Jan. 6, 1942. S. F. LI 2,268,755

LIGATURE TIER

Filed May 1, 1939

FIG_2_

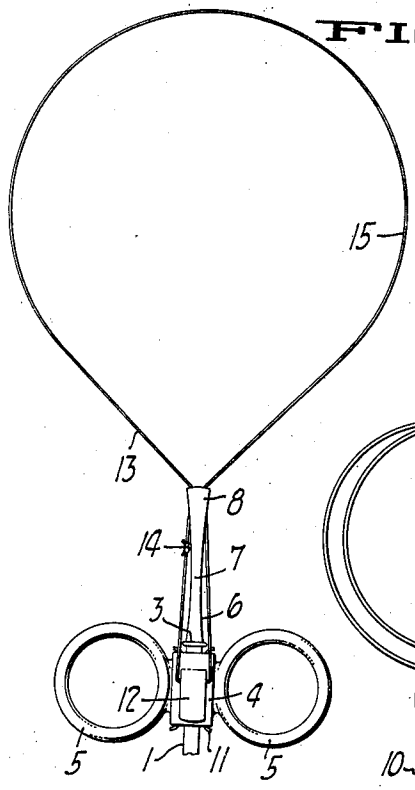
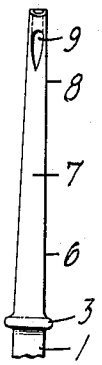


FIG_4_



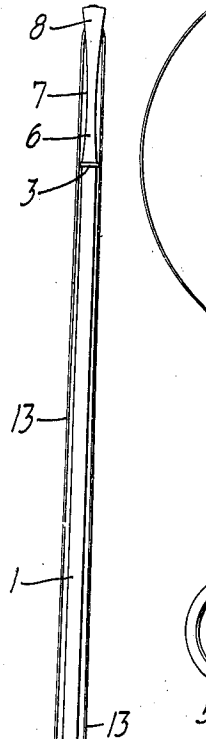


FIG_1_

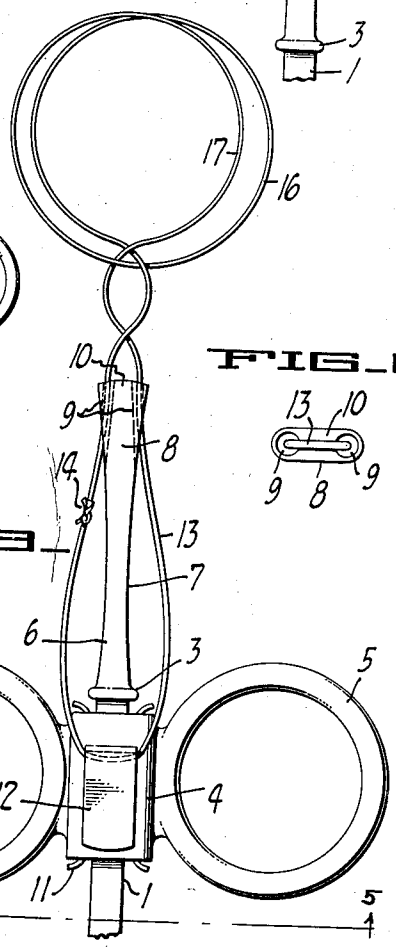
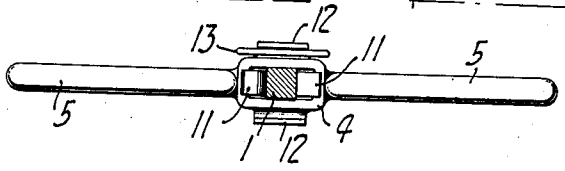


FIG_6_

FIG_3_

FIG_5_



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LIGATURE TIER

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Application May 1, 1939, Serial No. 271,044

1 Claim. (Cl. 128—326)

This invention relates to a ligature tier, and has for its objects the provision of simple and easily manipulated means for positively tying blood vessels, particularly where such blood vessels are positioned in places where they cannot readily be tied by hand, although this invention greatly facilitates the tying operation irrespective of where the vessel to be tied is located. Another object of the invention is a tier adapted to secure a tight clove hitch around a blood vessel. Other objects and advantages will appear in the following specification and in the drawing.

In the drawing,

Fig. 1 is an elevational view of the tier.

Fig. 2 is an elevational view of the tier showing the same positioned preparatory to forming a clove hitch.

Fig. 3 is a fragmentary elevational view showing the outer end of the device of Fig. 1 with the clove hitch formed preparatory to positioning over a blood vessel.

Fig. 4 is an enlarged view of the outer end only of my tier, taken at right angles to the view of Fig. 1.

Fig. 5 is an enlarged sectional view taken along line 5—5 of Fig. 3.

Fig. 6 is an enlarged end view of the tier showing the outer end.

In detail, my tier comprises a straight elongated rod 1 provided with a ring 2 at one end projecting outwardly from said one end, which ring is adapted to receive therein the thumb of the operator. Relatively close to the opposite end of said rod, the same is formed with a slight enlargement or ridge 3 projecting radially outwardly of the longitudinal axis of said rod, which ridge is adapted to form a stop or abutment for a sleeve 4 that is slidably fitted on the rod for sliding longitudinally of the latter between the ring and the said stop 3. The length of said rod between the ring 2 and stop is preferably square in cross-section, with the bore of the sleeve also square, to prevent rotation of the sleeve on said rod.

Said sleeve is provided with a pair of rings 5 secured thereto, one ring projecting laterally outwardly of one side of the sleeve and the other ring projecting outwardly of the opposite side thereof. Said rings 5 are disposed in the same plane as the plane of ring 2, and said rings, respectively, are adapted to receive therein the index and middle finger of the hand of the operator, when the thumb of such hand is inserted in ring 2. Thus, with the fingers in the above position, it is obvious that the rod, with the sleeve thereon, will be supported by the three above designated fingers, for directing the outer end of the rod in any desired direction and for positioning said outer end in the desired position. Also when sleeve 4 is spaced from the handle, the former may be readily pulled toward the handle by drawing the rings 5 toward said handle while the thumb supports the rod stationary.

The extension 6 of rod 1 that projects axially outwardly of the latter beyond the stop 3, is preferably formed with two relatively flat opposite sides that taper convergently from stop 3 outwardly, and the width of the said extension 6 in the planes of said sides is restricted intermediate opposite ends of the extension to form a neck portion at 7. This restriction of said extension is relatively gradual, rather than abrupt, thus the outer end of the extension flares outwardly to its widest dimension to form a flared relatively flattened end 8 with the widest dimension at the extreme outer end of the rod.

Extending axially of the extension from the restricted portion of its neck, two passageways 9 are provided, which passageways are at opposite sides of the axis of said extension, and open outwardly of the outer end of the extension leaving a relatively small portion 10 of the stock of said extension between said openings.

In order that the sliding fit of sleeve 4 on rod 1 be sufficiently tight to insure the sleeve remaining in any desired position between stop 3 and the ring 2 independently of the fingers of the operator holding the same in such position, I preferably secure a flat, bowed spring 11 or the like, between one wall of the bore through said sleeve and the rod, or such springs may be at opposite sides of the bore and rod, as indicated in the drawing, the spring being adapted to react between the sleeve and rod to frictionally hold the sleeve against accidental sliding, but the resistance to its sliding not being enough to be objectionable when the operator desires to effect movement of the sleeve.

As already described, rings 5 are disposed at two of the opposite sides of the sleeve 4. The opposite remaining two sides carry hook members 12 that are directed toward the end of the rod carrying ring 2. These hook members are flat short strips secured at one of their ends to the end of the sleeve nearest the outer end of the rod, which strips are substantially the width and length of the side of the sleeve to which they are respectively secured.

The opposite ends of the strips are free from securement to the sleeve. The side of each strip or hook member adjacent the wall of the sleeve opposed thereto, extends slightly divergently relative to said wall from its end that is secured thereto, thus forming space of substantially wedge shape with the apex thereof at the ends nearest the outer end of the rod.

The ligature of this invention is a thread 13 of the conventional linen material, which ligature is threaded through one of the openings 9 from the end of the latter adjacent stop 3, and is then

passed over the portion 10 between said openings and is threaded through the opposite opening 9 in direction from the outer end of the opening toward the inner end of the extension 6, or toward ring 2. The portions of the ligature extending from the inner ends of openings 9, are then tied together as at 14, to form an endless loop, which, when passed over one of the hook members 12 to be engaged thereby, and when sleeve 4 is moved relatively close to the ring 2, but slightly spaced from the latter, will draw the ligature taut between said hook member and the outer end of the extension 6, as shown in Fig. 1.

Insofar as the elements of the ligature tier itself is concerned, with the attachment of the ligature, as above described, the assembly is complete.

In explanation of the operation of the device, a brief description may be helpful. In tying a blood vessel, it is essential that at least two turns of the ligature around the vessel be established, and that the knot or hitch be of a character to insure against accidental loosening before the vessel is sufficiently healed to in itself secure the same closed. The clove hitch is not only highly satisfactory to effect this result, but is recommended. However, the difficulty of tying blood vessels in relatively inaccessible places by use of the fingers only, whether the clove hitch is used or any other knot or hitch, is apparent. Attempts have been made to develop instruments that will accomplish the tying in two operations, that is by making one turn around the vessel with the ligature, and then tying a simple knot, and then making another turn and repeating the operation. With my device the entire tying is accomplished in one operation from manipulation by the fingers outside the body of the patient and the ligature may be drawn as tightly about the vessel as desired, being only limited by the tensile strength of the ligature.

Referring to Fig. 2, the sleeve 4 is first moved toward stop 3 a sufficient distance to enable drawing the ligature outward of the openings 9 to provide a relatively large loop 15. By spreading this loop laterally between several slightly bent fingers of the right and left hand, respectively, with the palm of the left hand and the rear side of the right hand facing the operator, it will be seen that the bent fingers of the right hand will be directed away from the operator and the bent fingers of the left hand will be facing toward the operator, with said fingers of both hands within the loop 15. By rotating the right hand a half turn clockwise and the left hand a half turn counter-clockwise, two loops 16, 17 (Fig. 3) will be formed, one enclosing the aforesaid several fingers of the right hand and the other enclosing the aforesaid fingers of the left hand. Now by slipping together the palm sides of the fingers of the right and left hand that are in said loops, by moving the ends of said fingers toward each other until the loops are brought together, the loops of the clove hitch (Fig. 3) are formed ready for tightening about a blood vessel. In actual practice a plurality of the rods with the loops of the clove hitch pre-formed, may be suspended from spreaders disposed in said loops ready for instant use by the surgeon.

To position the loops of the clove hitch over a blood vessel, the end of the vessel is secured closed in the usual manner between the jaws of one end of a pair of conventional artery forceps. The loops of the clove hitch are then slipped over the handles of said artery forceps and the thumb, index and middle finger of the operator are then engaged in rings 2 and 5 as already described. By drawing sleeve 4 toward ring 2 by manipulation of said fingers, the loops of the hitch are closed, due to engagement of the outer end of extension 6 with the point of crossing of the threads of the loops adjacent thereto. The restricted loops are then moved over the jaws of the artery forceps and over the blood vessel and are tightened about said vessel by further drawing of sleeve 4 toward the inner end of rod 1. When the loops are tightened sufficiently, the forceps are removed and the portions of the ligature outward of the loops are slackened by slipping sleeve 4 toward the outer end of the tier, and then said portions are severed at points relatively close to the knot thus tied.

It is apparent that the operation of positioning and tightening the clove hitch can be rapidly accomplished without inconvenience to the patient or operator, and the hitch can be exactly positioned wherever desired, and tightened to any desired degree of tightness, from a point remote from the blood vessel and outside the body of the patient. It is particularly important to note that the clove hitch provides the double turn of the ligature about the blood vessel and provides a non-slipping knot when tightened.

It is, of course, obvious that the description as to the forming of the loops to provide the clove hitch preparatory to application thereof over the blood vessel, might be accomplished in other ways than in the manner described, but the manner I have described has been found convenient. The important thing is that an enlarged clove hitch is pre-formed outwardly of the outer end of rod 1, with the ends of the thread extending away from the loops of the hitch being secured to means adapted to be manipulated to tighten the loops about a blood vessel.

While the foregoing description is specifically directed to tying a clove hitch, which provides a double turn of the ligature around the blood vessel, which is preferable, it is intended that the scope of the claim cover any knot or hitch adapted to be formed in a loop, such as shown in Fig. 2 and in which the tightening of such hitch will be effected by manual manipulation of a device outwardly of the hitch, substantially in the manner as described herein.

Having described my invention, I claim:

The method of tying a ligature about the end of a severed blood vessel that comprises forming an endless ligature into a pair of open loops adjacent each other at one of their sides and connected together at said sides by separate portions of the ligature in a manner for restricting the opening in one loop by pulling on the other loop; slidably supporting said portions in a guide element for axial movement of such portions; forming said one loop into a clove hitch in which said portions are continuations of the ends of said hitch; engaging the said other loop over a support movable in direction away from said guide element and clove hitch with such support extending through said other loop, positioning the clove hitch over such end of a blood vessel with the latter extending through the loops of the clove hitch and thereafter moving said support in said direction while holding the guide element adjacent said vessel and while maintaining said support extended through said other loop until the loops of the clove hitch are tightened about said vessel.

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