

United States Patent

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[72] Inventor **Jack E. Wilkinson**
2411 Divisadero St., Fresno, Calif. 93721
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Primary Examiner—Richard J. Herbst
Assistant Examiner—Michael J. Keenan
Attorney—Lynn H. Latta

[54] **SURGICAL CLAMP APPARATUS**
4 Claims, 10 Drawing Figs.

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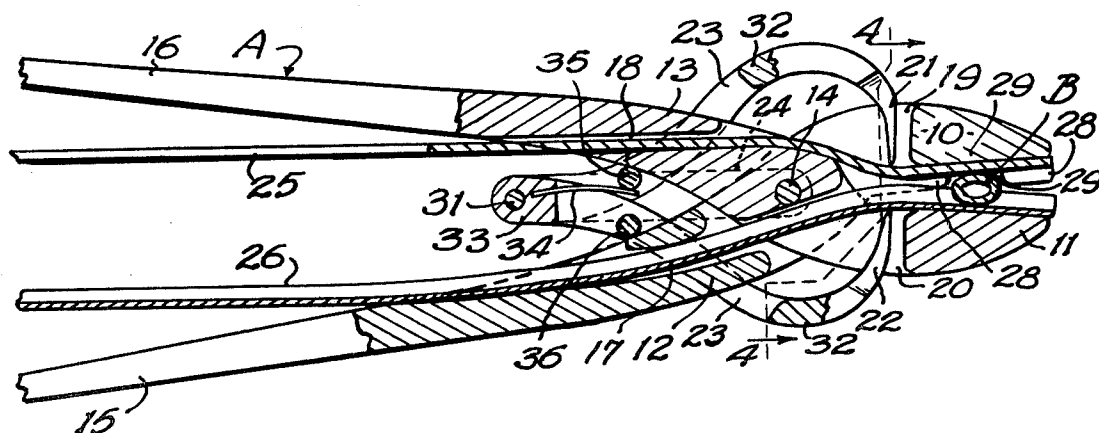
[50] Field of Search..... **72/409,**
410, 334; 227/19, 21, 80; 128/325, 326; 29/243.56

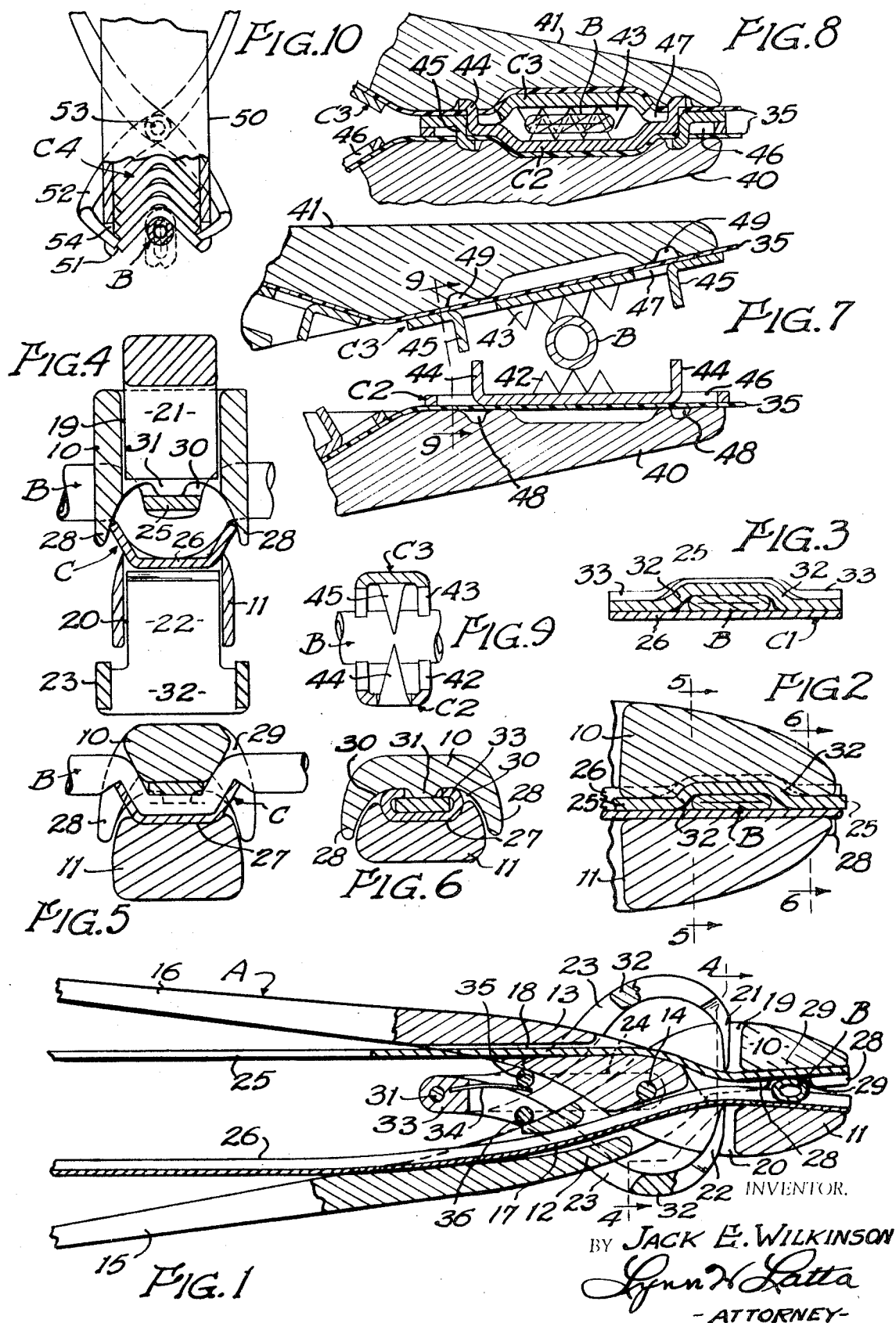
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ABSTRACT: A surgical clamp for closing off blood vessels and the like, in the form of a small self-locking clip, and an applicator in which a series of such clips can be fed into position between a pair of jaws adapted to close and lock the clip around a blood vessel or the like, in constricting relation thereto.





SURGICAL CLAMP APPARATUS

BACKGROUND OF THE INVENTION

In the past, the common practice in closing blood vessels during surgery has been to utilize clamps, usually in the form of tongs or forceps, for collapsing a cut end of a vessel between jaws which are then locked together until such time as the blood vessel is either restored by suturing its cut ends, or permanently closed by suturing or tying off the cut ends with nooses drawn tight and secured, as by tying.

OBJECTS OF INVENTION

The general object of the present invention is to provide an apparatus which is operable to rapidly apply small constrictive bandlike clamps to cut ends of blood vessels and the like, the clamps being substantially no more bulky than a ligature noose, thus performing the functions of a conventional clamp and of a suture or tie-noose as well.

IN THE DRAWINGS

FIG. 1 is a side view, partially in section, of a clamp applicator and blood vessel clamp in an initial stage of closing, embodying one form of the invention;

FIG. 2 is a longitudinal sectional view of the clamp and the jaws of the applicator in closed position;

FIG. 3 is a longitudinal sectional view of the clamp in closing engagement with a blood vessel;

FIG. 4 is a cross-sectional view taken on line 4-4 of FIG. 1;

FIG. 5 is a cross-sectional view taken on line 5-5 of FIG. 2;

FIG. 6 is a cross-sectional view taken on line 6-6 of FIG. 2;

FIG. 7 is a fragmentary longitudinal sectional view of an applicator and clamp embodying a modified form of the invention, shown in an initial stage of application to a blood vessel;

FIG. 8 is a longitudinal sectional view of the same, clamped upon the blood vessel and closing it;

FIG. 9 is a cross-sectional view taken on line 9-9 of FIG. 7; and

FIG. 10 is a fragmentary cross-sectional view of an applicator and a series of clamps embodying another form of the invention.

DESCRIPTION

Referring now to FIGS. 1-6 in detail, the apparatus shown therein comprises an applicator A generally similar to a pair of tongs, having a pair of jaws adapted to receive between them a blood vessel B; and clamp means C consisting of a pair of metal strips adapted to be fed through the applicator A in bracketing relation to the blood vessel B and then to be closed around the blood vessel and clamped together so as to provide a clamp to close the blood vessel; the clamp then being severed from the strips from which it has been formed.

Applicator A comprises a pair of jaws 10, 11 having respective shanks 12, 13 disposed in crossed relation and pivotally connected by a pin 14, the shanks being continued into handles 15, 16. Shanks 12, 13 are provided with guide means in the form of apertures 17, 18 through which clamp strips C are fed between jaws 10, 11, and with apertures 19, 20, through which cutting teeth 21, 22 can be operated to snip the strips C away from a pair of clamp elements that have been attached to a blood vessel. Teeth 21, 22 may be carried by levers 23 attached by floating links 24 to handles 15, 16. Floating links 24 (one on each side of the applicator A) are pivoted at their forward ends upon the connecting pivot pin 14 of shanks 12, 13 and are connected by a pivot 31 at their rear ends of levers 23 in embracing relation thereto. Levers 23 are likewise disposed on respective sides of applicator shanks 12, 13, in laterally spaced pairs joined by bridge portions 32 in bifurcated structures. The inner levers 23 are joined by an integral crossbar 33. Link 24 may be centered by a leaf spring 34 anchored in crossbar 33 and engaging an actuator pin 35 bridging the outer pair of levers 23. Pin 35, and a pin 36 bridging the inner pair of levers 23, are arranged to be engaged between shanks

12, 13 as the jaws 10, 11 are approaching closed positions, to press the levers 23 inwardly so as to effect shearing action of teeth 21, 22.

Clamp means C comprises a strip or ribbon 25 and a channel strip 26, seen in cross section in FIG. 5, its concave side facing the strip 25. Jaw 11 has a longitudinally extending channel recess 27 in which channel strip 26 is cradled and supported as portions of its side flanges are folded inwardly over strip 25 on opposite sides of a blood vessel B, the folding being done by folding lips 28 on jaw 10. The lips 28 are in pairs spaced apart longitudinally of jaw 10 so as to provide a gap 29 through which blood vessel B may be laid across the channel strip 26 (FIGS. 1 and 5) preparatory to closing the applicator jaws 10, 11 (FIGS. 2 and 6) to form the clamp C1 (FIG. 3) which is then severed from clamp strips C by shearing operation of teeth 21, 22.

The forming lips 28 of each pair (FIGS. 4 and 6) have inwardly converging inner walls defining laterally opposed forming cavities 30 which are separated by a central land 31 which bears against clamp strip 25 on a respective side of gap 29 and presses it firmly against the bottom web of channel strip 26 after bending it at 32 downwardly around respective sides of blood vessel B (FIG. 2). The cavities 30 are shaped so as to bend the channel flanges on respective sides of blood vessel B inwardly over the adjacent portions of strip 25 to form securing lips 33 (FIG. 3) clamped around the edges of strip 25 to secure the sections of the finished clamp C1 in closed positions clamping the vessel B in collapsed, closed condition.

OPERATION

In using the apparatus, a surgeon, having uncovered a number of blood vessels in an incision (e.g. a number of lateral branches from a trunk artery or vein to a stomach that is to be partially or wholly removed) will insert the applicator A into the incision with the jaws sufficiently opened to freely receive a blood vessel to be clamped off, until the vessel is registered with the gap 29 between lips 28; and will then squeeze the handles 15, 16 so as to bring the jaws 10, 11 into closed position. FIG. 1 shows the applicator in an intermediate position of jaw closing in which blood vessel B has been pushed into channel strip 26 by the portion of clamp strip 25 lying across the vessel, and in which the lips 28 of upper jaw 10 have made contact with the edges of the side flanges of channel strip 26 (FIGS. 1 and 4). In the final stage of closing, the portions of the flanges of channel 26 lying on opposite sides of blood vessel B will be bent inwardly and downwardly around the edges of the portions of strip 25 that are bent downwardly against the web of channel strip 26 on respective sides of blood vessel B, and will clamp these portions of strip 25 against the channel web. The blood vessel B will then be collapsed between the intermediate portions of strip 25 and channel strip 26 and thus sealed off so that it can be severed to permit the diseased organ to be removed. The strips 25 and 26 are then severed from the formed clamp C1 by squeezing levers 23 to effect shearing action of teeth 21, 22.

When one clamp has been installed, the strips 25, 26 are advanced through apertures 17, 18 and between the jaws 10, 11 until their forward ends reach the tips of the jaws. Another blood vessel is the bracketed between the applicator jaws as thus lined by the clamp strips, and the applicator is again operated to squeeze the jaws shut and to form another clamp C1 as described above.

In some cases it may be desirable to sever the strips 25, 26 when the applicator is in the partially closed position shown in FIG. 1, and to then complete the closing of clamp C1 upon the blood vessel. This can be effected by suitable spacing of the pins 35 from levers 23 in positions of handles 15, 16.

FIGS. 7, 8 and 9 disclose a modified form of the invention wherein a succession of clamp elements C2, C3, are mounted on continuous plastic tapes 35 and are fed between applicator jaws 40, 41 as in FIG. 1. Clamp elements C2, C3 have longitudinally extending arrays of teeth 42, 43 (e.g. along respective

margins of barlike bodies of the clamp elements) and a blood vessel B is adapted to be embraced between these arrays of teeth and thereby collapsed by bringing the jaws 40, 41 together (FIG. 8). Clamp elements C2, C3 also have respective fastener tabs 44, 45 struck from apertures 46, 47, adjacent their respective ends, the tabs 45 being positioned to slide past the outer sides of tabs 44 as the two clamp elements are brought together, the tabs of each clamp element projecting though the apertures of the opposed clamp element. As the tabs thus project through the opposed clamp elements, they pierce the tapes 35 and enter forming recesses 48, 49 in the opposed applicator jaws, and are thereby turned over and secured against the outer sides of the opposed clamp elements, as in FIG. 8. Thus the clamp elements C2, C3 are locked together with the blood vessel B collapsed between them. The blood vessel is partially pierced by the teeth 42, 43, and thus the clamp is securely attached to the blood vessel and cannot slip off the end of the vessel after the vessel has been severed adjacent the clamp.

FIG. 10 discloses another applicator and clamp apparatus comprising a plurality of clamp elements C4 of ribbon metal and of chevron shape, contained in a cartridge 50 and fed to the mouth thereof where they are retained by stops 51 on opposite sides of the cartridge. Closing tongs 52, pivoted at 53 to cartridge 50, are operable to engage the ends of the bottom clamp element C4 through slots 54 in the sides of the cartridge, and to bend the arms of the clamp element into clamping engagement with a blood vessel B so as to collapse it. Upon the retracting the tongs 52, the closed clamp is released from the cartridge and the stack of clamp elements are shifted until the next clamp element engages the stops 51, in position to be engaged by tongs 52.

I claim:

1. In an apparatus for closing tubular anatomical vessels, an applicator comprising:

opposed jaws adapted to receive between them a clamp forming means comprising a pair of complementary metal strips, one of plain ribbon form and the other of channel cross section having longitudinally extending side flanges between which said ribbon-form strip is receivable; means to guide strips longitudinally through said applicator and toward the tips of said jaws;

opposed cutter teeth on said jaws adapted to shear off successive lengths of said strips to constitute successive pairs of opposed clamping elements; and

means on said jaws to bend respective side flange portions of the channel section clamping elements over the side margins of opposed ribbon-form clamping elements so as to lock the opposed clamping elements together with the vessel extending transversely between the intermediate portions of said clamping elements.

2. Apparatus as defined in claim 1 wherein said applicator is in the form of tongs including a pair of handles extending integrally from the respective jaws and a pivot connecting said handles; and

means on said handles for guiding the respective strips past said pivot and into the space between said jaws.

3. Apparatus as defined in claim 1, wherein one of said jaws has a longitudinally extending channel recess for receiving and supporting the channel section of said other strip; and

the other jaw has a pair of laterally spaced folding lips engageable with the flanges of said other strip and operable to fold them over the side margins of said one strip of plain ribbon form.

4. Apparatus as defined in claim 2, wherein said folding lips are provided with transversely opposed notches to receive an anatomical vessel between longitudinally spaced areas of folding of said flanges over said one strip.