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"LIGATING DEVICE"

This invention relates to a surgical ligator for locating and clamping a generally U-shaped clip about a tubular member.

The application is related to co-pending U.K. Patent Application No. 81/11817 corresponding to U.S. Patent Application No. 06/142675 filed 22nd April, 1980.

Ligating devices are well known and are used in surgical operations, wherever it is necessary to clamp off permanently a vessel, such as a vein. Generally, a U-shaped clip is placed about the vessel to be ligated and then the ligator is actuated to clamp the vessel, by means of the clip. In all heretofore available ligators, the actuation of the ligating mechanism also functioned to feed a clip into position to be formed. Thus, the effort of the surgeon not only did the clamping of the clip, but also the feeding of the clips into position to be clamped.

In the co-pending application referred to above, a spring urged magazine for clips was provided in one

of the two handle members of the ligator and as soon as one clip was clamped, a spring fed a succeeding ligator in position for the next clamping operation. Other known ligating devices are disclosed in U.S. Patent No.4152920 and U.S. Patent No.4166466 dated 4th September 1979 in the name of R.J. Harvick.

According to the present invention there is provided a surgical ligator to locate and clamp a substantially U-shaped clip about a tubular member to close off the tubular member, said ligator comprising a magazine housing containing a supply of said clips, said housing at its distal end terminating in a clip clamping portion, said ligator having a clip clamping handle and a clip feeding handle to be grasped by the hand of a surgeon in pliers-like fashion, said clip clamping handle being pivotally secured to said magazine housing and having a clip clamping end configured to co-operate with said clip clamping portion of said magazine housing to clamp a clip about a tubular member, said clip-clamping handle being shiftable by the hand of a surgeon between an open unactuated position and an actuated closed clip-clamping position, said clip feeding handle being pivotally secured to said magazine housing, said clip feeding handle being shiftable by the same hand of a surgeon between an open unactuated position and a closed actuated position, means

operatively connected to said clip feeding handle to shift the forwardmost clip of said supply from said magazine housing to a position between said clip clamping portion of said magazine housing and said clip clamping end of said clip clamping handle upon the shifting of said clip feeding handle from said actuated position to said unactuated position, and means to ensure proper sequential movement of said handles.

The invention also provides a surgical ligator to locate and clamp a substantially U-shaped clip about a tubular member to close off the tubular member, said ligator comprising a magazine housing containing a supply of clips, a clip clamping handle and clip feeding handle pivotally secured to said magazine housing, said housing at its distal end and said distal end of said clip clamping handle each terminating in a clamping portion, said clip clamping handle being operative to clamp one of said clips between said clamping portions upon actuation of said handles, and feed means for sequentially feeding said clips between said clamping portions to be clamped, said feed means including a feed element operatively connected to said clip feeding handle and shiftable upon actuation of said clip feeding handle to a ready position adjacent

the next clip to be fed from said magazine, and sequentially upon release of said clip feeding handle to a feed position in which said next clip is positioned by said feed element between said clamping portions to be clamped.

Thus, in this device also, the clamping of the clips about the vessel to be ligated requires the surgeon's effort whilst the feed of the clips takes place automatically during clamping of a clip.

By way of example, an embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a plan view of the device, according to the invention.

Figure 2 is a side elevational view thereof.

Figure 3 is a partial, cross sectional view, taken along the line 3-3 of Figure 5.

Figure 4 is a cross sectional view, taken along the line 4-4 of Figure 7.

Figure 5 is a cross sectional view, taken along the line 5-5 of Figure 1.

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Figure 5a is a fragmentary view, similar to Figure 5 showing the feed finger in its retracted position.

Figure 6 is a fragmentary, cross sectional view, through the proximal end of the device, showing the ends of the handles in their normal position.

Figure 7 is a partial, plan view of the distal end of the device, with a ligating clip partially closed.

Figure 8 is a view similar to Figure 7, showing the ligating clip fully closed.

Figure 9 si a fragmentary view, similar to Figure 6, but showing the handles of the device partially actuated.

DETAILED DESCRIPTION

As best seen in Figure 1, the ligating device comprises a magazine housing 10 having a cover 10a and a pair of handles 2 and 3. The handle 2 is pivotally secured to the magazine housing 10, by means of pivot pins 4, while the handle 3 is pivotally secured to the magazine housing by the pivot pins 5. It should be noted, that the handle 2 is the clip clamping handle, while the handle 3 is the clip feeding handle.

As best seen in Figure 3, the magazine housing 10, includes a supply of clips 6 disposed in end-to-end relation, a feeder plate 7 and a spring 8.

As best seen in Figure 4, the magazine housing 10 is provided with a cover 10a. The feed finger track plate is indicated at 9 and it houses the feed finger 11. Thus, the feed finger 11, is guided in the feed finger track plate 9. The parts are held in position in the magazine by means of the magazine housing cover 10a, which is attached to the magazine housing 10, in any suitable manner.

As is best seen in Figure 6, the clip feeding handle 3, is biased normally against a stop pin 12, by means of the resilient element 13. The clip clamping handle 2, is normally biased against the stop pin 14, by the resilient member 15. A bell crank 16, is pivotally mounted in the handle 3, by pivot pin 17. The bell crank 16, is operatively connected to the actuating pin 18, which is fixedly mounted in the magazine housing 10. The bell crank 16 is also operatively connected to an actuation rod 19, by a pivot pin 20 and the other end of the actuation rod 19, houses a bushing 21, which is operatively connected to the feed finger 11. It must be observed that the resilient member 15, which biases the clip clamping handle 2, against the stop pin 14 (which moves in the arcuate slot 14a) is stronger than the resilient member 13 which biases the handle 3 against the

stop pin 12 (which moves in the arcuate slot 12a). The pin 18 can move in the slot 18a.

In the Figures, the vessel to be ligated is indicated at 30. Referring to Figures 5 and 5a there is shown a magazine housing detent 31 and it will be clear that the spring 8 and the feeder plate 7, bear against the last of the supply of clips 6 and urge them toward the distal end of the device and up against the magazine housing detent 31.

OPERATION OF THE LIGATOR

From the foregoing description, it should now be clear that, assuming a supply of clips to be disposed in the magazine housing 10-10a, the spring 8 and the feeder plate 7 will urge the supply of clips 6 forwardly, toward the distal end of the device and up against the magazine housing detent 31. The first operation of the device, will have to involve a squeezing of the handles together, without attempting to place a clip, simply so that the feeding finger will be retracted from the distal end of the device and by contact with the detent 31, will be caused to hop over the detent 31 and move to a position behind the next clip in the magazine. Then, as the handles are released, the feed finger 11 will move from the position shown in Figure 5a, to the position shown in

Figure 5, where it has moved the first clip in the magazine into the clamping portion of the device, ready for emplacement to ligate a vessel. As feed finger 11 is pushed forward against the first clip in the magazine, the detent 31 is depressed, permitting the feed finger 11 and the first clip 6 to advance to the clamping portion of the device. When the feed finger 11 and the first clip 6 have passed over the depressed detent 31,it is permitted to spring back into place, thereby positioning the next clip to be fed.

The way in which this is accomplished can best be seen by a comparison of Figures 6 and 9. Figure 6 shows the proximal end of the device, in its unactuated position. It will be seen that the resilient member 15 urges the clamping handle 2 in a counterclockwise direction so that the handle stops in a position with the stop pin 14 against the left hand end of the slot 14a, as seen in Figures 6 and 9. At the same time, the feeding handle 3 is forced by its resilient member 13 to a position in a clockwise direction such that the stop pin 12 abuts the right hand end of the slot 12a.

Upon initial actuation of the device, since the resilient member 13 is weaker than the member 15, the handle member 3 will start to move in a counterclockwise direction, and as it does so, the pin 18 acting

in the slot 18a causes the bell crank 16 to move in a clockwise direction and to pull the actuating link 19 downward, as seen in Figures 6 and 9. This is what causes the feeding finger to be retracted to a position to feed the next clip.

When the handle member 3 has moved to a position where surface 3a of handle member 3 is in contact with surface 10c of magazine 10, the resilient element 15 begins to yield and the clamping handle member 2 then begins to close the clip 6, as shown in Figure 7. It will be noted, that the clamp closes with its open end first, so as to capture the vessel 30. Further compression of the clip then completely ligates it as seen in Figure 8. Surface 2a of clamping handle 2, in co-operation with surface 10b of magazine 10 serves as a stop for clip clamping , thereby prohibiting overload of the device.

As the surgeon releases the handle members 2 and 3, the linkage described in connection with Figures 6 and 9 operates in the reverse direction and causes the feed finger, which is now in the position shown in Figure 5a, to move toward the distal end of the device to the position, shown in Figure 5, advancing the next clip 6 into position to be clamped about a vessel.

It will be seen that the feeding of clips, into position for clamping, takes place automatically during clamping of a clip and is accomplished when the surgeon releases the handles 2 and 3.

By reference to Figure 3, it will be noted that there is a hole 7a in the plate 7. The purpose of this is to prevent utilization of the ligator when all the ligating clips have been expended. It accomplishes this by the feed finger co-operating with the hole 7a, to advance the feeder plate 7 into the clamping area of the device.

It will be noted that, once the handles have been actuated in a new ligator, there will be a clip in position to be formed, when the ligator is in its unactuated position. Thereafter, each time a clip is emplaced and the handles are released, another clip is fed into position for subsequent emplacement. In actual practice, when a ligator is manufactured, it is tested several times before packaging and sterilization. Thus, when a ligator is unpacked for use in the operating room, it will already have a clip in position to be clamped.

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CLAIMS:

1. A surgical ligator to locate and clamp a substantially U-shaped clip about a tubular member to close off the tubular member, said ligator comprising a magazine housing containing a supply of said clips, said housing at its distal end terminating in a clip clamping portion, said ligator having a clip clamping handle and a clip feeding handle to be grasped by the hand of a surgeon in pliers-like fashion, said clip clamping handle being pivotally secured to said magazine housing and having a clip clamping end configured to co-operate with said clip clamping portion of said magazine housing to clamp a clip about a tubular member, said clip clamping handle being shiftable by the hand of a surgeon between an open unactuated position and an actuated closed clip-clamping position, said clip feeding handle being pivotally secured to said magazine housing, said clip feeding handle being shiftable by the same hand of a surgeon between an open unactuated position and a closed actuated position, means operatively connected to said clip feeding handle to shift the forwardmost clip of said supply from said magazine housing to a position between said clip clamping portion of said magazine housing and said clip

clamping end of said clip clamping handle upon the shifting of said clip feeding handle from said actuated position to said unactuated position, and means to ensure proper sequential movement of said handles.

2. A ligator as claimed in claim 1 having a magazine housing detent means adjacent said clamping portion, and means continuously urging said supply of clips against said detent means, said clip shifting means operative upon release of said clip feeding handle, serving to push a leading clip past said detent means between said clamping portion of said magazine housing and said clip clamping end of said clip clamping handle.

3. A ligator as claimed in claim 2 wherein a feeder plate is disposed in said magazine housing behind said supply of clips and a spring is arranged behind said feeder plate to urge said supply of clips continuously toward said clamping portion and against said detent means, said means to shift said forward-most clip comprising a feeding finger in said magazine housing and a linkage between said feeding finger and said clip feeding handle, such that said feeding finger is retracted from said clamping portion when said clip feeding handle is shifted from said open unactuated position to said closed actuated position, and advanced

toward said clamping portion when said clip feeding handle is released to said open unactuated position, to push a clip past said detent means and between said clamping portion of said magazine housing and said clamping end of said clip clamping handle to be clamped on the next actuation of said handles.

4. A ligator as claimed in claim 3 wherein said clamping handle is pivotally secured to said magazine housing adjacent said clamping portion for mechanical advantage, and said feeding handle is pivotally secured to said magazine housing at a point further removed from said clamping ~~handle~~ portion.

5. A ligator as claimed in claim 4 wherein each of said handles is biased against a stop, to normally occupy an open position.

6. A ligator as claimed in claim 5 wherein said biasing means for said clip clamping handle is stronger than said biasing means for said clip feeding handle whereby upon actuation of said handles, said feeding handle moves first to retract said feeding finger, and after said feeding finger is retracted, said clamping handle moves to clamp a clip which is in position between said clamping portion of said magazine housing and said clip clamping end of said clip clamping handle.

7. A ligator as claimed in any preceding claim wherein means are provided to prevent actuation of the ligator when the said supply of clips is exhausted.

8. A ligator as claimed in any preceding claim wherein a clip is initially disposed in position between the clamping portion of said magazine housing and the clamping end of the said clamping handle when said handles are in their unactuated positions.

9. A surgical ligator to locate and clamp a substantially U-shaped clip about a tubular member to close off the tubular member, said ligator comprising a magazine housing containing a supply of clips, a clip clamping handle and clip feeding handle pivotally secured to said magazine housing, said housing at its distal end and said distal end of said clip clamping handle each terminating in a clamping portion, said clip clamping handle being operative to clamp one of said clips between said clamping portions upon actuation of said handles, and feed means for sequentially feeding said clips between said clamping portions to be clamped, said feed means including a feed element operatively connected to said clip feeding handle and shiftable upon actuation of said clip feeding handle to a ready position adjacent the next clip to be fed from said magazine, and sequentially upon release of said clip

feeding handle to a feed position in which said next clip is positioned by said feed element between said clamping portions to be clamped.

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