

March 5, 1963

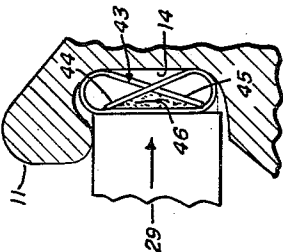
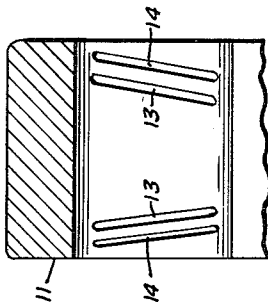
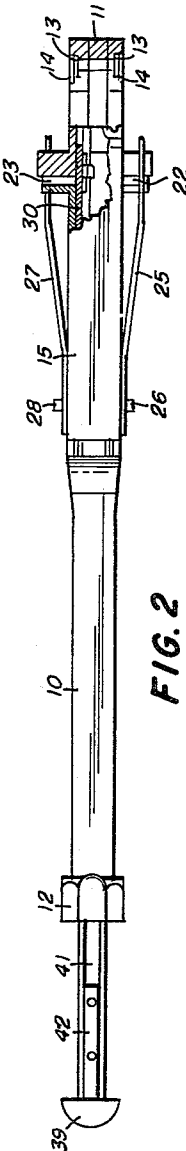
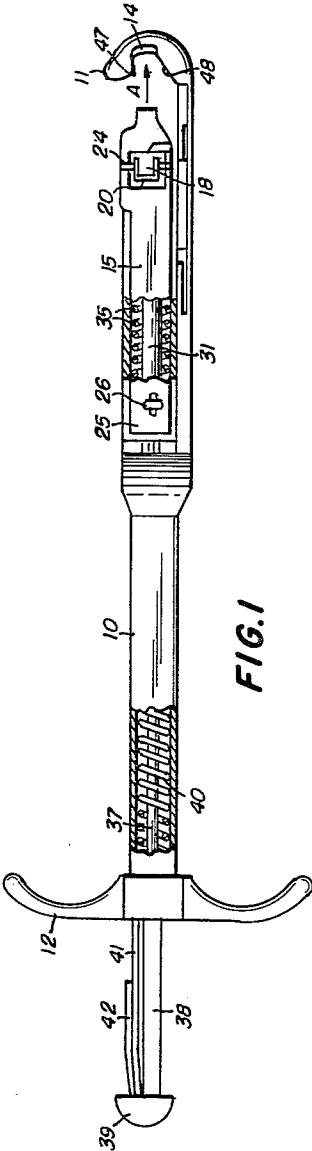
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3,079,608

INSTRUMENT FOR LIGATING BLOOD VESSELS WITH METAL STAPLES

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2 Sheets-Sheet 1



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INSTRUMENT FOR LIGATING BLOOD VESSELS WITH METAL STAPLES

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2 Sheets-Sheet 2

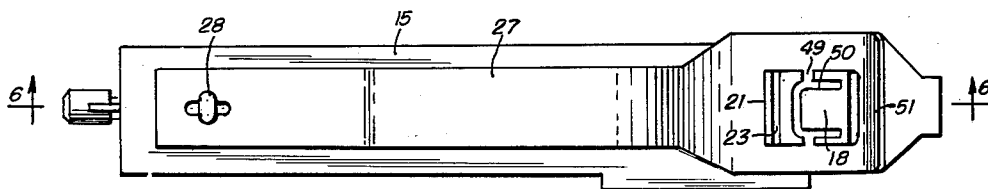


FIG. 5

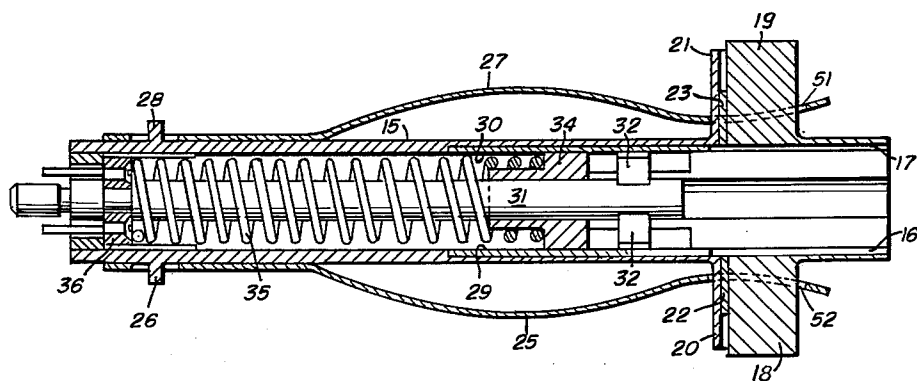


FIG. 6

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INSTRUMENT FOR LIGATING BLOOD VESSELS WITH METAL STAPLES

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This invention relates to surgery and more particularly to an instrument for ligating blood vessels with U-shaped metal staples and the instrument is particularly well adapted for performing such an operation in a deep cavity and only requires dissection of the blood vessel from the surrounding tissue for a relatively short or limited length.

Instruments for ligating blood vessels with metal staples have heretofore been proposed and utilized, but in order to provide ligations of hemostatic tightness and adequate strength it has been necessary with these prior art instruments to utilize two staples on each end of the blood vessel, one staple being bent into the form of an oval and surrounding the vessel to compress the walls thereof and the other staple, the distal one, being adapted to pierce with its ends the walls of the vessel to prevent inadvertent displacement of the first staple. The use of two staples on each end of a severed blood vessel requires that such vessel be dissected from the surrounding tissue over a considerable length which unduly complicates the operation and may possibly result in delaying recovery of the patient, and consequently an instrument which provides a suitable ligation while permitting dissection of the vessel from the surrounding tissue for a relatively short length represents a material step forward in the art.

It is accordingly an object of the invention to provide an instrument for ligating blood vessels with metal staples and which requires only the application of a single staple to each end of the severed blood vessel.

A further object of the invention is the provision of an instrument for ligating blood vessels with metal staples, which instrument is particularly well adapted for performing such operation in a deep cavity.

A still further object of the invention is the provision of an instrument for ligating blood vessels with metal staples, which instrument may be conveniently operated to simultaneously apply two staples to a blood vessel to provide adequate ligation on each end of, the vessel as it is thereafter severed between the staples.

Another object of the invention is the provision of an instrument for ligating blood vessels with metal staples, which instrument includes an anvil part providing for gathering the vessel walls prior to ligation, to exclude any chance of piercing the vessel as the ends of the staples approach the vessel.

Another object of the invention is the provision of an instrument for ligating blood vessels with metal staples, which instrument serves to apply a staple in such a manner as to embrace the vessel on three sides and compress the same to provide a suitable ligation.

A further object of the invention is the provision of an instrument for ligating blood vessels with metal staples, which instrument includes a staple magazine for successively feeding staples to the driving means thereby permitting a relatively large number of such operations to be performed in rapid sequence.

A still further object of the invention is the provision of an instrument for ligating blood vessels with metal staples, which instrument includes means for preventing inadvertent operation during sterilization or careless handling.

Further objects and advantages of the invention will

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be apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevational view with parts in section and broken away for greater clarity and showing an instrument constructed in accordance with this invention;

FIG. 2 a top plan view with parts broken away and in section for greater clarity and showing the instrument of FIG. 1;

FIG. 3 a fragmentary sectional view showing the manner in which the anvil operates to bend a staple for the purpose of clamping or compressing the walls of a blood vessel on three sides;

FIG. 4 a fragmentary elevational view showing the formation of the anvil recesses in the fixed jaw and looking in the direction of the arrow A in FIG. 1;

FIG. 5 a side elevational view of the staple magazine and associated parts; and

FIG. 6 a sectional view taken substantially on the line 6—6 of FIG. 5 and showing the internal structure of the staple magazine, as well as the location and manner of operation of the staple drivers.

With continued reference to the drawing, there is shown an instrument for ligating blood vessels with metal staples constructed in accordance with this invention and which may well comprise an elongated hollow body 10 terminating at one end in a hook-shaped jaw 11 and provided on the opposite end with a handle 12. As shown in FIG. 4, the fixed hook-shaped jaw 11 is provided on the inner face thereof with inclined recesses 13 and 14 which form staple clinching anvils. It is to be understood that the fixed jaw 11 is provided with a second pair of inclined recesses transversely spaced from the recesses 13 and 14, each pair of recesses serving to bend a staple. The working face of the hook-shaped jaw when viewed from the side as shown in FIG. 1, has two faces 47 and 48 converging toward the inclined recesses 13 and 14 and making the internal profile of the hook look like a truncated pyramid. When operating the instrument, the said faces ensure that the vessel to be ligated slides off such faces and into engagement with the staple engaging anvils and that the walls of the vessel are gathered in one definite position on the anvils.

A staple driving mechanism 15 is slidably mounted on the body 10 for movement toward and away from the fixed jaw 11 and the mechanism 15 is provided with spaced longitudinally extending staple drive channels 16 and 17 in alignment with the anvil recesses 13 and 14, the channel 16 serving to guide a staple into engagement with one pair of recesses 13 and 14 and the channel 17 serving to guide a second staple into engagement with the other pair of recesses 13 and 14. The width of channels 16 and 17 is equal to the width of the staples and the depth of the channels is equal to the diameter of the staples. Projecting from opposite sides of the mechanism 15 are lugs 18 and 19, lug 18 having a channel 20 communicating with the staple drive channel 16 and lug 19 having a channel 21 communicating with the staple guide channel 17. As seen from FIG. 5, the shape of the channels 20 and 21 exactly correspond to the U-shape of an unbent staple, the channels being intended to be charged with staples, thus forming staple magazines. Slidably disposed in the channel 20 is a staple pusher 22 and slidably disposed in the channel 21 is a similar staple pusher 23. Pushers 22 and 23 are provided with projecting lugs 24 which extend through slots 49 and 50 in the magazine. Staple pushers 23 and 22 slide in the channels 20 and 21. The lugs on feeder 22 are engaged by a leaf spring 25 secured to the mechanism 15, as at 26, while the lugs on pusher 23 are engaged by a leaf spring 27 secured to the mechanism 15 as at 28. The opposite ends of leaf springs 25 and 27 have openings 51 and 52 through which

the magazine lugs 18 and 19 pass. The leaf springs press inwardly on the pushers 22 and 23 to feed the staples toward drive channels 16 and 17.

A staple driver 29 is slidably disposed in the staple drive channel 16 and a similar staple driver 30 is slidably disposed in the staple drive channel 17. A staple driver push rod 31 is coupled to the staple drivers 29 and 30 at 32 and 33. An abutment 34 slidably surrounds the rod 31 and is fixed to the body of mechanism 15. Bearing against the abutment 34 is one end of a compression spring 35 which also surrounds the rod 31 and the opposite end of the spring 35 bears against an abutment 36 fixed to the rod 31.

An actuating rod 37 extends through the body 10 and projects outwardly of the handle 12, the outwardly projecting portion 38 of the rod 37 terminating in a hand engaging knob 39. The opposite end of the actuating rod 37 is in threaded connection with the push rod 31. A compression spring 40 disposed in the body 10 and surrounding the actuating rod 37 serves to urge rod 37 toward the left as viewed in FIG. 1. A leaf spring 41 is secured to the projecting portion 38 of the rod 37 and mounted on the spring 41 is a lug 42 which, in the position shown in FIG. 1, engages the handle 12 and prevents inward movement of the rod 37 beyond a predetermined point. The lug 42 and spring 41 may be depressed manually to slide inwardly of the handle 12 and permit full inward movement of the rod 37 when performing a ligating operation.

In operating the instrument of this invention it is assumed that a supply of staples are disposed in the channels 20 and 21 and that the staple pushers 22 and 23 actuated by spring 25 and 27 engage such staples to urge the same toward and into the staple drive channels 16 and 17. A blood vessel to be ligated is positioned within the hooked-shaped fixed jaw 11 in engagement with the inner surface thereof and the actuating rod 37 is moved inwardly relative to handle 12 to move the staple drive mechanism 15 forward or toward the right as viewed in FIG. 1, and into engagement with the blood vessel to hold the same in place within the fixed jaw 11. The actuating rod 37 is moved inwardly to carry the staple mechanism 15 forward or toward the right as viewed in FIG. 1 to press the blood vessel against the fixed jaw 11. Then lug 42 is finger pressed toward the projecting part 38 of rod 37 and the rod is moved toward the fixed jaw 11. Such movement results in moving the staple drivers 29 and 30 forward. As best shown in FIG. 3, the staple driver 29 engages the central portion 43 of a staple and the legs 44 and 45 of the staple straddle the blood vessel 46 with the leg 45 moving into engagement with the anvil recess 13 and the leg 44 moving into engagement with the anvil recess 14. Further forward movement of the driver 29 results in bending the legs 44 and 45 of the staple to the shape shown in FIG. 3 and this results in compressing the walls of the blood vessel 46 between the legs 44 and 45 and the central portion of the staple 43. As will be seen from an inspection of FIG. 3, the space between the legs 44 and 45 and the central portions 43 of the staple is triangular in nature thereby serving to engage the blood vessel 46 from three sides and to adequately compress the same to provide a hemostatic ligation and furthermore, this frictional engagement between the staple and the blood vessel is sufficient to prevent inadvertent displacement of the staple thereon. The operation of the staple driving and clinching means has been described for a single staple, but it is to be understood that the other staple driven by the driver 30 operates in the same manner and is applied to the blood vessel 46 in spaced relation to the first staple and that the application of both staples takes place simultaneously. Subsequently the blood vessel 46 may be severed between the staples applied thereto. Upon completion of application of the staples, the hand engaging knob 39 may be released

and the compression springs 35 and 40 operate to return the staple mechanism 15 and actuating rod 37 to inoperative position and preparatory to a subsequent ligating operation. At this time, rod 31 returns the staple drivers 29 and 30 to initial position after which a subsequent pair of staples are fed from the channels 20 and 21 by pushers 22 and 23 actuated by leaf springs 25 and 27 into channels 16 and 17, now free from the drivers, and the instrument is now ready for further operation.

It will be apparent that by the above described invention there has been provided a relatively simple, yet highly effective instrument for ligating blood vessels and due to the particular formation of the instrument, the same is well adapted to perform such operation in deep cavities and since it is only necessary to provide two closely spaced staples on the blood vessel, it is only necessary to dissect a limited length of the blood vessel from the surrounding tissue in order to permit insertion of the instrument of this invention to perform the ligating operation.

It will be obvious to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof and therefore the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. An instrument for ligating blood vessels with metal staples, said instrument comprising an elongated hollow body terminating at one end in a hook-shaped jaw, a handle on the opposite end of said body, spaced inclined recesses in said jaw providing staple clinching anvils, a staple mechanism slidably mounted on said body for movement toward and away from said jaw, a pair of staple drive channels in said mechanism in alignment with said recesses, a staple driver slidably disposed in each channel, staple magazine means on opposite sides of said mechanism for holding a supply of staples, pushers operatively associated with said staple magazine means, a leaf spring mounted on each side of said mechanism and engaging said pushers to feed staples one at a time into said channels, a push rod slidably received in said body and connected to said drivers, the opposite end of said rod projecting from said opposite end of said body and having a hand engaging knob, a compression spring in said mechanism for returning said drivers to inoperative position, a compression spring in said body for returning said mechanism to inoperative position, a leaf spring on the projecting end of said rod and a lug on said last named spring for engaging said handle to prevent inadvertent operation of said drivers, whereby with a blood vessel disposed in engagement with said jaw operation of said push rod will serve to move said mechanism toward said jaw to clamp the vessel and continued operation of said push rod will actuate said drivers to push the staples out of said channels, around said blood vessel and into engagement with said anvils to bend said staples and compress said blood vessel from three sides at spaced locations to provide hemostatic ligations.

2. An instrument for ligating blood vessels with metal staples, said instrument comprising an elongated hollow body terminating at one end in a hook-shaped jaw, a handle on the opposite end of said body, spaced inclined recesses in said jaw providing staple clinching anvils, a staple mechanism slidably mounted on said body for movement toward and away from said jaw, a pair of staple drive channels in said mechanism in alignment with said recesses, a staple driver slidably disposed in each channel, staple magazine means on opposite sides of said mechanism for holding a supply of staples, pushers operatively associated with said staple magazine means, a leaf spring mounted on each side of said mechanism and engaging said pushers to feed staples one at a time into said channels, a push rod slidably received in said body and connected to said drivers, the opposite end of said rod

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projecting from said opposite end of said body and having a hand engaging knob, a compression spring in said mechanism for returning said drivers to inoperative position, a compression spring in said body for returning said mechanism to inoperative position and means to prevent inadvertent operation of said drivers, whereby with a blood vessel disposed in engagement with said jaw operation of said push rod will serve to move said mechanism toward said jaw to clamp the vessel and continued operation of said push rod will actuate said drivers to push the staples out of said channels, around said blood vessel and into engagement with said anvils to bend said staples and compress said blood vessel from three sides at spaced locations to provide hemostatic ligations.

3. An instrument for ligating blood vessels with metal staples, said instrument comprising an elongated hollow body terminating at one end in a hook-shaped jaw, a handle on the opposite end of said body, spaced inclined recesses in said jaw providing staple clinching anvils, a staple mechanism slidably mounted on said body for movement toward and away from said jaw, a pair of staple drive channels in said mechanism in alignment with said recesses, a staple driver slidably disposed in each channel, staple magazine means on opposite sides of said mechanism for holding a supply of staples, pushers operatively associated with said staple magazine means, a leaf spring mounted on each side of said mechanism and engaging said pushers to feed staples one at a time into said channels, a push rod slidably received in said body and connected to said drivers, the opposite end of said rod projecting from said opposite end of said body and having a hand-engaging knob, a compression spring in said mechanism for returning said drivers to inoperative position and a compression spring in said body for returning said mechanism to inoperative position, whereby with a blood vessel disposed in engagement with said jaw operation of said push rod will serve to move said mechanism toward said jaw to clamp the vessel and continued operation of said push rod will actuate said drivers to push the staples out of said channels, around said blood vessel and into engagement with said anvils to bend said staples and compress said blood vessel from three sides at spaced locations to provide hemostatic ligations.

4. An instrument for ligating blood vessels with metal staples, said instrument comprising an elongated hollow body terminating at one end in a hook-shaped jaw, a handle on the opposite end of said body, spaced inclined recesses in said jaw providing staple clinching anvils, a staple mechanism slidably mounted on said body for movement toward and away from said jaw, a pair of staple drive channels in said mechanism in alignment with said recesses, a staple driver slidably disposed in each channel, staple magazine means on opposite sides of said mechanism for holding a supply of staples, means to push staples one at a time into said channels, a push rod slidably received in said body and connected to said drivers, the opposite end of said rod projecting from said opposite end of said body and having a hand engaging knob, a compression spring in said mechanism for returning said drivers to inoperative position and a compression spring in said body for returning said mechanism to inoperative position, whereby with a blood vessel disposed in engagement with said jaw operation of said push rod will serve to move said mechanism toward said

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jaw to clamp the vessel and continued operation of said push rod will actuate said drivers to push the staples out of said channels, around said blood vessel and into engagement with said anvils to bend said staples and compress said blood vessel from three sides at spaced locations to provide hemostatic ligations.

5. An instrument for ligating blood vessels with metal staples, said instrument comprising an elongated hollow body terminating at one end in a hook-shaped jaw, a handle on the opposite end of said body, spaced inclined recesses in said jaw providing staple clinching anvils, a staple mechanism slidably mounted on said body for movement toward and away from said jaw, a pair of staple drive channels in said mechanism in alignment with said recesses, a staple driver slidably disposed in each channel, a push rod slidably received in said body and connected to said drivers, the opposite end of said rod projecting from said opposite end of said body, a compression spring in said mechanism for returning said drivers to inoperative position and a compression spring in said body for returning said mechanism to inoperative position, whereby with a blood vessel disposed in engagement with said jaw operation of said push rod will serve to move said mechanism toward said jaw to clamp the vessel and continued operation of said push rod will actuate said drivers to push staples out of said channels, around said blood vessel and into engagement with said anvil to bend said staples and compress said blood vessel from three sides at spaced locations to provide hemostatic ligations.

6. An instrument for ligating blood vessels with metal staples, said instrument comprising an elongated hollow body terminating at one end in a hooked-shaped jaw, a handle on the opposite end of said body, spaced inclined recesses in said jaw providing staple clinching anvils, a staple mechanism slidably mounted on said body for movement toward and away from said jaw, a pair of staple drive channels in said mechanism in alignment with said recesses, a staple driver slidably disposed in each channel, a push rod slidably received in said body and connected to said drivers, the opposite end of said rod projecting from said opposite end of said body, means for returning said drivers to inoperative position and means for returning said rod to inoperative position, whereby with a blood vessel disposed in engagement with said jaw operation of said push rod will serve to move said mechanism toward said jaw to clamp the vessel and continued operation of said push rod will actuate said drivers to push staples out of said channels, around said blood vessel and into engagement with said anvils to bend said staples and compress said blood vessel from three sides at spaced locations to provide hemostatic ligations.

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