Nov. 13, 1928. 1,691,386

B. FISHER

SURGICAL INSTRUMENT FOR MAKING LIGATURES

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Fig. 1

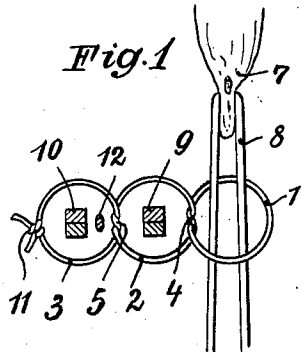


Fig. 2

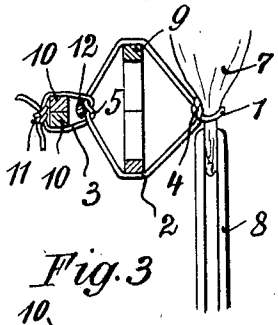


Fig. 3

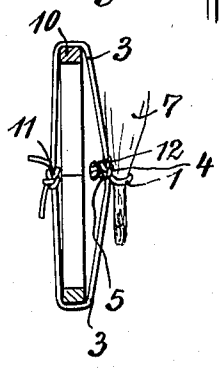


Fig. 8

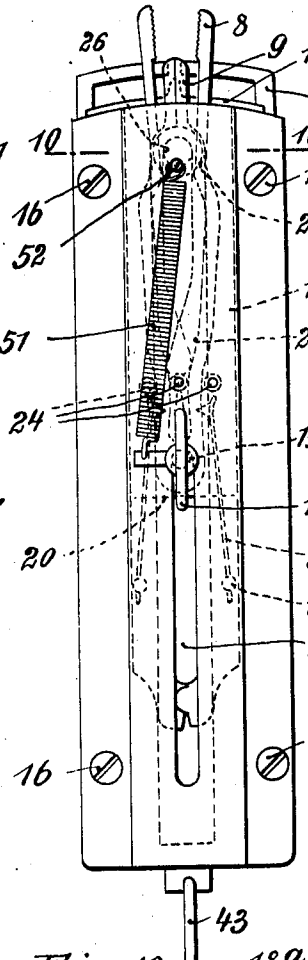


Fig. 9

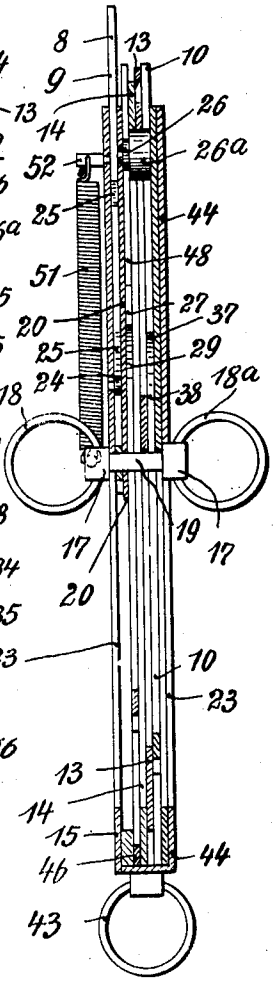
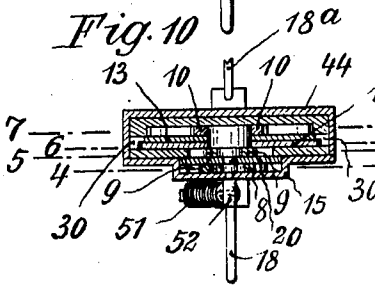


Fig. 10



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SURGICAL INSTRUMENT FOR MAKING LIGATURES

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Fig. 4

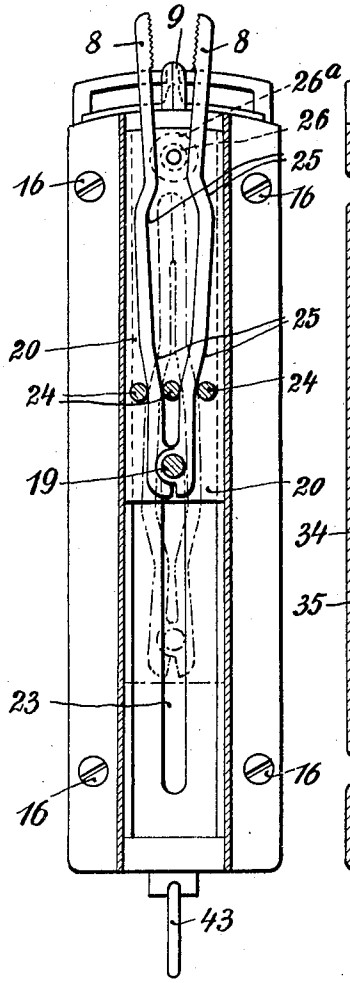


Fig. 5

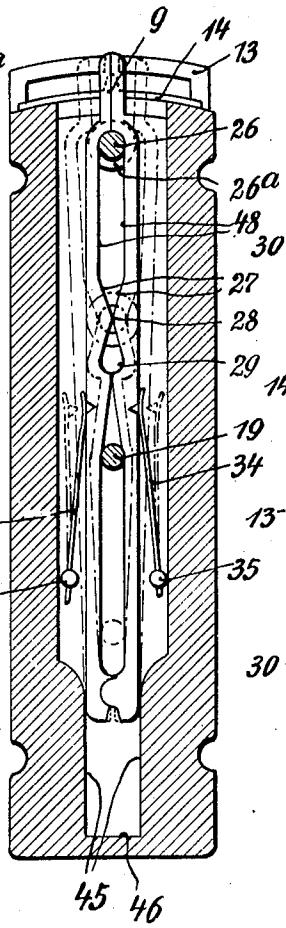
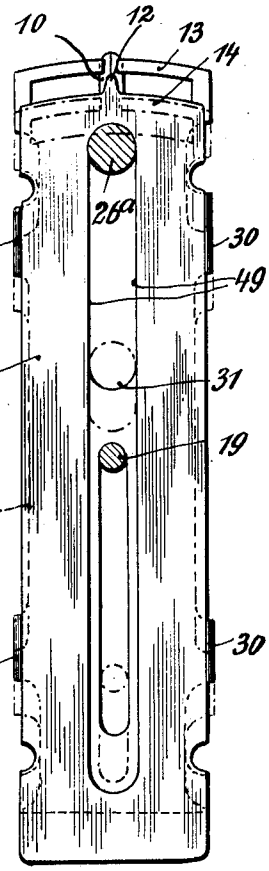


Fig. 6



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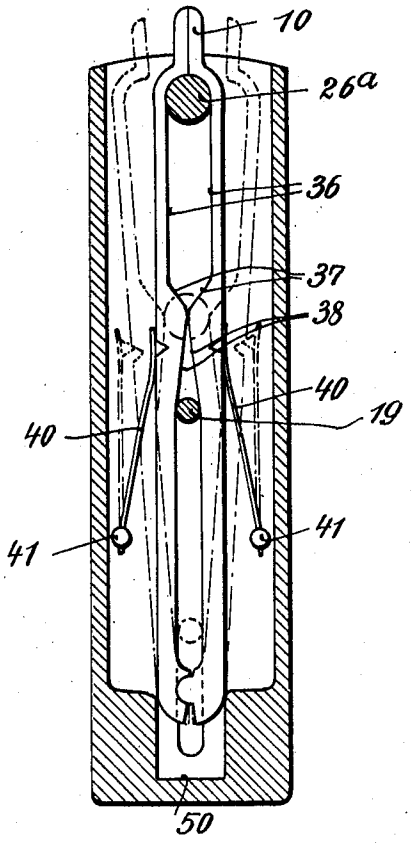
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SURGICAL INSTRUMENT FOR MAKING LIGATURES

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Fig. 7



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Patented Nov. 13, 1928.

1,691,386

UNITED STATES PATENT OFFICE.

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SURGICAL INSTRUMENT FOR MAKING LIGATURES.

Application filed April 12, 1927, Serial No 183 116, and in Germany April 16, 1926.

In operative surgery where tissues are to be severed and accidental bleeding is to be staunched by applying ligatures, clamping implements equipped with locking means are usually employed for compressing the bleeding tissue or arteries prior to tying up the same by means of a cat-gut thread which involves considerable work.

This is objectionable inasmuch as the operative surgeon, when compelled by an incidental bleeding to stop and interrupt the main operation must take care of the intercurrent hemorrhage involving the application of ligatures which is, at the present state of the art, a wearisome time consuming work.

The object of my invention is to remedy this defect and with this object in view I provide a new instrument for automatically or mechanically ligating bleeding tissues, arteries and the like by means of a three-loop cat-gut thread or the like in which the three loops are interconnected by displaceable, loose ties or convolutions and the third loop is closed by a regularly tied knot so that when the first loop is placed over and about a bleeding tissue cone for the ligating purpose, the said ties or convolutions between the three loops can be displaced under tension and in succession towards the bleeding tissue so as to first tie up or strangulate the latter and subsequently form a regularly tied locking knot thereon in the manner of a hand-made ligature. The said displacement of the intermediate loose ties or convolutions is mechanically accomplished by successively enlarging or stretching the first loop and the second loop of the prepared cat-gut thread, as will be explained more in detail in the following specification and with reference to the accompanying drawings.

As regards the construction and operation of the instrument embodying my invention in general, the same comprises a clamping or compressing device, a duplicate stretching device and preferably also a thread severing device, all assembled in a frame or casing provided with means for the operating surgeon to handle the instrument with one hand so at to bring about at one pull only the successive operations of compressing the tissue or artery to be ligated, tying up the same, forming the locking tie or knot and cutting off the useless thread.

The compressing device preferably is a forceps and the stretching devices are forceps-like implements disposed in juxtaposition with the severing device preferably located between them, the arrangement being such that, upon the pull of the operator's hand, the forceps encircled by the first loop of the duly prepared three-looped cat-gut thread, will close and move inwards with the tissue or artery compressed between its jaws and held ready for the application of the ligature, thereafter the one stretching implement encircled by the second loop of the thread will open to tie up the first convolution, thereupon the said stretching implement will likewise move inwards and at the same time the second stretching implement encircled by the third loop of the thread will open to tie up the second convolution for the production of a properly locked knot or ligature, and finally the two-bladed severing device, if provided, will be operated to cut off the useless thread.

Three-loop cat-gut threads for use in connection with my improved instrument may be kept in stock. Prior to making a ligature a single piece of such threads is to be attached to the instrument in a manner that the three loops will encircle respectively, the free ends or jaws of the forceps and the two stretching implements. If desired, a device for automatically supplying a thread to the three operating members as required or each time a ligature has been made, may be combined with the instrument.

Having thus set forth in general the principles upon which my invention depends and having shown the particular improvements effected over the prior art, reference now is had to the following detailed specification and drawings in which there is exhibited one example or embodiment of the invention which is in no way intended as a limitation upon the scope of the appended claims, as it is to be clearly understood that variations and modifications which properly fall within the true scope of said claims may be resorted to when found expedient, and the right is reserved to embodiments other than that actually illustrated herein to the full extent indicated by the general meaning of the terms in which the claims are expressed.

In the accompanying drawings forming a part of this specification and showing for purposes of exemplification a preferred form

and manner in which the invention may be embodied and practised, but without limiting the claims to such illustrative instance:

Figures 1 to 3 are diagrammatic views illustrating the mode of operation in tying up a bleeding portion or cone of tissue; Figure 4 is a section taken on the line 4—4, Figure 5 a section taken on the line 5—5, Figure 6 a section taken on the line 6—6 and Figure 7 a section on the line 7—7 of Figure 10; Figure 8 is a front view of the instrument shown in Figure 7; Figure 9 is a longitudinal sectional view, and Figure 10 is a section taken on the line 10—10 of Figure 8.

Referring to Figures 1 to 3 I will first explain the manner in which a surgical ligature is to be made with the aid of the instrument. The cat-gut threads usually employed for ligatures, are tied into three successive bows or loops 1, 2 and 3 with a single, loose tie or convolution 4 between the loops 1 and 2, a similar loose tie 5 between the loops 2 and 3 and a fixed or double-tied regular knot 11 connecting the two ends of the thread, as will be readily understood on inspection of Figure 1.

The instrument comprises a foreceps 8, a two-bladed or shanked stretching device 9 which I call a stretcher and a similar device or stretcher 10, all the three devices or tools 8, 9 and 10 being arranged in parallel relationship in the instrument so as to allow of the following manipulations and proceedings.

The first loop 1 is placed about the forceps 8 serving to grip and hold the bleeding part or tissue 7 which I call a "tissue cone" on account of its more or less conical shape, the second loop 2 is laid about the closed stretcher 9 and the third loop 3 is placed about the other stretcher 10, a fixed nose or member 12 being provided in the instrument to also project through the loop 3 between the stretcher 10 and the loose tie 5, so as to afford a backing for the tie 5. The position of the single parts so far described are clearly illustrated in Figure 1.

After the tissue cone 7 has been gripped by the forceps 8, the loop 1 is placed about the tissue cone, whereupon the stretcher 9 opens in order to stretch or widen the loop 2 with the result that the loop 1 will contract and the loose convolution or tie 4 move towards the tissue cone so as to firmly tie up the latter or the bleeding artery therein, whilst the convolution or tie 5 moves at the same time towards and onto the stationary backing 12.

The proceedings and positions of the single parts so far described are fully shown in and apparent from Figure 2.

In the next step the stretcher 10 opens and, in accordance therewith, the stretcher 9 closes and moves out of the loop 2 so as to allow the stretcher 10 to widen the loop 3 to the full compass of the two loops 2 and 3 combined and to thereby move the tie 5 towards the tie 4 and interlock the same in the regular way of tying an ordinary fixed knot.

The proceedings and positions of the single parts so far described are readily apparent from Figure 3. It will be seen that the parts 1, 4 and 5 of the cat-gut thread in Figure 3 form a correct surgical ligature, a scissorlike device being provided in the instrument shown for cutting off the two ends of the thread near the knot 4, 5 as will be explained more in detail in the following description of the instrument.

As above stated a preferred construction of the instrument is illustrated in Figures 4 to 10. The operating parts of the instrument are enclosed in working relationship in an approximately rectangular frame or casing 44 with a cover or lid 15 detachably affixed thereto by means of screws 16, see Figure 8. The instrument is intended to be handled by three fingers of the surgeon's hand, three rings 43, 18 and 18^a being provided for the purpose at proper places on the casing, the ring 43 serving for the reception of the thumb and the two rings 18 and 18^a serving for the reception of the fore finger and the middle finger. The ring 43 is firmly connected with the end or bottom wall of the casing, whilst the bosses 17 of the rings 18 and 18^a are provided with screw-threaded holes (not shown) fitting on the two threaded ends of a bolt 19 for rigid engagement therewith, as will be seen in Figure 9.

The bolt 19 forms the pivot of the forceps 8 and is held in the position shown in Figures 8 and 9 by the agency of a coiled spring 51. The one end of the spring 51 is attached to a pin 52 fixed to the lid 15 and the other end of the spring is connected with a lug or nose integral with the one boss 17. The bolt 19 is located or arranged in two longitudinal slots 23 of the casing and the lid, respectively, and adapted to be moved therein in the direction towards the thumb-ring 43 against the tension of the spring 51. Mounted on the bolt 19 is a slide 20 arranged to move together with the bolt 19 and which carries a fixed, stepped cam or equivalent formation, the smaller step 26 of the same engaging between the shanks of the one stretcher 9, see Figure 5, and the larger step 26^a thereof controlling a scissorlike cutting device 13, 14, see Figure 6, and engaging between the shanks of the other stretcher 10, see Figure 7.

In the Figures 4 to 7 the operating members, such as the forceps, the stretches and the scissors, are shown in two positions, the one drawn in full lines and the other one drawn in dotted or dot-and-dash lines.

The shanks of the forceps 8, see Figure 4, for gripping and compressing the bleeding tissue 7 or the like while surrounded by the first loop 1 of the cat-gut thread, as described with reference to Figure 1, are curved or bent to form camming tracks 25 for co-operation with

pins 24 immovably seated or fixed in the casing, so that as or when the bolt 19 equipped with the two rings 18 and 18ª, is moved in the slots 23 down towards the ring 43, the shanks of the forceps 8 will be closed for the gripping purpose.

The shanks or arms of the stretcher 9, see Figure 5, for applying the convolution or loose tie 4, see Figure 1, onto the bleeding tissue 7, see Figure 2, are likewise curved or bent to form camming tracks 48 for co-operation with the cam-step 26. When the bolt 19 with the slide 20 is moved downwards in Figure 5 the cam-step 26 first runs idle in the track 48, but on striking upon the inclined faces 27 of the shanks, the latter will open and thereafter close again when the cam-step 26 has passed beyond the contacting points 28 of the track. The means employed for closing the stretcher 9, as above stated, comprise two springs 34 fixed in stationary pins or lugs 35 and arranged with their free ends to exert pressure on the shanks of the stretcher, as will be readily understood on inspection of Figure 5. As soon as the cam-step 26 has passed over and beyond the contacting points 28 of the track so as to be received by the snugly fitting cavity 29 of the track, the cam-step 26 will act, owing to the continued down-movement of the bolt 19, to move the stretcher 9 bodily and in closed position downwards and with its bottom ends sliding in the guiding recess 45. The bottom wall or face 46 prevents the stretcher from slipping out of the casing.

The other stretcher 10 for the reception of the loop 3, see Figure 1, is constructed and arranged in a manner similar to that of the stretcher 9 hereinbefore described. The shanks of the stretcher 10 are curved or bent to form a track comprising an idle section 36, an inclined section 37 and a section 38 for the stretching actuation above described with reference to Figure 3, as will be clearly understood on inspection of Figure 7. In the latter figure it will be seen, that the cam-step 26ª serves to actuate the stretcher by co-operating with the shanks thereof forming the track, springs 41 fixed in stationary studs 40 being provided for holding the shanks in closed position just as described with reference to the springs 34 in Figure 5. The bottom wall and face 50 prevents the stretcher 10 from slipping out of the casing.

Intermediate between the two stretchers 9 and 10 a scissorlike severing device is provided. The same comprises a stationary plate 14 and a second plate 13 closely adjacent to the plate 14 and adapted to be moved lengthwise with relation to the latter. The co-operating edges of the two plates are sharpened for the cutting purpose as will be seen in Figure 9. The top of the plate 14, see Figure 6, is shaped to form the nose 12 for giving a hold to the convolution or loose tie 5 in the operation of widening the loop 2 by means of the stretcher 9, as hereinbefore explained with reference to Figure 2.

The movable plate 13 is controlled by the cam-step 26ª of the slide 20. Upon the downward movement of the bolt 19 the cam-step 26ª first runs idle in the longitudinal slots or track 49, but as soon as the step 26ª hits the lower edge 31 of the slot of the plate 13, the plate 13 will be caused to move along with the slide 20 so that the sharpened top edges of the two plates will grip the cat-gut threads between them and sever the same near the tied knot 4, 5, as described with reference to Figure 3. To ensure a proper sliding movement the plate 13 is provided with laterally bent edge pieces or flanges 30 adapted to get hold of and slide on the edges of the stationary plate 14.

After the ring-armed bolt 18 has been moved down to its lowermost position and the ligature thus has been properly applied, the spring 51 will act to return the several parts to their initial positions.

What I claim is:—

1. A surgical instrument for making ligatures, comprising in combination a casing, a forceps and a plurality of knotting stretchers operatively mounted in the casing, and a common actuating means for successively operating the forceps and the individual stretchers.

2. A surgical instrument for making ligatures, comprising in combination a frame or casing, a forceps in said casing, two stretchers in said casing, the said forceps and stretchers adapted to move lengthwise in succession upon the manual actuation of a controlling member with the result that the forceps will be closed and withdrawn into the casing, the one stretcher then will open and close and likewise withdraw into the casing whereupon the second stretcher will open, substantially as and for the purpose set forth.

3. A surgical instrument for making ligatures, comprising in combination a casing, a forceps and a plurality of knotting stretchers operatively mounted in the casing, and a slide mechanism movable in the casing and operatively connected with the forceps and the stretchers so that the movement of the slide mechanism in one direction initially positions the forceps, and stretchers preliminary to a knotting operation and movement of the slide in the other direction successively actuates the forceps and the individual stretchers.

4. A surgical instrument for making ligatures, comprising in combination a frame or casing, a forceps and two stretchers mounted in parallelism in said casing and adapted to move lengthwise therein, a controlling bolt, adapted to be displaced in longitudinal slots of the casing, a slide supported by said bolt so as to move along therewith, and a cam member connected with the said slide and adapted to control the movements of the stretchers.

5. A surgical instrument as claimed in claim 4, wherein the forceps comprises members with camming shanks pivoted on the bolt, and pins on the slide engaging the camming shanks to actuate the forceps during movement of the slide.

6. A surgical instrument as claimed in claim 4, wherein the bolt and the slide are returned to their initial position by a spring attached at its ends respectively to the casing and to the bolt.

7. A surgical instrument as claimed in claim 4, wherein the cam member is stepped, the smaller step thereof serving to control and open one of the stretchers, and springs for returning the opened stretchers to closed position.

8. A surgical instrument as claimed in claim 4, wherein the cam member is stepped, the larger step thereof serving to control and open one of the stretchers, and springs for returning the opened stretchers to closed position.

9. A surgical instrument as claimed in claim 4, wherein a severing device is provided between the two stretchers.

In testimony whereof I affix my signature.

BERTRAM FISHER.