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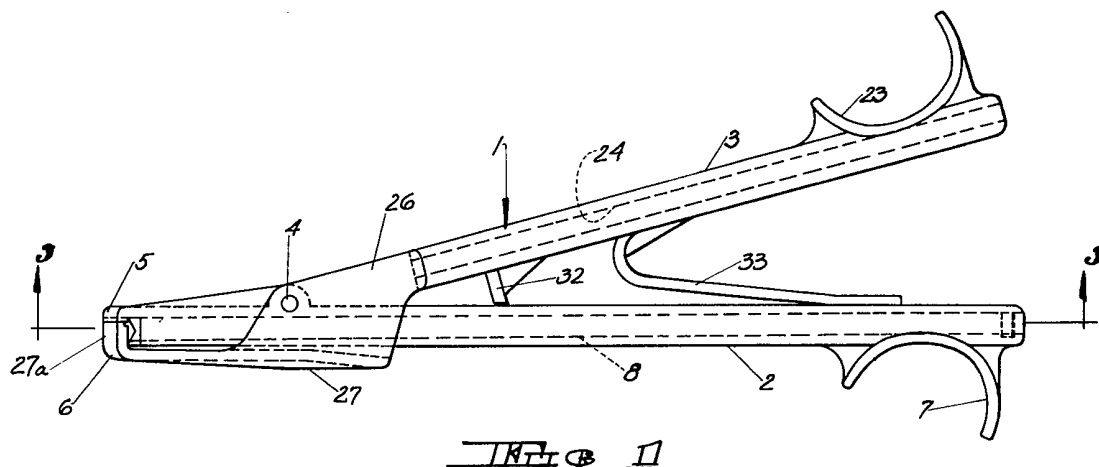
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(54) Clip ligator

(57) A surgical ligator to locate and clamp a substantially U-shaped clip

about a tubular member such as a blood vessel comprises handle elements pivoted in pliers-like fashion and terminating at their forward ends in clamping jaw portions. The first handle has a longitudinal cavity comprising a magazine for a row of clips arranged edge-to-edge. The jaw portions of the first and second handle elements each have a locator stop for the forwardmost clip of the row to position the forwardmost clip for use. The magazine of the first handle has a spring actuated shoe to advance the row of clips forward to position the forwardmost of the row against the locator stops. The first and second handles and their jaws are pivotable between an open position and a closed clip-clamping position. A spring is provided to bias the handle elements and their jaw portions to the open position.



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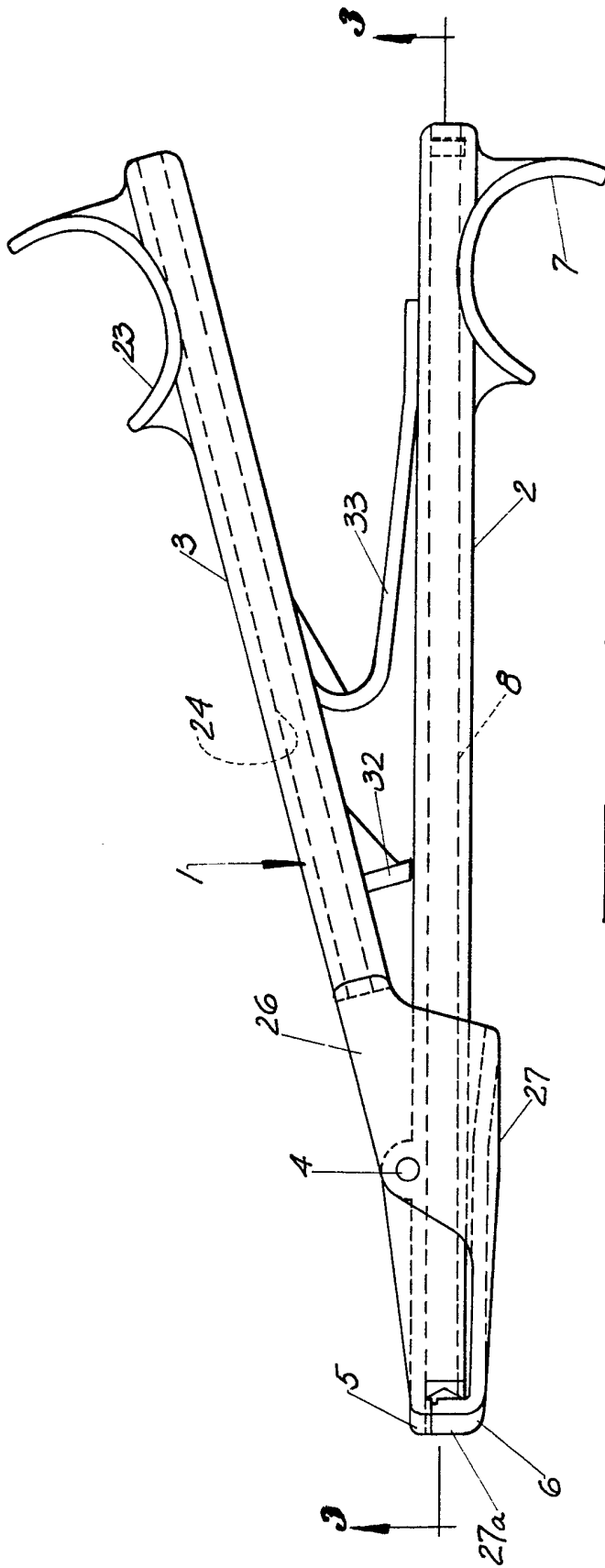


FIG 1

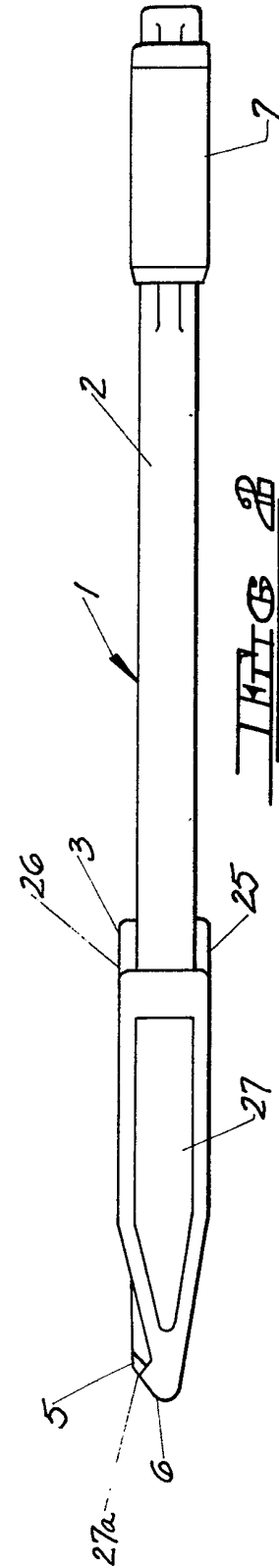
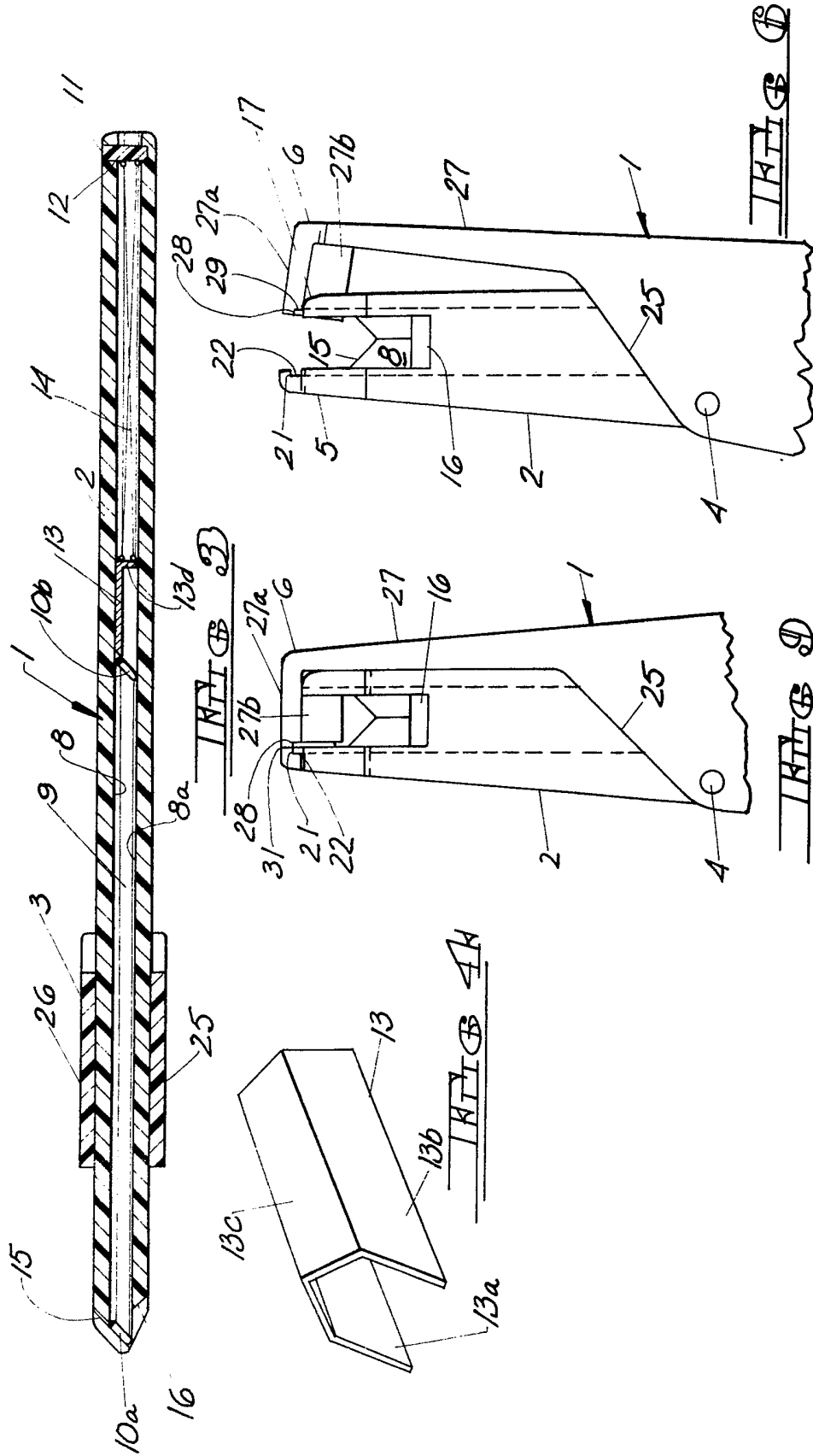
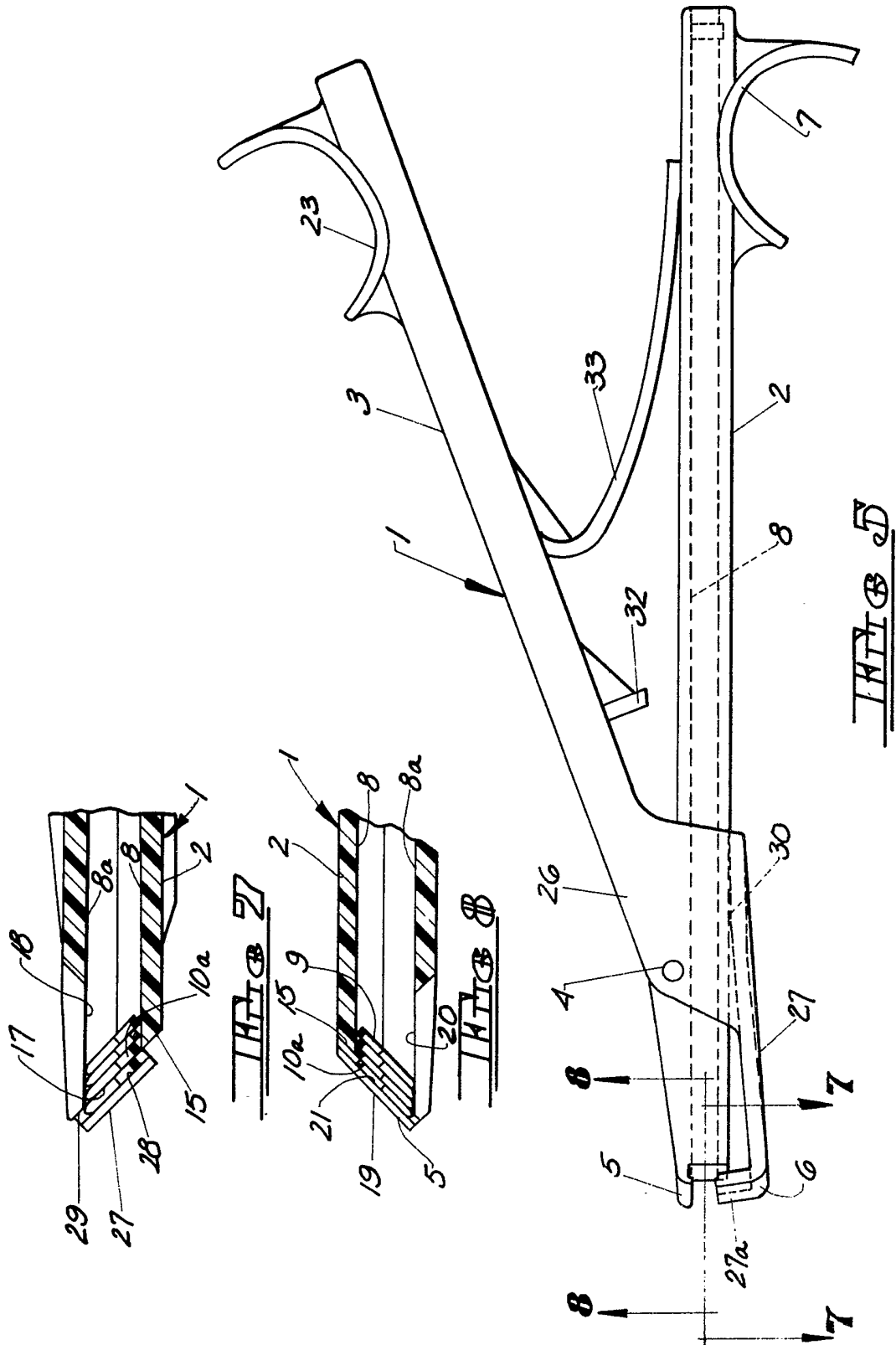
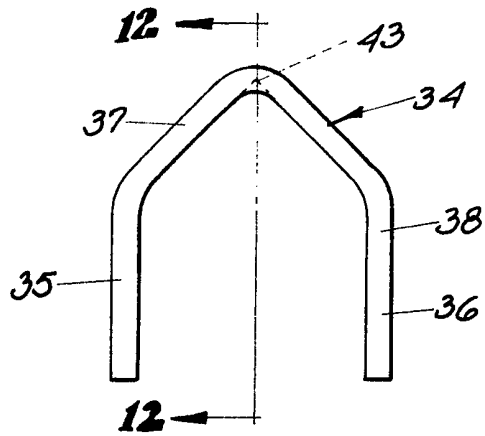
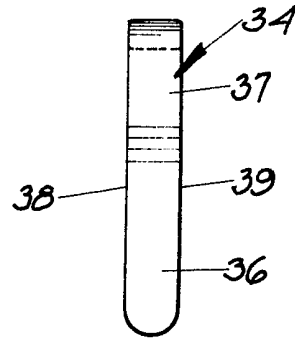
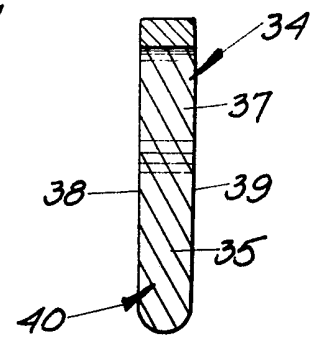
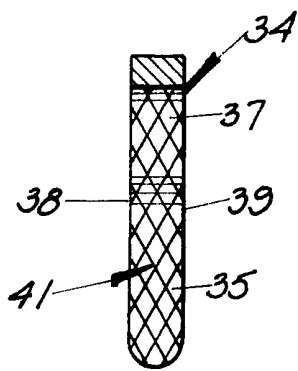
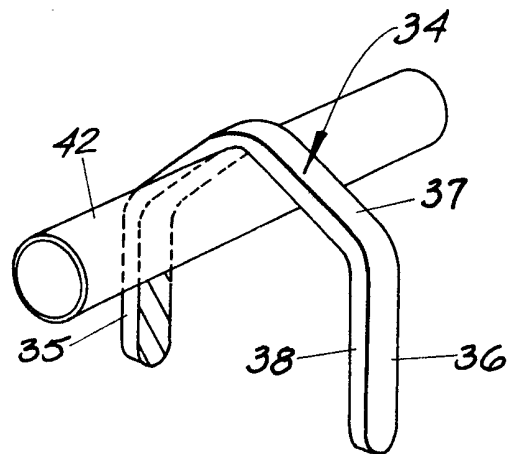
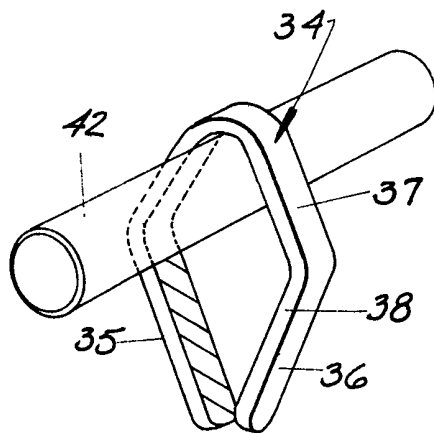
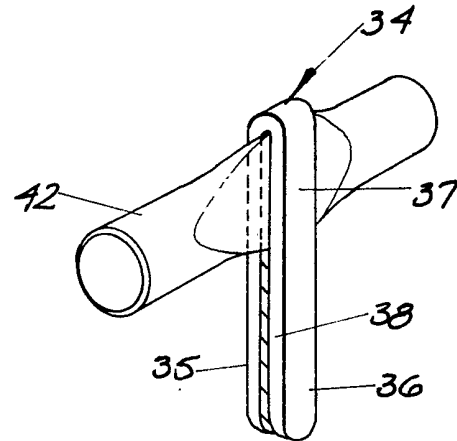


FIG 2





FIG. 10FIG. 11FIG. 12FIG. 13FIG. 14FIG. 15FIG. 16

SPECIFICATION

Ligator**5 Technical field**

The invention relates to a surgical ligator, and more particularly to such a ligator having a magazine for a row of clips located in one of its handle elements with means constantly urging the forwardmost clip of the row into position for use.

Background art

Prior art workers have devised many types of ligators, including ligators which apply a knotted loop of gut or synthetic suture material to the tubular member. Such ligators are taught, for example, in United States Patents 3,687,138; 4,038,988 and 4,050,465.

A great many of the prior art ligators, however, are intended to apply a generally U-shaped clip to clamp the tubular member. United States Patents 3,777,538; 3,867,944 and 4,027,501 are examples of such surgical devices wherein each clip is individually located in the jaws of the instrument, no magazine or cartridge being used. United States Patents 3,631,707; 3,774,438 and 3,827,277 are exemplary of those surgical clip applicators utilizing a separate magazine or cartridge. In this instance, the surgical instrument is used to engage and withdraw a clip from the separate magazine, and thereafter to apply the clip to the tubular member.

Prior art workers have also developed surgical ligators having cartridges either built into the instrument or affixed thereto as an attachment. In most instances, the clips are located in the cartridge in end-to-end relationship, one behind the other, feeding legs foremost. This arrangement greatly reduces the number of clips which can be contained in the cartridge. Examples of such instruments are taught in United States Patents 2,968,041; 3,006,344; 3,082,426; 3,740,994 and 3,844,289. United States Patent 3,581,557 teaches a surgical clamp applying instrument having a vertical stack of clamps. In United States Patents 3,576,288 and 3,592,377 the clips are mounted on and advanced by a threaded member. Finally, United States Patent 2,874,384 describes a ligator having a small magazine of clips in face-to-face relationship and extending laterally of the instrument.

The prior art ligators provided with magazines or cartridges of clips are characterized by a number of disadvantages. First of all, the cartridges or magazines are of limited capacity and, in most instances, the orientation of the clips within the magazine or cartridge contribute to this limited capacity. In many instances, a part of the force utilized to actuate the prior art ligators is required to shift a clip to its position wherein it may be applied to the tubular member intended to be clamped. In some instances, wholly separate manipulation of the cartridge or magazine device is required.

The present invention constitutes an improvement over prior art ligators. The ligator herein described is a pliers-like structure having a pair of handle elements terminating at their forward ends in jaw

portions. The first handle element contains a magazine for a row of clips arranged in edge-to-edge relationship. The jaw portion of the first handle element has a stop means to properly locate the forwardmost clip of the row in position for use. The jaw portion of the second handle element also has a locator stop. Means are provided within the magazine to constantly urge and advance the row of clips forwardly so that the forwardmost clip of the row will always be in position for use. Thus, no portion of the force required to operate the ligator is used to advance the clips.

The size of the magazine and the orientation of the clips therein enable the provision of a large number of clips within the magazine. The arrangement of the jaw portions is such that the jaws provide front and side containment of the forwardmost clip of the row thereof, while the next succeeding clip in the row (or ultimately the shoe) provides rearward containment for the forwardmost clip. The ligator of the present invention is extremely simple in design and construction and may be provided in both reusable and disposable forms.

90 Disclosure of the invention

In accordance with the invention there is provided a surgical ligator to locate and clamp a substantially U-shaped clip about a tubular member such as a blood vessel or the like to close off the tubular member. The ligator comprises a pair of handle elements pivotally joined together in pliers-like fashion. The handle elements terminate at their forward ends in clamping jaw portions.

A first one of the handle elements has a longitudinal cavity formed therein and extending from its rearward end to its forward jaw portion. This longitudinal cavity comprises a magazine to receive a row of clips arranged in edge-to-edge relationship. The jaw portion of this handle element also has a locator stop to properly locate and maintain the forwardmost clip of the row in position for application to a tubular member. The longitudinal magazine of the first handle element has a spring actuated shoe therein which constantly urges and advances the row of clips forwardly so that the first clip of the row is properly located in position for use.

The handle elements and their forwardmost jaw portions are pivotable between a normal open position and a closed clip-clamping position. Spring means are provided in association with the handle elements to bias the handle elements to their open position. The jaw portion of the second handle element also has a locator stop for the forwardmost clip of the row, when the jaw portions are in their open position. As the jaw portions pivot to their closed, clip-clamping position, the jaw portion of the second handle element shifts across the front of the magazine and flattens the forwardmost clip against the jaw portion of the first handle element.

The ligator of the present invention may be made in a reusable form of metal or other appropriate material suitable for use in a surgical environment and capable of withstanding sterilization by one or more of the well known methods. The simplicity of the structure is such that the ligator also lends itself

well to being molded of an appropriate plastic material so that it can be provided in the form of a single-use, disposable instrument.

5 *Brief description of the drawings*

Figure 1 is a top plan view of the ligator of the present invention.

Figure 2 is a side elevational view of the ligator of *Figure 1*.

10 *Figure 3* is a cross sectional view taken along section line 3-3 of *Figure 1*.

Figure 4 is a perspective view of an exemplary form of shoe for use with the ligator of the present invention.

15 *Figure 5* is a top plan view of the ligator, similar to *Figure 1*, but illustrating the handle elements and their jaw portions in their normal open position.

Figure 6 is a fragmentary bottom view of the jaws portions of the ligator in their normal open position.

20 *Figure 7* is a fragmentary cross sectional view taken along section line 7-7 of *Figure 5*.

Figure 8 is a fragmentary cross sectional view taken along section line 8-8 of *Figure 5*.

25 *Figure 9* is a fragmentary bottom view of the jaw portions of the ligator, similar to *Figure 6*, but illustrating the jaw portions in their closed, clip-clamping position.

Figure 10 is a front elevational view of a clip for use with the ligator of the present invention.

30 *Figure 11* is side elevational view of the clip of *Figure 10*, as viewed from the right in that *Figure*.

Figure 12 is a cross sectional view taken along section line 12-12 of *Figure 10*.

35 *Figure 13* is a cross sectional view, similar to *Figure 12*, illustrating a different knurl pattern on the inside surface of the clip.

Figure 14 is a fragmentary perspective view of the clip of *Figure 10* as initially located about a tubular member to be clamped.

40 *Figure 15* is a fragmentary perspective view, similar to *Figure 14*, and illustrating the clip in an intermediate stage of the clamping process.

Figure 16 is a fragmentary perspective view, similar to *Figures 14* and *15*, and illustrating the clip 45 in its fully clamped position about the tubular member.

Best mode of carrying out the invention

Reference is first made to *Figures 1* and *2* wherein 50 like parts have been given like index numerals. The ligator is generally indicated at *1* and comprises a first handle element *2* and a second handle element *3* pivotally joined together by pivot pin *4*. The first handle element *2* terminates at its forward end in a jaw portion *5*. Similarly, the second handle element 55 *3* has a jaw portion *6* at its forward end.

As indicated above, the ligator *1* of the present invention could be manufactured of stainless steel or other appropriate material for use in a surgical 60 environment so as to constitute a permanent, reusable, sterilizable surgical appliance. The simplicity of its structure, however, lends itself well to be molded of plastic material such as glass filled polycarbonate, glass filled nylon, or the like, so as to constitute a 65 single-use, disposable surgical appliance. For pur-

poses of an exemplary showing, the ligator *1* is illustrated herein as being molded of such a plastic material.

Reference is now made to *Figures 1* through *3*. The 70 first handle element *2* is of substantially rectangular cross section and may be provided at its rearward end with an arcuate finger grip element *7*. Throughout its length, the first handle element *2* has a longitudinal cavity *8* formed therein. The cavity *8* 75 comprises a magazine for the receipt of a row *9* of clips. In *Figure 3*, the row *9* of clips is illustrated semi-diagrammatically, in edge-to-edge relationship the forwardmost and rearwardmost clips being fully illustrated at *10a* and *10b*, respectively.

80 When a clip is applied to a tubular member such as a blood vessel or the like, the clip will be oriented at about 90° to the tubular member. The ligator *1* of the present application will be oriented at approximately 45° to the tubular member during the clip-applying 85 step. As a result of this, the clips of row *9* will slope rearwardly in magazine *8*, lying at an angle of approximately 45° to the bottom surface *8a* of magazine *8*, as shown in *Figure 3*. The cross sectional configuration of magazine *8* will depend 90 upon the shape of the clips of row *9* and should be such as to just nicely receive the row *9* of clips in such a way that the row *9* of clips is readily advanceable through the magazine with the indi- 95 vidual clips of the row maintaining their proper alignment.

Since the cavity constituting magazine *8* extends through the length of the first handle element *2*, the clips may be inserted in the magazine from the rearward end of handle *2*. The rearward end of 100 handle *2* may thereafter be closed by any appropriate means. For purposes of an exemplary showing, a plug *11* is illustrated as being inserted in a slot *12* extending partway through first handle element *2* and transversely thereof.

105 Located immediately behind the row *9* of clips there is a shoe *13*. The shoe is most clearly shown in *Figures 3* and *4* and comprises an elongated member which may have substantially the same configuration as the clips mounted within magazine *8*. This is 110 shown by a comparison of *Figures 4* and *10*. *Figure 10* illustrates an exemplary clip which will be described hereinafter. The shoe of *Figure 13* is shown as comprising a pair of downwardly depend- ing sides *13a* and *13b* joined together by an inverted 115 V-shaped upper portion *13c*. The shoe *13* is closed at its rear end, as at *13d* (see *Figure 3*), and is open at its forward end, the forward edges sloping rearwardly at an angle of about 45° , to match the slope of the rearwardmost clip *10b* of row *9*.

120 Immediately behind shoe *13*, a compression spring (semi-diagrammatically illustrated in *Figure 3* at *14*) is located in magazine *8*. The forward end of compression spring *14* abuts the rear end *13d* of shoe *13* while the rear end of spring *14* abuts plug 125 *11*. The spring *14* and shoe *13* cooperate to constantly urge and advance the row *9* of clips to locate the forwardmost clip *10a* of the row in position for use. Thus, the advancement of the clips of row *9* is essentially automatic and wholly separate from the 130 force required to actuate the ligator *1*.

Referring to Figure 3, at the forward end of first handle 2 the upper surface of the handle terminates in an upwardly and rearwardly sloping edge 15, sloping at an angle of about 45°. The bottom surface of first handle 2 terminates in an edge 16 which slopes rearwardly and downwardly at an angle of about 45°.

Figure 5 is a plan view of the ligator 1 and Figure 7 is a cross sectional view taken along section line 7-7 of Figure 5. It will be noted from these Figures that the upper side of first handle element 2 (as viewed in Figure 5) terminates in a downwardly and forwardly sloping front edge 15, again at an angle of about 45° to the bottom surface 8a (Figure 7) of magazine 9. The bottom surface 8a continues along the lower side wall (as viewed in Figure 5) in the form of a rail 18 along which one leg of each of the clips of the row 9 can slide. This is clearly shown in Figure 7.

The upper side of first handle element 2 (as viewed in Figure 5) terminates in a forward edge 19 which slopes forwardly and downwardly, again at an angle of about 45° to the bottom surface 8a of magazine 8. This is shown in Figure 8. Once again, the bottom surface 8a of magazine 8 continues nearly to this forward edge in the form of a rail 20 along which the other legs of the clips can slide.

The forward edge 19 of the upper side of first handle element 2 (as seen in Figure 5) extends further forward than the forward edge 17 of the lower side and is hook-shaped, as is most clearly seen in Figure 6. This forms a forward surface 21 which slightly overlaps the forward end of magazine 8 and constitutes a locator stop for the forwardmost clip 10a of row 9. The locator stop or surface 21 again lies at an angle of about 45° to the bottom surface of the magazine 8. The edge 15 of the top portion of first handle element 2 is spaced from the surface 21 by a distance slightly greater than the thickness of a clip, as is rail 20. This produces a surface 22 (Figure 6) between the locator stop 21 and edge 15 and the forward end of rail 20 which constitutes a clamping surface used to close a clip and serving to make the forward end of the upper side of first handle element 2 (as seen in Figure 5) constitute the clamping jaw 5. (See also Figure 6).

Reference is now made to Figures 1, 2, 3 and 6 for a description of the second handle element 3. The second handle element 3 may be provided at its rearward end with an arcuate finger grip 23 similar to arcuate finger grip 7. Since the embodiment illustrated is molded of a plastic material, the straight longitudinal rearward portion of second handle element 3 may have an axial bore 24 formed therein for purposes of material savings. At the forward end of that portion of the second handle element 3 containing axial bore 24, the handle element is bifurcated. Bifurcations 25 and 26 are illustrated in Figures 3 and 6. The first handle element 2 passes between bifurcations 25 and 26, as described above, and is pivotally attached to the bifurcations 25 and 26 by pivot pin 4.

The bifurcations 25 and 26 are joined by a side wall 27 which, at its forward end, is generally hook-shaped, having a portion 27a extending substantially at right angles thereto and sloping upwardly and

rearwardly at an angle of about 45°. The inside corner of the free end of portion 27a is notched to form a first upwardly and rearwardly sloping surface 28 similar to surface 21 of first handle element 2 and also serving as a locator stop for the forwardmost clip 10a of row 9. The notch also forms a second surface 29 extending upwardly at an angle of about 45° and constituting a clamping surface similar to clamping surface 22 and adapted to cooperate therewith to close the forwardmost clamp 10a of row 9 about a tubular member. Thus, the forward end of second handle element 3 constitutes a jaw, heretofore designated 6. The portion 27a of wall 27 of second handle element 3 has an inside surface 27b (see Figures 6 and 9) which slopes upwardly and rearwardly at an angle of about 45° and just clears the forward edge 17 of the right side of first handle element 2 (as viewed in Figure 6).

The first and second handle elements 2 and 3, joined together by pivot pin 4, are swingable between a normal open position and a closed clip-clamping position. Figures 5 and 6 illustrate the ligator with its first and second handle elements 2 and 3 and its jaws 5 and 6 in their normal open position. This normal open position is determined by the abutment of the inside surface of wall 27 of second handle element 3 against the side of first handle element 2, as at 30 in Figure 5. The closed clip-clamping position of jaws 5 and 6 and first and second handle elements 2 and 3 is determined first of all by abutment of the jaws as at 31 in Figure 9. It is also determined by abutment of a stop means 32, formed on second handle element 3 against the side of first handle element 2. This relieves the forces on pivot pin 4.

To complete the structure, a spring means is provided to bias the first and second handle elements 2 and 3 and jaws 5 and 6 to their normal open position. For purposes of an exemplary showing, the ligator 1 is shown in Figures 1 and 5 as being provided with a leaf spring 33 constituting an integral one-piece part of second handle element 3. The free end of leaf spring 33 abuts the first handle element 2 and tends to urge the first and second handle elements 2 and 3 and the jaws 5 and 6 to their normal open position as shown in Figure 5. It will be understood by one skilled in the art that a metallic leaf spring or other spring-like device could be substituted for the molded plastic spring 33, if desired.

An exemplary and preferred embodiment of ligator clip is generally indicated at 34 in Figures 10 through 12. The clip 34 may be made of any appropriate material suitable for use in a surgical environment and for permanent residence in the human body. Tantalum, for example, has been found to be excellent for this purpose.

The clip 34 is generally of inverted U-shaped configuration having parallel leg portions 35 and 36 and a bridge or crown portion 37. While the crown portion may be arcuate, it is preferred that it have an inverted V-shaped configuration as shown in Figure 10.

The clip has edges 38 and 39 (see Figure 11) and when a plurality of clips are arranged in a row, the

edges 39 of one clip is in abutment with the edges 38 of the next adjacent clip, and so on, as shown in Figures 3, 7 and 8. This, therefore, is what is meant by the phrase "edge-to-edge relationship" as used

5 herein and in the claims.

To aid in gripping the tubular member to be clamped off, it is preferred that the inside surface of the legs 35 and 36 and the crown portion 37 be knurled. In Figure 12, the inside surface of leg 35 and the adjacent portion of crown 37 are shown as being provided with diagonal knurling generally indicated at 40. Preferably, the remainder of crown 34 and leg 36 will be similarly knurled but in the opposite direction. Alternatively, the inside surfaces of legs 35 and 36 and crown portion 37 can be double knurled as is generally indicated at 41 in Figure 13.

Figures 14 through 16 illustrate the application of clip 34 to a tubular member 42 such as a blood vessel. The ligator 1 (not shown) is cause to approach the tubular member 42 at an angle of about 45° thereto and the tubular member 42 is received between ligator jaws 5 and 6. The forwardmost clip of the row thereof is therefore located over tubular member 42 and at right angles thereto, as shown in Figure 14. As the jaws of the ligator approach each other, the uppermost portion of the crown will bend first bringing the free ends of the clip legs 35 and 36 together as shown in Figure 15. When the jaws 5 and 6 of ligator 1 are pivoted to their fully closed, clip-clamping position, the leg and crown portions of the clip are closed against each other with the tubular member 42 firmly clamped therebetween as shown in Figure 16. To assure that the crown portion of the clip first bends during the clip-applying procedure (in the manner shown in Figure 15), it is within the scope of the invention to provide a notch (shown in broken lines at 43 in Figure 10) on the inside surface of the crown portion of the clip at the position where the bend is to take place.

The ligator 1 and the clip 34 having been described in detail, the mode of operation of the ligator may be set forth as follows. The ligator is grasped by the surgeon with his thumb engaged in finger grip 7 and his middle finger (for example) engaged in finger grip 23. The ligator will normally be in its open position as illustrated in Figure 5. The cooperation of shoe 13 and compression spring 14 will assure that the forwardmost clip 10a of row 9 will be in abutment with locator stop 21 of jaw 5 and locator stop 28 of jaw 6. The ligator 1 is cause to approach the tubular member to be closed at an angle of about 45° thereto, with the tubular member located between jaws 5 and 6. Thereafter, the surgeon squeezes first and second handle element 2 and 3 toward each other and against the action of leaf spring 33. The jaw surface 22 of jaw 5 and the jaw surface 29 of jaw 6 will engage the legs of the forwardmost clip. Continued actuation by the surgeon will cause jaw 6 to wipe across the magazine 8 placing and clamping the forwardmost clip of row 9 in the manner described with respect to Figure 14 through 16. The ligator jaws are then permitted to pivot toward their open position by the surgeon and the ligator is lifted away from the tubular member

having been clamped, thereby removing the clamped clip from the ligator. The shoe 13 and compression spring 14 will immediately assure that the next adjacent clamp, now the forwardmost clamp of row 9, will abut locator stop surface 21 of jaw 5. If jaw 6 is not yet fully opened, the clip will simply abut the inside surface 27b of jaw 6. When jaw 6 reaches its fully open position, the clip will abut its locator stop surface 28 and the ligating procedure can be repeated.

Modifications may be made in the invention without departing from the spirit of it.

CLAIMS

80 1. A surgical ligator to locate and clamp a substantially inverted U-shaped clip about a tubular body member to close off the tubular member, said ligator comprising first and second handle element pivoted together in pliers-like fashion and terminating at their forward ends in clamping jaw portions, said first and second handle elements and their clamping jaw portions being pivotable between a normal open position and a closed clip-clamping position, means in association with said handle elements to bias said handle elements and their clamping jaw portions to said normal open position, a magazine for a row of clips, said clamping jaw portion of at least one of said handle elements having a locator stop for the forwardmost clip of said row to properly position said forwardmost clip for use, and means in said magazine independent of tool actuation energy to constantly urge and advance said row of clips to position said forwardmost clip of said row against said locator stop.

2. The structure claimed in claim 1 including a second locator stop on said clamping jaw portion on the other of said handle elements, said second locator stop being contacted by said forwardmost clip of said row when said first and second handle elements and their clamping jaw portions are in said normal open position.

3. The structure claimed in claim 1 including a shoe slidably mounted in said magazine and being in abutment with the rearwardmost clip of said row, and a compression spring in said magazine, behind said shoe, to constantly urge and advance said shoe and thus said row of clips to position said forwardmost clip of said row against said locator stop.

4. The structure claimed in claim 1, including a second locator stop on said clamping jaw portion on the other of said handle elements, said second locator stop being contacted by said forwardmost clip of said row when said first and second handle elements and their clamping jaw portions are in said normal open positions and including a shoe slidably mounted in said magazine and being in abutment with the rearwardmost clip of said row, and a compression spring in said magazine, behind said shoe, to constantly urge and advance said shoe and thus said row of clips to position said forwardmost clip of said row against said locator stop, said row of clips being contained at their front and sides by said jaws, and longitudinally between said locator stops and said shoe.

5 5. The structure claimed in claim 1 wherein said clips of said row lean rearwardly in said magazine so as to lie at an angle of about 45° to the long axis of said magazine.

5 6. The structure claimed in claim 1 wherein said means to bias said handle elements and their clamping jaw portions to said normal open position comprises a leaf spring, one end of said leaf spring being affixed to one of said first and second handle
10 elements, the other end of said leaf spring being free and constantly abutting the other of said first and second handle elements.

7. The structure claimed in claim 1 wherein said handle elements and their clamping jaw portions of
15 said ligator are molded of a plastic material suitable for use in a surgical environment.

8. The structure claimed in claim 1, wherein said magazine is formed as a longitudinal cavity in said first handle element.

20 9. The structure claimed in claim 1, wherein said jaws are provided with rails constituting extensions of said magazine.

10. The structure claimed in claim 1, wherein said row of clips is arranged in edge-to-edge re-
25 lationship to provide for short feed distance.

11. A surgical ligator to locate and clamp a substantially inverted U-shaped clip about a tubular member substantially as hereinbefore described with reference to the accompanying drawings.