

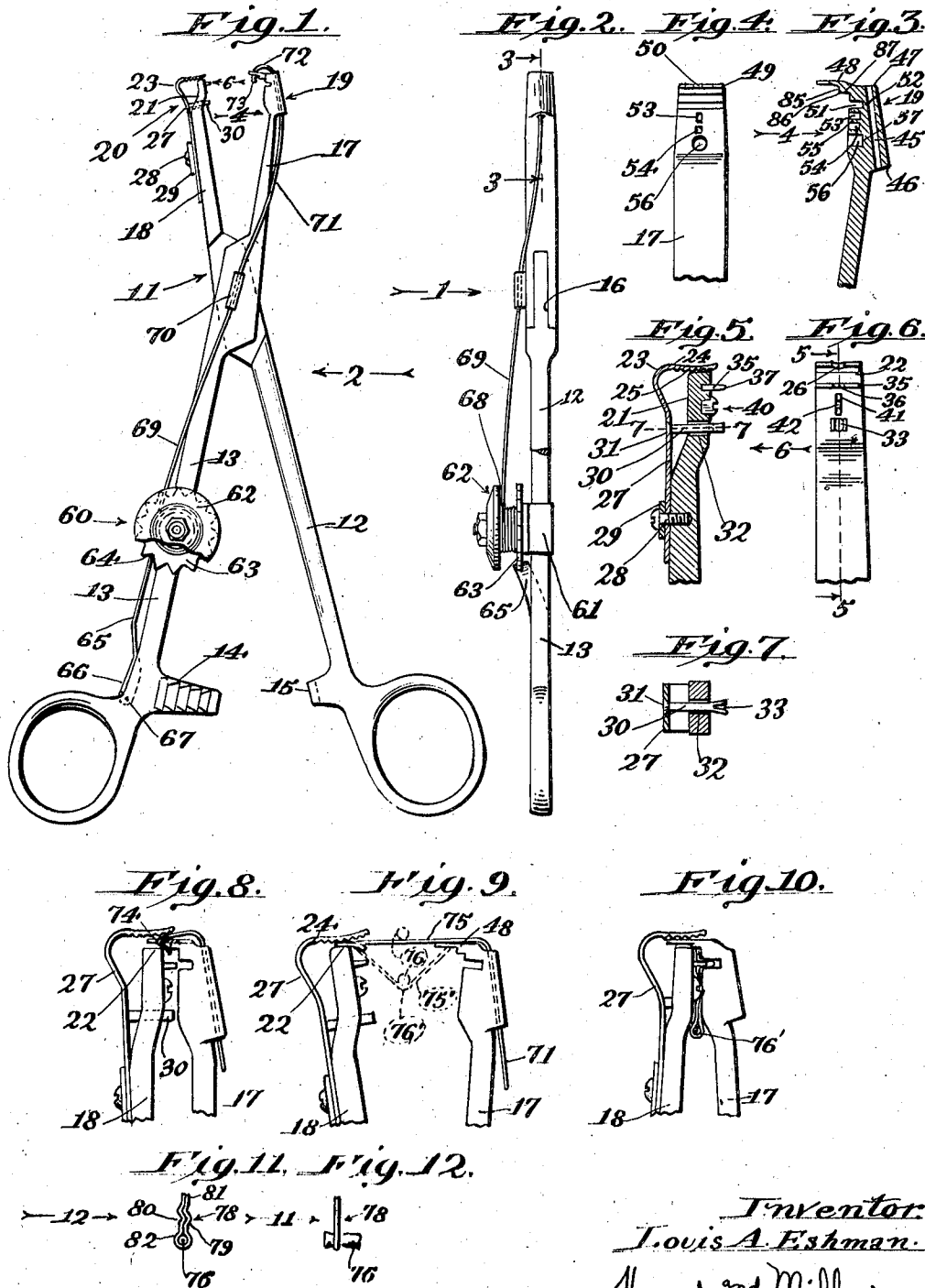
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L. A. ESHMAN

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HEMOSTAT

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Inventor
Louis A. Eshman
Hazard & Miller
Attorneys

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HEMOSTAT

Louis A. Eshman, Los Angeles, Calif.

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My invention relates to a hemostat of a type to prevent bleeding by forming a ligature around an artery, vein, arteriole, venule or other blood vessel or the like, for convenience designated herein as a blood vessel.

In various surgical operations it is the present practice to ligate blood vessels with hand operated instruments or by hand using catgut in which each individual ligature made must be done by either hand operation or by hand manipulation of a tool and usually the blood vessel must be clamped prior to or at the time of applying the catgut ligature. In some operations a large number of ligatures of blood vessels must be made and as the time for performing the operation is usually more or less limited, a considerable amount of time available is consumed in making these various ligatures of the blood vessels.

An object and feature of this present invention is a combination hemostat and catgut applying or ligating device which functions to wrap the gut around a blood vessel while it is still imbedded in a surface portion of the flesh to effect the firm attachment or ligating of the ends of the gut wrapped around the blood vessel and to cut or sever the ends leaving a finished ligature in which the blood vessel has been compressed, the gut ligature has been wrapped around the blood vessel, the ligature severed and the portion of the blood vessel slightly separated from the surrounding flesh. I make use of the property of surgical gut that when portions are squeezed, squashed or pressed together and at the same time crimped, that adhesive characteristics are developed which form a firm and continuous attachment of the two parts of the gut.

With my invention I use the softened catgut such as received directly from the sterile containers in which case the gut is soft and flexible and has practically no springiness as is the case of the dried gut. Therefore, the gut is readily wrapped around the blood vessel and when the overlapping end portions are clamped together they adhere without the necessity of forming a knot. This action is therefore quickly performed and when the two ends adjacent the parts of the gut adhering together are severed, it leaves a complete ligature due to the adhesive properties of the gut when two parts are firmly pressed or squeezed together. A feature of my invention therefore relates not only to the implement but to the manner of making the ligature in which the end portions of the gut after wrapping around a blood vessel are compressed and in effect squashed one onto the other to firmly adhere,

Another object and feature of my invention as it relates to the implement is in using a cross handled tool pivoted in the manner of surgical shears and having one stem with clamping or gripping jaws for the free end of the gut and the other stem having a finger for feeding the end into the gripping jaws. The gut is preferably supplied from a spool mounted on one of the handles which passes through guide eyes, one being adjacent the pivot and the other adjacent the stem having the finger, the gut being held under tension. With this device a feature in the operation is pressing a strand of the gut held between the clamping jaw and the finger when spread apart against the flesh where a blood vessel is imbedded in the surface and then squeezing the handles together which causes the jaw and the fingers to again engage. At the same time the blood vessel is squeezed between complementary devices on the end of the stem including a pin and a pressure device. These bring the stretched gut into the tight engagement with the blood vessel, a knifelike device formed preferably on the jaw portion of the tool then operates to sever the ends, at the same time the end portions of the gut after being wrapped around the blood vessel are clamped and squashed together forming the adhesive type of ligature.

My invention also comprehends the manner or method of surgically ligating a member such as a blood vessel or the like, in which a strand of stretched gut is looped around the member, the two portions of the strand are formed into a bight with the portions of the strand in contact and in alignment, then these portions are squashed or pressed to form a binding union of the two portions of the strand. In addition, the strand is crimped and finally severed. This procedure leaves as the final result, the member such as a blood vessel, with the gut looped thereabout and two portions of a strand secured together by being squashed and crimped until they adhere.

My invention is illustrated in connection with the accompanying drawing, in which:

Figure 1 is a side elevation taken in the direction of the arrow 1 of Figure 2.

Figure 2 is an edge elevation taken in the direction of the arrow 2 of Figure 1.

Figure 3 is a detail longitudinal section on the line 3—3 of Figure 2 in the direction of the arrows through the jaw on the right hand stem having the feeding finger and the series of sockets or recesses.

Figure 4 is a front elevation of the jaw of

Figure 3 taken in the direction of the arrow 4 of Figure 1 or 3.

Figure 5 is a detail longitudinal section on the line 5-5 of Figure 6, of the jaw on the left hand stem showing the resilient gripping jaws, the knife blade, the squashing implement and the guide pin.

Figure 6 is a front elevation of the jaw of Figure 5 taken in the direction of the arrow 6 of Figure 1 or 5.

Figure 7 is a transverse section on the line 7-7 of Figure 5 in the direction of the arrows.

Figure 8 is a partial elevation of the jaws showing the first step in gripping the free end of the catgut by the resilient jaws on the left hand stem.

Figure 9 is an elevation similar to Figure 8 showing however the gut stretched between the left hand clamping jaw and the right hand jaw and indicating the manner in which the gut is pressed by the jaws around a blood vessel or the like.

Figure 10 is an elevation similar to Figures 8 and 9 illustrating however the final action involving squashing the blood vessel between the jaws squashing the soft catgut on one side of the blood vessel and severing or cutting the free ends of the gut to make the crimped ligature.

Figure 11 is a cross section through a blood vessel with the catgut looped therearound and crimped to form the ligature, such section being taken in the direction of the arrow 11 of Figure 12.

Figure 12 is an elevation of the ligature of Figure 11 taken in the direction of the arrow 12 of Figure 11.

In my invention I employ a scissorlike device 11 in which there are two handles 12 and 13, each having a finger loop. One of the handles is provided with a ratchet bar 14 extending therefrom and the other with a gripping tooth 15 to engage therewith as is common in surgical shears. The left handle is illustrated as having a slot 16 therethrough and through this extends the right hand handle, there being a pivot of a known type. Thus, there are two stems, a right stem 17 and a left stem 18 providing at their ends a right hand jaw 19 and a left hand jaw 20.

The left hand jaw 20 illustrated particularly in Figures 5, 6, and 7 has an offset end piece 21 with a flat end 22. A resilient gripping jaw 23 has an end piece 24 with a roughened under surface indicated at 25 and an edge notch 26. This jaw has a resilient spring arm 27 extending along the stem 18 to which it is secured by a bolt 28 using an elongated washer 29 under the head of the bolt. Integrally connected to the spring arm 27 is a guide pin 30, this being as shown as attached by a riveted head 31 and such pin extends through a perforation 32 in the offset part 21 of the jaw. The pin has a notch 33 on the end which extends through the perforation 32.

Located on the jaw 20 is a transverse knife blade 35. This extends between the side edges of the offset end of the stem 18 and it has a notch 36 in the end. This knife blade has a slightly rounded outer edge 37 so that it is not a sharp edged implement.

A pressing or squashing stud 40 is secured to the face of the offset portion 21 of the jaw 20. This has parallel sides 41 and a central transverse notch 42. This squashing stud is positioned between the blade 37 and the guide pin 30 and is centrally located as regards these elements, being in alignment with the notches 26, 36 and 33.

This squashing stud is narrower than the guide pin 30 and is substantially equal in width to the notch 33 formed in the end of this pin.

The right hand jaw 19 has a threading perforation 45 on the back extending from the lower end 46 to the outer end 47 and at this outer end there is an inwardly extending finger 48, the upper surface of the finger being in alignment with the outer end 47 of the jaw. This finger terminates in a slightly rounded outer edge 49 and has a longitudinal notch 50 positioned centrally therein.

Below the finger 48 there is a transverse blade receiving slot 51. This extends from side to side of the jaw 19 on the stem 17 and is of sufficient width to allow the knife blade 35 to have a working fit therein and is of sufficient depth so that when the jaws are squeezed as tight together as possible, that the blade is slightly spaced from the bottom or base 52 of this slot 51.

Located below the slot 51 there are two rectangular recesses 53 and 54, these being separated by a narrow fin 55. These recesses are to receive the projecting portions of the squashing stud 40, the fin 55 engaging in the transverse notch 42 of this stud and thus forming a limit to the inward movement of the jaws 19 and 20 towards each other. Located below the recesses 53 and 54 there is a cylindrical socket 56, this being positioned to receive the end of the guide pin 30. The base 57 of this socket is adapted to be engaged by the end of the guide pin. On account of this pin being resiliently mounted when the jaws are fully clamped together, the pin 30 pushes outwardly on the spring arm 27 and thus gives a slight movement to the resilient jaw end 24. It will be noted that the recesses 53 and 54 are centrally located as regards the sides of the jaw 19 and these are only of sufficient width to allow the proper fit of the narrow squashing stud 40. They are thus of less width considered transversely than the cylindrical socket 56 to receive the guide pin 30.

The feed of the gut thread is by using a spool or reel 60 which is shown as mounted on the arm 13 by a collar 61 or the like. The reel has an outer flange 62 and an inner flange 63, this latter having a toothed edge 64 engaged by the free end of the spring 65, the fixed end 66 being secured to the handle 13 by a screw 67 or the like. A winding of gut 68 is illustrated as being wound on the spool and has a lead 69 along the handle 13, then through an elongated eye 70 substantially in alignment with the pivot pin of the handle, thence there is a lead 71 to the threading perforation 45 from which an end section 72 of the gut thread leads over the end of the finger 48 engaging in the notch 50 and having a slight downturned end 73. On account of the gut being soft and flexible but without substantial springiness or resilient action the gut is readily bent over the end of the finger and remains in this position with the portions 71 and 69 sufficiently tight to retain the gut in the proper position.

In the first action to properly thread the gut, the handles are squeezed together a sufficient amount to bring the jaws 19 and 20 substantially into the relation shown in Figure 8. This causes the finger 48 to become inserted underneath the upper portion 24 of the flexible jaw 23 mounted on the end of the spring 27 slightly upwardly inserting a fold or reverse bend 74 adjacent the end of the gut thread between the end 22 of the offset jaw portion 21 and the re-

silient jaw 24. The gut is thus engaged by the teeth 25 or roughened surface on the underside of this resilient jaw 24 so that as the handles are moved apart thus separating the jaws 19 and 20, the folded end of the gut is held by the jaw 20 between its end portion 22 and the flexible jaw 24. This causes the gut to have a tightly stretched strand portion 75 as illustrated in full lines in Figure 9 between the spaced apart jaws.

Immediately below the finger 48 on the jaw 19 there is a downward offset 85 with a shearing edge 86 and a flat surface 87 therebelow connecting with the main body of the jaw above the transverse slot 51 (note Figure 3). This shearing edge coacts with the top surface 22 of the end piece 21 of the jaw 20 when the two jaws are squeezed as tight together as possible. In this action the finger 48 has lifted the spring jaw 24 leaving sufficient space for the action of the shearing edge 86 operating with the surface 22 to shear the strands of the gut. This thus severs the gut.

The action and the manner of operating the device is indicated mainly in Figures 8 through 12 in which in Figure 9 a blood vessel is indicated by the numeral 16 in its first position in full lines. This however, in ligating operations is embedded in the flesh. The implement is pressed somewhat obliquely so that the jaws straddle the blood vessel and force this with a certain amount of the flesh somewhat into the position shown by 16', in Figure 9. This causes a partial bight indicated at 15' to be formed in the strand 75, this being indicated in dotted lines. As the jaws are pressed inwardly the bight 15' of the strand is forced downwardly somewhat into the position of Figure 10 and the longitudinal notch 33 of the guide pin 30 functions to align the two strands of the gut in contact with each other and lining up with the axis of the pin 30, therefore such guide pin, when its end is forced into the cylindrical socket 56 of the jaw 19, positively holds the two parts of the strand of gut closely contiguous to the blood vessel and a certain amount of the flesh adhering thereto, somewhat as shown in Figure 10.

The operation and functioning of the squashing stud 40 which has the central transverse notch 42 is to press or squash the two aligned parts of the gut, the two parts of the stud may force the gut slightly into the recesses 53 and 54 on the jaw 19, the fin 55 registering with the notch 42. This forms part of the kink shown in the gut in Figure 11.

The knifelike blade 35 which as above mentioned, has a rounded edge with a notch 36 therein, presses the two strands of gut forcing these slightly into the transverse slot 51 in the jaw 19 and firmly holding these two strands while being severed as above mentioned, by the shearing edge 86 operating in conjunction with the surface 22 of the end 21 of the opposite jaw 20 when the two main jaws are forced tightly together. This action squashes the soft gut together and forms a series of kinks in the bight formed by the two strands somewhat as shown in Figures 11 and 12, thus forming a ligature which pulls tight around the blood vessel and any flesh adhering thereto without positively squashing the blood vessel.

By moving the handles apart thus releasing the jaws 19 and 20 from the position of Figure 10 to that of Figure 9, the blood vessel thus ligated is released and at the same time the looped over end 13 of the gut is left and the

clamp between the flexible jaw 24 and the end 22 of the offset rigid portion of the jaw 20 is ready for another operation. This action usually leaves a short section of the first used portion of the gut caught in the jaw 20 but this is not in the way and may be left without removal or may be removed by a sharp instrument or by the fingers, however, the operation of clamping the jaws together frees any small end of the gut caught in the jaw 20 between its flexible portion and its rigid portion. Thus as soon as one blood vessel has been squeezed and ligated with the flexible gut, the gut is threaded in the implement ready for a second operation, etc.

The type of ligature is indicated in Figures 11 and 12 in which the blood vessel 16' has the two portions of the strand 75 looped thereabout. These two strands are parallel. The type of ligature is indicated by the assembly numeral 78 in which on one side there is a hump 79 and on the other side a depression 80. The end portions severed by the shearing edge 86 are indicated at 81, the immediate loop around the blood vessel being indicated at 82. It is to be understood, however, that the two portions of the gut are so pressed and squeezed together that in reality they merge or adhere together. The crimps and kinks formed in the squashed gut aid in the adhesion of the two portions of the gut strand.

In the operation of my hemostat of course a surgeon will be guided by his prior experience and by the size of the blood vessel or other tissue to be ligated. For instance, should the blood vessel be quite small and readily picked up, the jaws should only be spread apart a sufficient amount to properly engage the blood vessel and to form the crimp and squashing of the gut. If the blood vessel and tissue to be engaged by the gut is larger, manifestly the jaws would be spread wider apart in order to provide a longer strand section such as illustrated at 75 in Figure 9. The minimum distance of spreading the jaws to provide a sufficient length of strand such as 75 between the jaws is such that the two sides of the bight must be engaged by the various crimping devices. When my device is used, in picking up a blood vessel there is usually a certain amount of the flesh surrounding such blood vessel and only as small an amount of this flesh is gripped as is necessary to form the ligature. This small portion of flesh is squeezed by the gut and it, with the blood vessel, is secured by the ligature and therefore this flesh is not immediately destroyed.

Where the instrument cannot readily pick up a deeply embedded blood vessel, such vessel may be engaged by a surgeon's hemostat or tissue forceps and brought to a position to engage the strand of gut between the jaws. Also it is not necessary to force the ends of the jaws deeply into the flesh as the instrument can be held at an acute angle to the surface having the blood vessel to be ligated. The illustration of Figure 9 is intended to show the relative position taken by the blood vessel at 16 and 16' as the jaws are moved together in various stages of the same operation to bring the blood vessel and the bight of the strand of gut into somewhat the position shown in Figure 10. If there is any flesh surrounding the blood vessel this may be removed from the jaws which squash the gut and therefore there would be no injury to such flesh. With my instrument of course it is manifest that the surgeon would require his skill in the operation of the device to make good ligatures and to operate

quickly, but with my instrument and manner of procedure, a series of members can be much more rapidly ligated than is the present practice.

Various changes may be made in the details of the construction without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. A hemostat comprising an instrument having stems pivotally connected, each with a jaw thereon, a feeding device for gut mounted on one of the jaws, a resilient jaw connected to the second jaw and adapted to retain the end of the gut on bringing the jaws together so that on separation of the jaws a strand of gut extends between said jaws whereby such strand may be looped around a member to be surgically ligated, means on the said jaws to align the end portions of the gut extending from the member surrounded by the gut and means to compress the end portions of the gut to secure same together whereby the gut may be securely attached to the member surrounded by the gut.

2. A hemostat as claimed in claim 1, one of the jaws having means to sever or cut the strands of the gut spaced from the portions of the gut secured by pressing together.

3. A hemostat comprising in combination an instrument having handles with stems pivotally connected together, one of the stems having a jaw with a gut feeding finger, the other stem having a second jaw with a resilient secondary jaw connected thereto whereby when the jaws are moved together the said finger is adapted to engage an end of a thread of gut in the secondary jaw so that on opening of the jaws a strand of gut stretches between the two jaws, the jaws being operative to form a loop in the gut around a member to be surgically ligated forming a bight in the strand, complementary means on the two main jaws to align the strand portions of the gut forming the bight, means to compress or squash together the said strand portions forming the bight and complementary means on the two main jaws to sever the two strand portions forming the bight spaced from the article to be ligated, the said severing means being operative when the two main jaws are brought together.

4. A hemostat as claimed in claim 3, means to feed the thread of gut to the said finger whereby on closing the jaws to loop the strand around the member to be ligated and in securing the bight of the loop together, a new strand becomes attached to the secondary jaw.

5. A hemostat comprising an instrument having stems pivotally connected together, each with a jaw thereon, means to grip one end of a thread of gut by one jaw, the other jaw having means to stretch a strand of gut from the holding jaw, the said jaws when brought together being adapted to form a bight on the strand around a blood vessel to be ligated, a guide means on one of the jaws having a notch to align the two portions of the strand of the bight one in contact with the other and a squashing means cooperative between the two jaws to squash the two portions of the strand forming the bight whereby the gut may form a ligature around the blood vessel.

6. A hemostat as claimed in claim 5, a severing means operative between the two jaws when firmly pressed together to sever the two portions of the strand forming the bight, the point of severance being displaced from the portion of the strand squashed together.

7. A hemostat as claimed in claim 5, the squash-

ing means including a squashing stud having a transverse notch on one jaw, the opposite jaw having recesses with a fin, the fin being adapted to interfit with the said notch to thereby form a crimp in the two portions of the strand forming the bight.

8. A hemostat as claimed in claim 5, one of the jaws having a transverse knife blade with a longitudinal notch in alignment with the notch of the guide means, the notch of the knife being adapted to engage the two parts of the strand forming the bight, the opposite jaw having a transverse slot to receive the said knife and thereby retain a firm grip on the two portions of the strand during the squashing of the said portions of the strand.

9. A hemostat comprising in combination an instrument having stems, each with a jaw thereon and means to mount said stems to bring the jaws into operative engagement, a first jaw having a fixed jaw element and a resilient element engaging the end thereof, the second jaw having a projecting finger with means to guide a thread of gut over the finger whereby on initially engaging the finger with the jaw elements of the first jaw, the end of a strand of gut may be gripped by the said jaw elements, the spreading apart of the jaws being adapted to form a strand of gut extending from the first to the second jaws adapted to form a loop with a bight of the strand around a member to be ligated, the said jaws having means to align the two portions of the strand forming the bight and means to squash the aligned portions of the strand, the second jaw having a shearing edge cooperative with the fixed jaw element of the first jaw and thereby sever the two portions of the strand forming the loop and bight on completion of the ligature.

10. A hemostat as claimed in claim 9, the means to align the two portions of the strand comprising a guide pin resiliently mounted on the first jaw and having a notch therein, the second jaw having a socket to receive the end of the guide pin.

11. A hemostat as claimed in claim 9, the means to squash the gut comprising a transverse knife-like device on the first jaw having a longitudinal notch to engage the portions of the strand of the gut, the second jaw having a transverse slot to receive the knife and a squashing stud on the first jaw cooperating with the second jaw to squash the gut.

12. A hemostat as claimed in claim 9, the second jaw having a device for guiding the gut, a means for supplying the thread of gut and maintaining a desired tension on the strand whereby the finger on the second jaw co-acts with the first fixed and resilient jaw elements when the shearing edge cooperates with the fixed element of the first jaw to shear the first strand of gut to insert the end of a second strand of the gut thread into gripping engagement between the resilient and fixed elements of the first jaw.

13. A hemostat comprising in combination pivotally connected handle members, each having a stem, one stem having a first jaw and the other a second jaw on the ends, a reel for gut mounted on one of the handles, the second jaw having a guiding perforation for the gut and a finger on the end facing towards the first jaw, said finger having a central notch, the finger being transverse to the jaw, the first jaw having a fixed end portion and a resilient gripping jaw with serrations whereby on moving the jaws together the said finger inserts the end of a thread of gut between the

fixed end and the resilient jaws and whereby on separating the jaws a taut strand of gut is stretched between the first and second jaws whereby said strand may form a loop around a member to be ligated, the first jaw having a guide pin connected to part of the resilient jaw, the guide pin having a notch to engage the two portions of the strand of gut which form a bight around the member, the second jaw having a socket to engage the said pin, a knifelike device on the first jaw having a notch to engage the gut, a transverse slot on the second jaw to receive the knifelike device, a squashing means on the first jaw cooperating with a complementary squashing means on the second jaw to squash, press together and crimp the two portions of the strand between the pin and the

said knifelike device and a severing means on the said jaws operative when the jaws are forced tightly together to sever the two portions of the strand spaced from the knife-like device.

14. A hemostat as claimed in claim 13, the said severing means having a shearing edge mounted on the second jaw immediately adjacent the said finger, said edge being operative with the fixed end of the first jaw, the said finger being adapted to space the resilient jaw from the said fixed end of the first jaw and insert the end of a second strand of the thread of gut between the fixed end and the resilient jaw on again spacing the jaws apart.

LOUIS A. ESHMAN.