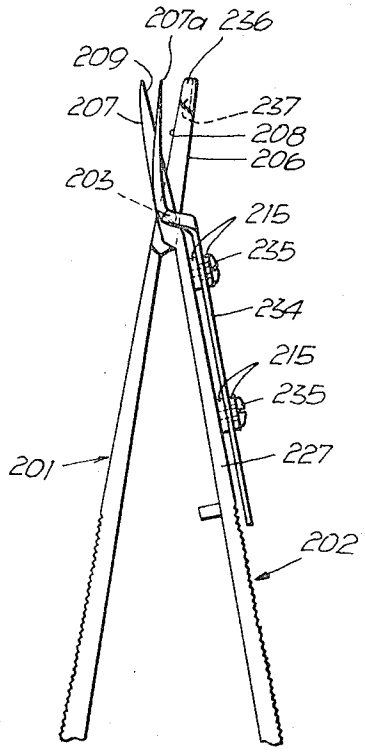
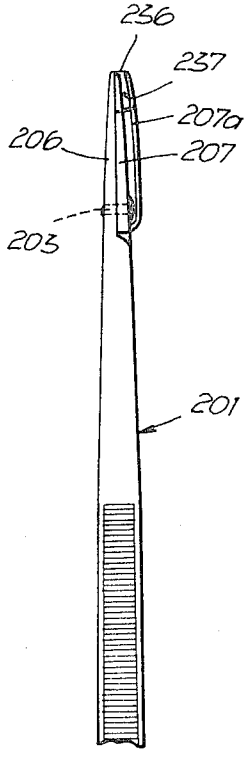


Fig. 8.



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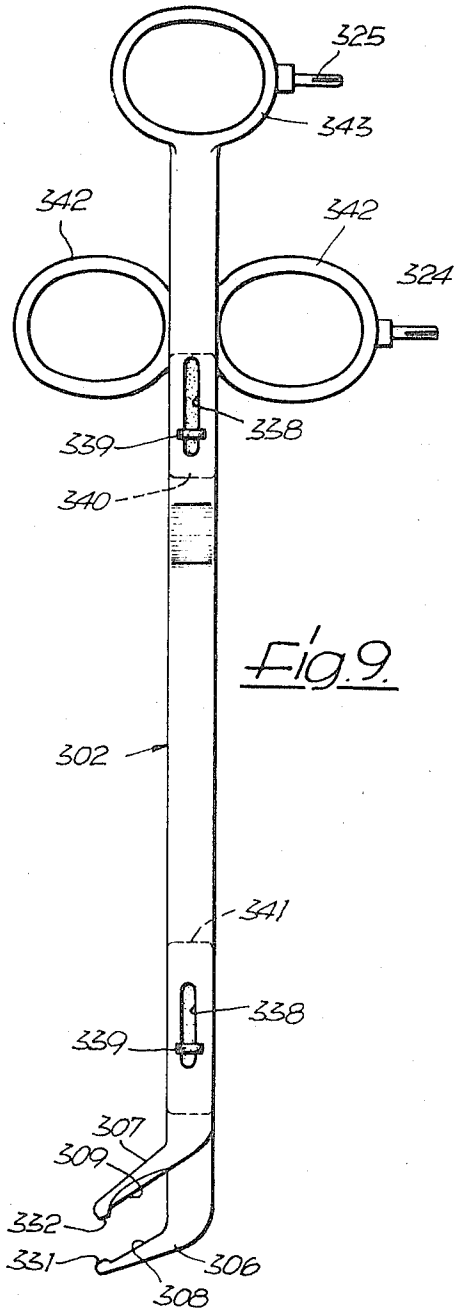

Fig. 9.

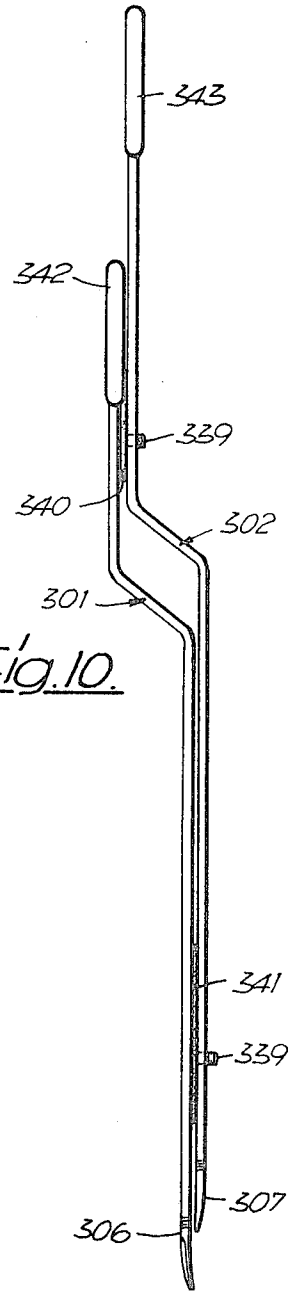

Fig. 10.

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SURGICAL CUTTING INSTRUMENT

This invention relates to a surgical cutting instrument with two cutting blades movable toward one another during cutting in scissor or knife-like fashion.

Surgical cutting instruments of this kind are known in a wide range of embodiments as scissors and knives, for instance as instruments for valvulotomies, commissurotomies, or the like. If these cutting instruments are being used for the sectioning of blood vessels, the blood vessels must subsequently be closed. To this end, it is known to connect the cutting instrument to one pole of a current source the other pole of which is connected to the patient's body. The moment the vessel has been cut through by the cutting instrument, the current source is connected. It then suffices to contact the severed blood vessel with the cutting instrument in order to close it by means of coagulation. It is also possible to achieve the coagulation upon cutting with a knife, simultaneously with the cutting. These surgical processes are however possible with larger blood vessels only. In micro-vessel surgery and in neurosurgery, these monopolar coagulation processes cannot always be used because the electric currents required to achieve coagulation are comparatively substantial and, in addition, all fabrics and vessels coming in contact with the instrument are coagulated as well which, in case of the coagulating of small vessels and in particular with coagulations in the area of the brain, the marrow and the jaws, may result in major complications.

For this reason, one uses in such cases bipolar coagulation forceps the two legs of which are electrically insulated from one another and can be connected to the two poles of a current source, thereby coagulating only what is being encompassed between the forceps arms. The use of these coagulation forceps is however quite cumbersome in view of the fact that the operating surgeon must, following coagulation of the blood vessel, remove the forceps from the operating area and subsequently use the cutting instrument, for instance a pair of scissors. The result is not only a time delay of the operation, which ought to be avoided at any cost, but also an increasing of the infection hazard. Besides, in micro-surgery, the introduction of a second instrument into the most narrow areas viewed under the microscope is extremely difficult.

It is the object of the invention to remedy this situation and to create a surgical cutting instrument by means of which the coagulation can be achieved without hazard of damage to the patient and without any need for the interchanging of instruments.

This object is achieved in the case of a surgical cutting instrument of the aforementioned kind in accordance with the invention in that there is provided an electrode electrically insulated from the first cutting blade and, to form two coagulation electrodes to achieve a bipolar coagulation, the first cutting blade and the electrode can be connected to the poles of an electric current source. The result is that the surgical instrument constitutes at the same time an instrument for bipolar coagulation, by means of which the vessel can be severed during bipolar coagulation or shortly thereafter, and consequently there is no need to interchange the instrument or to introduce a second instrument to the coagulated point.

With a preferred embodiment of the invention it may be provided that, for the purpose of forming the electrode by means of the second cutting blade, the latter is electrically insulated from the first cutting blade. The result is a preferred design of the instrument that differs little in appearance or function from standard cutting instruments thereby exhibiting all the benefits of the latter and nevertheless permitting a bipolar coagulation.

By means of suitable insulation, the invention can be used with practically all conventional surgical cutting instruments having two cutting blades movable with respect to one another.

The applicabilities of the invention are not limited to micro-surgery in view of the fact that it is advantageous also in the case of macro-surgery to cause a coagulation to take place only between the parts forming the electrodes and not, as in the case of the known monopolar process, at all those points where the instrument constituting as a whole the one electrode contacts parts of the patient's body and coagulates or damages them.

The invention is explained in detail below in the following description of four exemplified embodiments illustrated in the drawings of surgical scissors in accordance with the invention.

In the drawings:

FIGS. 1 and 2 show an elevation and side view, respectively, of the first exemplified embodiment;

FIG. 3 shows a cross-section, on an enlarged scale, along line III—III of FIG. 1;

FIGS. 4 and 5 show an elevation and side view, respectively, of a second exemplified embodiment;

FIG. 6 shows a cross-section, on an enlarged scale, along line VI—VI of FIG. 4;

FIGS. 7 and 8 show a partial elevation and side view of a third exemplified embodiment; and

FIGS. 9 and 10 show an elevation and side view of a fourth exemplified embodiment.

The first exemplified embodiment of a pair of surgical scissors illustrated in FIGS. 1 to 3 shows a first scissor leg 1 and a second scissor leg 2 pivotally interconnected by means of the closing screw 3 of the pair of scissors, around the axis of said screw. The two cutting arms 4 and 5 of the two scissor legs 1 and 2 are designed at their free ends as cutting blades 6 and 7 in such a way that they will touch one another with their cutting edges 8 and 9, respectively, upon closing of the scissors only.

The two scissor legs 1 and 2 are electrically insulated from one another. To this end, an insulating plate 11 has been provided at the joint of the scissors between the two legs 1 and 2 of the scissors, which is fastened in a recess 12 of the first leg 1 of the scissors and which contains substantially in its center a bore for the shaft 13 of the closing screw 3 fastened with its thread in a taphole of the first leg 1 of the pair of scissors.

The closing screw 3 passing with its stem 13 through a bore of the second leg 2 of the scissors is electrically insulated from the second leg 2 of the scissors, by the fact that between the head 14 and the stem 13 of the closing screw 3, on the one hand, and the second leg 2 of the scissors, on the other, there has been provided an electrically insulating washer 15 or an electrically insulating sleeve 16.

The ends of the legs 1 and 2 opposite the cutting blades 6 and 7 are designed as flat springs 17 and 18, respectively, and joined at their free ends by a disk-shaped insulating head 19. For this purpose, the insulating head 19 is provided with two recesses 21 and 22, respectively, for engaging the free ends of the flat springs 17 and 18, these recesses having the shape of circle segments in a plane parallel to the flat faces of the disk 19, and being laterally defined by the flanges 23 forming the faces of the insulating head 19. In each of the flanges 23 there have been provided bores adjacent to one another as shown in FIG. 1, in which are fitted pins 24 and 25 to which the ends of the flat springs 17 and 18 are firmly connected within the recesses 21 and 22.

The handles 26 and 27 of the scissor legs 1 and 2, designed at their ends as flat springs 17 and 18, are provided with knurlings 28 along their sides facing away from one another. To prevent the contacting of the two handles 26 and 27 upon cutting with this pair of surgical scissors, thereby causing a short-circuit, a projecting electrically insulating pin 29 is attached to the side of the handle 27 facing the handle 26.

The moment the two pins 24 and 25 are inserted into the contact recesses of an electric socket connected to a power source, the two scissor legs 1 and 2 and hence also the two cutting blades 6 and 7 form two electrodes that are electrically insulated from one another. If, in the course of a surgical operation, a vessel is to be severed by means of the blades 8 and 9, there then occurs a coagulation between the two blades 8 and 9 the moment said blades touch the vessel to be severed. To that end, the voltage of the current source can be selected in such a way that a coagulation will occur only at the moment

when the distance of the two electrodes is as great as the distance of the two blades **8** and **9** during the surgical operation so that a contacting of other parts of the patient by parts of the two scissor legs **1** and **2** that are further apart will not cause any coagulation or damage to the patient.

To avoid repetitions in the description of the subsequent exemplified embodiment, the parts in the drawing corresponding to those of the first exemplified embodiment are designated by reference digits increased in each case by 100 so that, through this assigning of said digits in the description of the following exemplified embodiments, reference is had to the first exemplified embodiment.

In the case of the second exemplified embodiment illustrated in FIGS. **4**, **5** and **6**, the two scissor legs **101** and **102** are insulated with respect to one another in like manner by an insulating plate **111**, a washer **115**, and a sleeve **116**. The essential difference of the second exemplified embodiment, as compared with the first, is that projections **131** and **132** respectively have been provided at the free ends of the blades **108** and **109** of the cutting blades **106** and **107**, respectively, which for the purpose of forming the coagulation electrodes proper upon the closing of the scissors, will clamp the tissue to be coagulated, before the edges **108** and **109** become effective. One reliably achieves, as a result, that the coagulation will occur prior to the actual cutting.

Another characteristic by which the second exemplified embodiment differs from the first resides in the fact that, in this case, the insulating head **119** is designed as a parallelepiped and that the ends of the flat springs **117** and **118** passing through the slots **133** of the insulating head **119** form flat pins **124** and **125**.

If the second exemplified embodiment of the pair of surgical scissors according to FIGS. **4** to **6** is used in a surgical operation, the tissue to be cut, for example a vessel, is first clamped between the projections **131** and **132** of the cutting blades **106** and **107** and thus coagulated. Only after coagulation has occurred is the vessel cut by means of the edges **108** and **109**.

In the case of the third exemplified embodiment of a pair of surgical scissors according to FIGS. **7** and **8**, the two scissor legs **201** and **202** are, in customary manner, pivotally interconnected by the closing screw **203**, one in metal-to-metal contact with the other and, as a result, not electrically insulated from one another. In order to achieve nevertheless a bipolar coagulation in this case, there has been provided an electrode **207***a* that is electrically insulated from the pair of scissors and is formed by the free end of a flexible spring **234** connected by means of two screws **235** to the handle **227** of the second scissor leg **202**, which are firmly screwed down in tapholes of the handle **227** and are insulated from the flexible spring **234** by insulating washers **215** and by insulating sleeves (not shown) corresponding to the sleeve **16** of the first exemplified embodiment. For purposes of cooperation of the electrodes **207***a* with the cutting arm of the scissor leg **201**, said cutting arm forming in this instance the cutting blade **206**, there has been provided a lateral projection **236** at the free end of the cutting blade **207** of the second cutting arm **202** a groove-like recess **237** for the second cutting blade **207**. The free end of the flexible spring **234** forming the electrode **207***a* is bent in such a way that it will contact the projection **236** upon the closing of the pair of scissors before the free ends of the edges **208** and **209** have come in contact with one another.

During a surgical operation, the tissue to be severed is first clamped between the electrode **207***a* and the projection **236** and coagulated because the electrode **207***a*, on the one hand, and the scissors, preferably the first scissor leg **201**, on the other, are connected with the two poles of a current source. The cutting will then occur subsequent to said coagulation only. This third embodiment offers the advantage that the coagulation point is situated in the direction of the swivel axis of the two scissor legs next to the cutting point so that, upon cutting, it is not the coagulation point itself but a point situated next to it that is being severed.

In the case of the fourth exemplified embodiment of the surgical scissors illustrated in FIGS. **9** and **10**, the two scissor legs **301** and **302** are, by means of insulating pins **339** attached to the first scissor leg **301** and slotted holes **338** in the second scissor leg, interconnected in such a way that they are not pivotally connected but are axially slidable. To keep the two scissor legs **301** and **302** at a distance from one another and to insulate them electrically from one another at the same time, there have been provided electrically insulating sliding elements **340** and **341** between the legs next to the slotted holes **338**.

At one of their extremities, the two scissor legs **301** and **302** are provided with cutting blades **306** and **307**, respectively, laterally projecting in the same direction as seen in FIG. **9**, which have edges **308** and **309**, respectively, corresponding to the edges **108** and **109** of the second exemplified embodiment, at the free ends of which there have been provided projections **331** and **332**, respectively, to form coagulation electrodes.

At the opposite ends of the two scissor legs **301** and **302**, finger grips have been provided. In this embodiment the scissor leg **301** has been designed to be somewhat shorter than the scissor leg **302** and is provided with two laterally projecting finger grips **342**, while the somewhat longer second scissor leg **302** is provided at its end with only one finger grip **343**. At one of the two finger grips **342** and at the finger grip **343** there have been provided electrical contact pins **342** and **325**, respectively.

In the case of the first two exemplified embodiments according to FIGS. **1** to **6** there has been provided a metal closing screw **3** or **103**, respectively. Said closing screw may however consist also of an insulating material, for instance a polyamide. In such a case there is required for insulating purposes between the two scissor legs **1** and **2**, or **101** and **102**, only the insulating plate **11** or **111**. In lieu of a closing screw there may also be provided a rivet.

What is claimed is:

1. A combination cutting and coagulating surgical instrument for use in microsurgery which comprises:

a. a pair of cutting members movable with respect to one another adapted to perform a cutting function;

b. insulating means to electrically insulate each of said pair of cutting members from one another;

c. a pair of connecting means one being provided for each of said pair of cutting members, each of said connecting means being adapted to be connected to the respective pole of an electric current source and thereby form a pair of coagulation electrodes at said cutting members for bipolar coagulation when each of said connecting means is connected to the respective poles of an electric current source.

2. A surgical instrument according to claim **1** wherein each of said pair of cutting members is pivotally mounted with respect to one another and include handle means extending therefrom, said handle means being in the form of a leaf spring which cooperate with one another.

3. A surgical instrument in accordance with claim **2** which further includes a lateral projection on one of said handle means and wherein a cooperating recess is provided in the other of said handle means to receive said projection when said handle means are brought toward engagement with one another.

4. A surgical instrument in accordance with claim **1** wherein said pair of cutting members are in the form of cooperating cutting blades pivotally mounted with respect to one another so as to operate in a scissor-like manner, and wherein said insulating means comprises an insulating plate interposed at the pivot point between said pair of cutting blades.

5. A surgical instrument in accordance with claim **4** which further includes a screw means for pivotally mounting said pair of cutting blades, said screw means including a head, a bearing surface adjacent said head, and a threaded portion at the lower end thereof, said screw being threadedly fastened to the cutting blade engaged with the lower end thereof while the

other cutting blade is pivotally supported about said bearing surface, and an insulating means interposed between the screw head and said other cutting blade so as to provide additional insulating means between said pair of cutting blades.

6. A surgical instrument in accordance with claim 4 wherein one of said cutting blades include a recess therein adapted to accept said insulating means.

7. A surgical instrument in accordance with claim 2 wherein said cutting members are in the form of cutting blades which contact one another only at their edges upon closing.

8. A surgical instrument in accordance with claim 7 wherein the edges of said cutting blades are shaped such that they will upon cutting contact one another first at their free ends.

9. A surgical instrument in accordance with claim 8 wherein the free end of at least one of said cutting blades includes a projection thereon adapted to clamp the tissue to be coagulated upon closing prior to said cutting blades contacting one another.

10. A surgical instrument in accordance with claim 1 wherein said cutting members are pivotally mounted with respect to one another so as to form scissor like cutting legs having handle portions extending therefrom, said handle portions being divergently disposed with respect to one another after the pivotal connecting point, spring members at the free end of said handle portions converging toward one another so as to meet upon closing thereof, and an insulating head interposed between said mating spring members upon closing thereof.

11. A surgical instrument in accordance with claim 10 wherein said insulating head is in the form of a plug.

12. A surgical instrument in accordance with claim 10 wherein said pair of scissor-like cutting legs are interconnected so as to be axially displacable with respect to one another, and which further includes slidable insulating elements adapted to electrically insulate each of said scissor-like cutting legs from one another.

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