

[54] PROCESS FOR LIGATING SECTIONED BLOOD VESSELS

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[52] U.S. Cl. .... 128/326

[51] Int. Cl. .... A61b 17/12

[58] Field of Search..... 128/325, 326, 327, 334 R, 128/320, 303 A, 305

[56] References Cited

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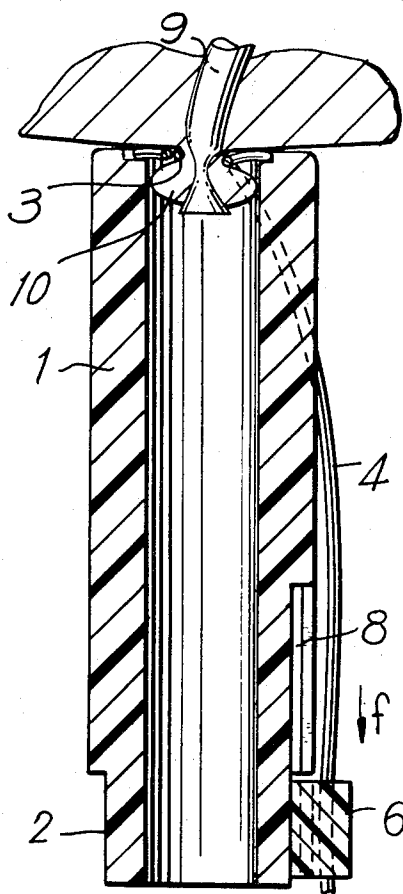
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Attorney, Agent, or Firm—Waters, Roditi, Schwartz & Nissen

[57] ABSTRACT

A process for ligating sectioned blood vessels comprising applying a cylindrical body adapted for removable attachment to a suction source against the end of a sectioned vessel and the tissue zone there surrounding to effect simultaneously the elimination of blood and the formation within the cylindrical body of a tissue bud containing the end of the vessel, and thereafter applying a ligature member to the tissue bud at the base thereof, while still applying the suction force, to close the vessel end. The closure member can be a loop of ligature thread which is supported at the open end of the cylindrical body and which is applied to the tissue bud by acting on an external actuator. The closure member can also be a metal clip which is initially supported within the cylindrical body and is deformed and clamped at the base of the bud by acting on an external actuator.

3 Claims, 19 Drawing Figures



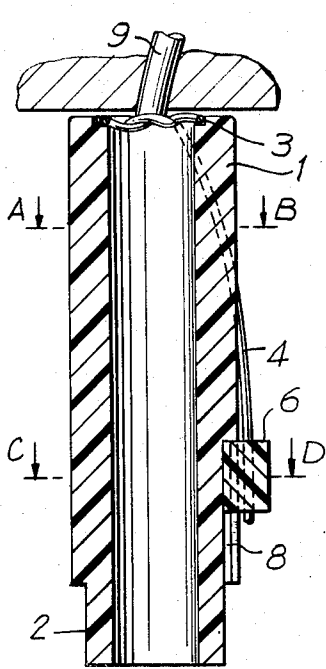


FIG. 1

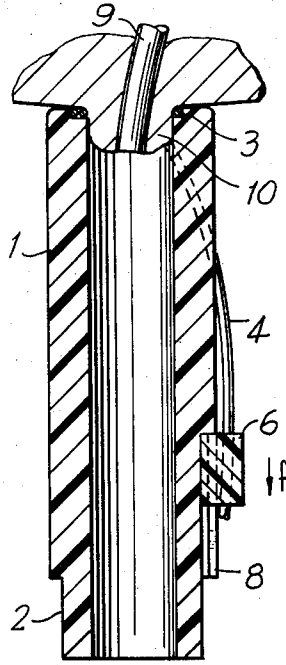


FIG. 2

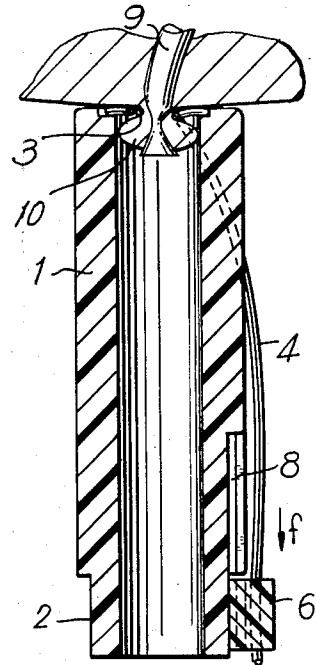


FIG. 3

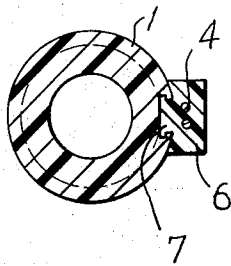


FIG. 5

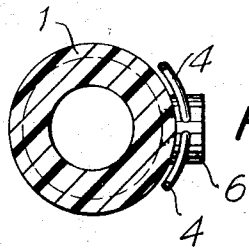


FIG. 6

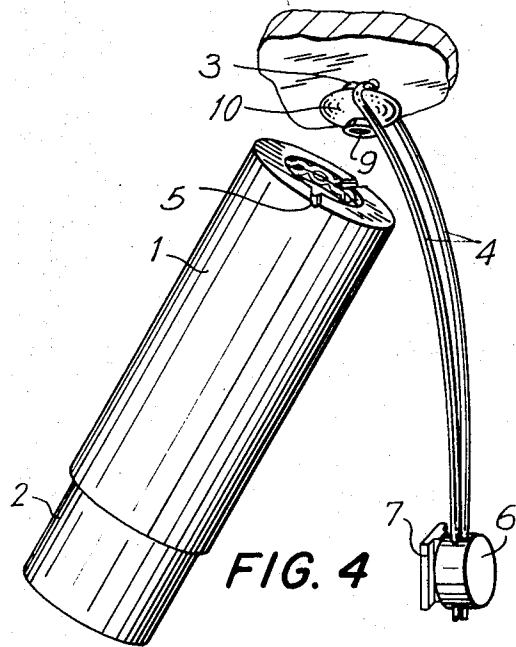


FIG. 4

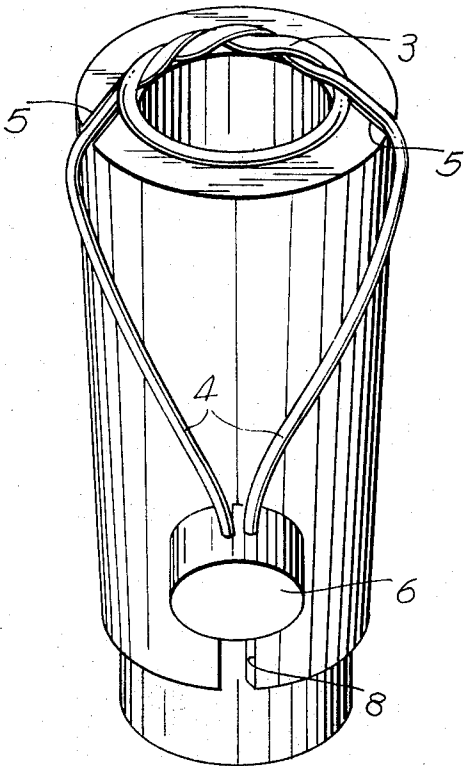


FIG. 7

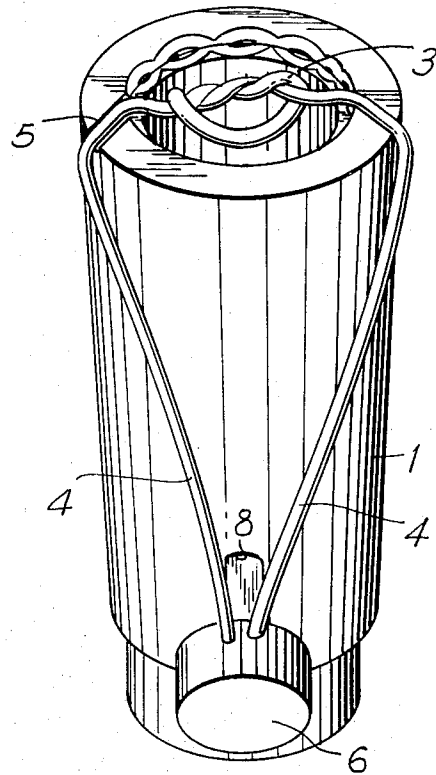


FIG. 9

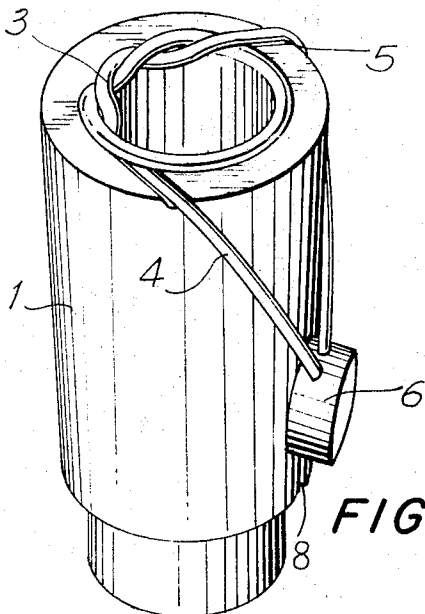
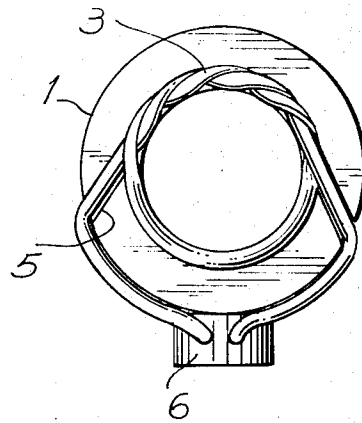
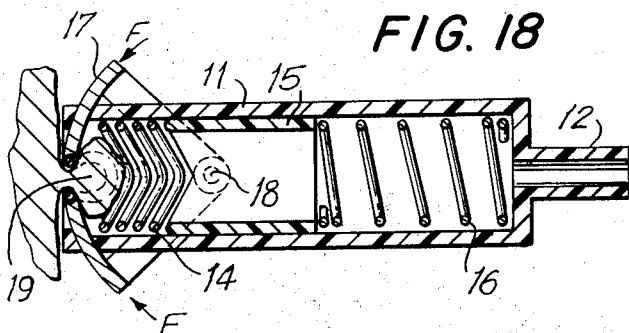
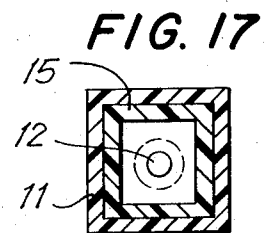
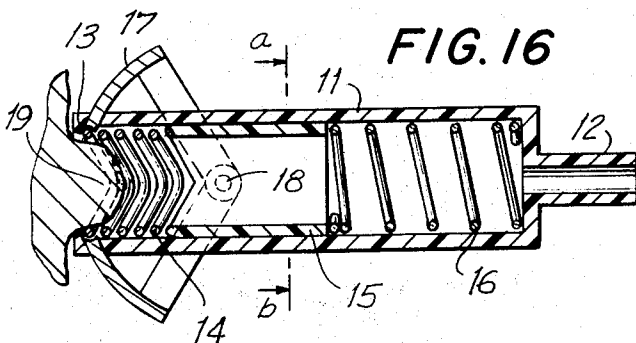
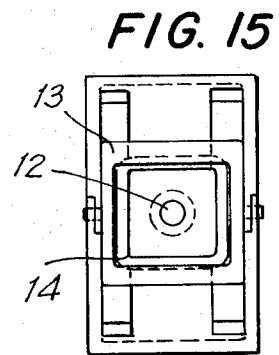
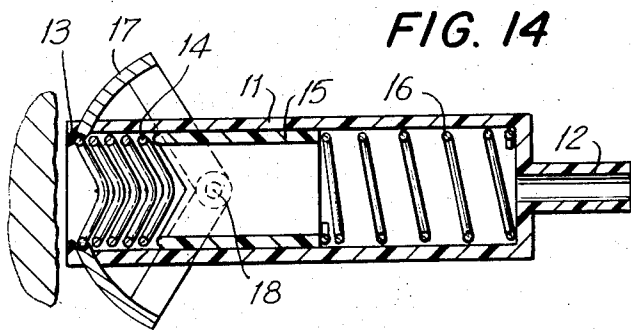
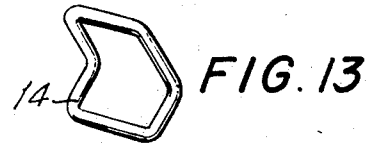
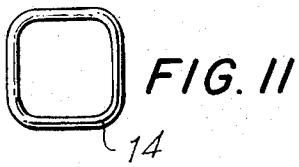


FIG. 8

FIG. 10





**FIG. 19**



## PROCESS FOR LIGATING SECTIONED BLOOD VESSELS

### CROSS RELATED APPLICATION

This application is a division of application Ser. No. 335,758, filed Feb. 26, 1973.

### BRIEF SUMMARY OF THE INVENTION

This invention relates to a process and apparatus for ligating sectioned blood vessels.

Hemostasis is a phase of a surgical operation where procedures are carried out for preventing or stopping the spread of blood in the operating area.

Hemostasis may arise in two ways:

In one situation the blood vessel is localized before sectioning. Two hemostatic clamps are placed on the vessel and the vessel may then be sectioned between the clamping points, without causing any blood flow, a ligature then being applied to each of the ends of the sectioned vessel.

In another situation, which is most frequent, the blood vessel is sectioned before the hemostatic clamps are applied. The blood flowing from the vessel is then absorbed either by swabbing or, more frequently, by use of a suction apparatus. The end of the sectioned vessel may then be correctly localized and a hemostatic clamp placed thereon. Finally, the end of the vessel is tied.

In both procedures described above, the ligation of the sectioned vessel is always delicate and may even be difficult to perform when the vessel is located at the bottom of a deep cut or in an area which is anatomically difficult to reach. The difficulty of the operation due to the slenderness of the vessels and to the inconvenient access is further aggravated by the fact that the hemostatic clamp most frequently conceals from the operator the portion of the vessel where the ligature is to be placed. It thus happens that the ligature thread squeezes the end of the clamp itself, thereby causing the breaking of the thread when the clamp is removed.

A further deficiency of the known procedure is that the placement of the hemostatic clamps has a traumatic effect on the peri-arterial tissues which are always clamped at the same time as the vessel and are thus crushed.

It is an object of the present invention to remedy these deficiencies by providing an apparatus whereby the easy and precise placement of ligatures on the extremities of sectioned vessels may be affected even in areas of difficult access, without causing the collapse of the peri-arterial tissues.

The invention further provides a process according to which the end of the sectioned vessel, together with the tissue area surrounding it are subjected to the action of a suction apparatus, such suction producing, simultaneously with the elimination of blood, the formation in the interior of the suction apparatus of a tissue cone. At the base of this cone there is then placed a preformed loop which is preset and detachably secured around the orifice of the tube at the end of the suction apparatus. The free portions of the thread which constitute the loop are then moved, by any suitable means, in a direction perpendicular to the plane of the loop. The closure of this loop and the contraction of the vessel may thus be controlled from a point remote from the operating area by pulling manually or by any other

means, upon the ends of the said free portions of the thread.

The apparatus provided by the invention comprises essentially a cylindrical member provided at one of its ends with means for removably securing the suction nozzle of a known suction apparatus and provided at its other end with a preformed loop of ligature thread, arranged around the circumference of the orifice of said cylindrical member, the loop being held detachably in place by any suitable means. The free portions of the loop are guided along external walls of the member and their ends are secured to a control member capable of being moved manually or otherwise along a generatrix of the cylindrical member.

According to another feature of the invention, the preformed ligature loop is detachably held in place by reason of the thread of the loop being embedded, substantially halfway in the thickness of the plastic material constituting the cylindrical member, this resulting from the molding of the member on the preformed loop.

The invention further comprises an apparatus for practising the process, which apparatus is characterized essentially by the fact that the contraction means consists of a metal clip suitably positioned within the body of the suction apparatus and the clamping action of which around the base of the tissue cone is controlled, by any suitable means, from a point remote from the area where the operation is performed.

In accordance with a preferred embodiment of the invention, the body of the suction apparatus constitutes a storage space for a plurality of clips arranged one behind the other, the first clip being located against a stop formed at the opening of the suction apparatus in which the tissue cone is formed. The clamping of the clip on the base of the cone is effected by closure of the jaws on the body of the apparatus, resilient means being provided for the placing against said stop of a succeeding clip after the first clip has been used.

Other features of the invention will become clear from the following description in conjunction with the accompanying drawings in which:

FIG. 1 is a view in longitudinal section of the apparatus of the present invention in place over a sectioned vessel;

FIG. 2 is a view similar to FIG. 1 after the application of suction which forms the tissue cone;

FIG. 3 shows the apparatus of FIG. 2 after the closure of the preformed loop around the tissue cone;

FIG. 4 is a perspective view showing the device removed after interruption of the suction;

FIG. 5 is a section along the line C-D of FIG. 1;

FIG. 6 is a section along the line A-B of FIG. 1;

FIGS. 7-10 are enlarged photographs of the cylindrical body carrying the preformed loop;

FIGS. 11, 12 and 13 show one embodiment of a clip seen in plan, in section and in perspective, respectively;

FIG. 14 is a view in longitudinal section of another embodiment of the apparatus according to the invention;

FIG. 15 is a view in front elevation view of the apparatus shown in FIG. 14;

FIG. 16 is a view in longitudinal section of the apparatus showing the tissue cone formed in the interior of the body of the apparatus;

FIG. 17 is a view in cross section along line *a-b* of FIG. 16;

FIG. 18 is a view in longitudinal section of the apparatus showing the jaws and the clip placed between them applied to the base of the tissue cone; and

FIG. 19 is a perspective view of a clip collapsed by the jaws.

### DETAILED DESCRIPTION

With reference to FIGS. 1 to 10, the apparatus of the invention comprises a cylindrical body 1, adapted to be secured to a suction apparatus (not shown) by any suitable means, for example by means of a reduced portion 2 adapted to engage in the suction nozzle of the suction apparatus.

At the end of the body 1 opposite the end which is connected to the suction apparatus, there is provided a preformed ligature thread loop 3. This loop is positioned around the opening of the cylindrical body 1 and is removably held in that position on a shoulder in the body by being embedded to substantially half-thickness of the thread within the plastic material of which the body 1 is made (FIGS. 7-10). The loop illustrated in the drawings and in the photographs forms, after clamping, a knot, called a "surgeon's knot". It will be understood that any other type of preformed loop may be used.

The free portion 4 of the loop, guided in two grooves 5 formed on the flange of the body 1 are bent down along the exterior sides of the body and are secured to a button 6 provided with a fastener 7 which is slidable along a guideway 8 formed in the side of the body.

The operation of the apparatus is as follows:

The end of the body 1, provided with the preformed loop, is applied to the orifice of a sectioned vessel 9 (FIG. 1). The suction apparatus, to which the device is connected, is then set in operation. The suction thus created in the interior of the axial cavity of the body 1, forms a small tissue cone or bud 10 in the center of which the section end of the vessel is located. It is then sufficient for the operator to move the slidable button 6 in the direction of the arrow *f* (FIGS. 2 and 3) to cause, by pulling on the loop ends 4, the closure of the loop 3 and the contraction of the vessel (FIG. 3).

It will be observed that the preformed loop which, as previously stated, has been embedded up to half the thickness of the thread within the plastic material of the body 1, will be easily removed by a pull on the loop ends 4.

At the end of the stroke of the button 6, the slide 7 leaves the guideway 8. The interruption of the suction, under the control of the operator, causes the tissue bud to be released. The body 1 may then be removed from the tissue and the loop ends 4 are cut to the desired length. The body 1 is then detached from the suction apparatus and is thrown away along with the slide button and the ends of the loop attached to it. At each hemostatic operation, a new cylindrical body, provided with a preformed loop, is used, as previously stated.

It is within the scope of the present invention to employ other means than those previously described. Thus for example, the preformed loop of thread may be secured to the end of the body by any suitable adhesive. Also the movement of the slide button may be effected by mechanical means, for example by a return spring, or by pneumatic means. In the latter case, the slide button may be made integral with a plunger movable

within a cylinder molded into the sides of the body, the suction created by the suction apparatus to which the body is connected being utilized for causing movement of the plunger after the cylinder has been operatively connected to the suction source of the suction apparatus.

A different embodiment of the invention is illustrated in FIGS. 11 through 18. In this embodiment, the apparatus comprises a hollow body 11 (FIG. 14) having an end portion adapted to be connected to a source of suction and having at its other end a shoulder 13 extending inwardly of the body 11. In the interior of the body 11 are a plurality of clips 14 pressed by a guide 15 slidable within the body 11. The guide in turn is urged by a spring 16 engaging the bottom of the body 11.

Jaws 17, in the form of semi-circular sectors, are pivotally mounted on a pin 18 carried by the body 11. The jaws are arranged in such manner that their ends which are directed toward the interior of the device engage the clip which abuts the shoulder 13.

The apparatus just described operates in the following manner:

The apparatus is placed opposite the zone where the operation is being performed (FIG. 14), and it sucks blood spread in the immediate vicinity of the sectioned vessel, thereby permitting the operator to locate the orifice (not shown) with precision. The end of the apparatus is then applied to this orifice (see FIG. 16) whereby the stopping of the bleeding by suction has the effect of closing the lips of the sectioned vessel. At the same time the suction causes the forming of a tissue bud 19 at the center of which is located the end of the sectioned vessel. The bud is formed in the interior of the body of the apparatus and hence in the interior of the clips located at the end of the apparatus.

It is thereafter sufficient for the operator to act upon the jaw 17 by any suitable mechanical or pneumatic means to cause the jaws to close in the direction of the arrows *F* (FIG. 18), thereby causing the bending of the clip which is situated against the shoulder 13 around opposite sides of the base of the bud, which results in the contraction of the bud and hence the hemostasis of the vessel.

The removal of the jaws, together with the interruption of the suction then permits removal of the apparatus from contact with the tissues.

The clips 14 are then pressed by the guide 15 against the end of the body of the apparatus until the next succeeding clip comes into engagement with the shoulder 13. The apparatus is then ready for a new operation.

It will be understood that various modifications of the invention may be made without departing from the scope of the invention, for example the shape of the clips, as well as the means utilized for causing the clamping of the clips into position on the base of the bud.

With the aid of the apparatus described herein, each hemostasis operation on a vessel may be performed rapidly, accurately and with ease, even under the least favorable operating conditions. Further, a large number of successive hemostasis operations may be performed upon numerous vessels which are sectioned in the course of an operation, without any preparation being necessary between operations.

We claim:

1. A process for ligating sectioned blood vessels comprising applying suction force to the end of a sectioned

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vessel, as well as the tissue zone surrounding it to effect simultaneously the elimination of blood and the formation of a tissue bud containing the end of the vessel, and contracting the tissue bud at the base thereof, while still applying the suction to close said vessel end.

2. A process as claimed in claim 1 wherein said contraction of the tissue bud is effected from a location re-

mote from said bud.

3. A process as claimed in claim 1 wherein the tissue bud is formed within a channel which is subjected to the suction force, and the tissue bud is contracted by applying a closure member thereto when the bud is in said channel.

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