INSTRUMENT FOR JOINING BLOOD VESSELS

Fig. 3

Fig. 4

Fig. 5

Fig. 13

Fig. 14

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[Signature]
This invention relates to the class of surgical instruments and more particularly to a forceps used for the joining of the blood vessels.

The instrument according to the invention is characterized by having two coxal pairs of forceps, one with a pair of semi-cylindrical enclosures on the tip of each leg for guiding staples of the Hotchkiss type paper fastener, and in each enclosure slides a semi-cylindrical plunger to push out the staples, and on each forceps a bell-crank with a long lever is provided to reciprocate the plunger, and the other forceps is provided with a pair of semi-cylindrical anvils to bend staples. Further, there is attached a tightening bar with a hook on the end cooperating with a taper-pin to adjust the distance between the faces of the tips of the forceps.

An object of this invention is to facilitate a mechanical joining of blood vessels during surgical operations safely and surely without using any thread but using staples. Because the existing method uses hand suture, the present invention reduces the time necessary for an operation thus improving the health of a patient.

A further object of the invention resides in the provision of means for stapling the ends of blood vessels together during surgical operations.

Yet another object of the invention resides in the provision of means for clamping off the ends of blood vessels securely so that the ends of the blood vessels may be dealt with into flanges with respect to a stapling or stitching head and an anvil, whereby the ends of the blood vessels can be securely stapled together without requiring their suture.

Still further objects and features of the invention reside in the provision of a surgical instrument that is highly efficient in operation, inexpensive to manufacture and produce, easy to use and in which may be easily sterilized so as to be rendered germ free and safe for surgical operations.

These, together with the various ancillary objects and features of the invention which will become apparent as the following description proceeds, are attained by this surgical instrument, a preferred embodiment of which has been illustrated in the accompanying drawings by way of example only, wherein:

Fig. 1 is a side elevational view of the instrument comprising the present invention;

Fig. 2 is a side elevational view showing the instrument with each pair of forceps in detached position relative to the other pair of forceps;

Fig. 3 is a partial front elevational view of the instrument in a position for feeding staples;

Fig. 4 is a front view of the forceps in an open position;

Fig. 5 is a view similar to Fig. 3, but showing the forceps in position for receiving staples;

Fig. 6 is a front view of the invention in an open position for receiving staples;

Fig. 7 is a horizontal sectional detail view as taken along the plane of line VII—VII in Fig. 1;

Figs. 8, 9 and 10 are sectional detail views similar to Fig. 7 but showing the invention during stages of operation thereof;

Fig. 11 is an enlarged elevational view of the stitching head;

Fig. 12 is an enlarged sectional detail view as taken along the plane of line XII—XII in Fig. 1;

Fig. 13 is an enlarged sectional detail view of the plunger forming a part of the stitching head;

Fig. 14 is a plan view of the plunger;

Fig. 15 is a plan view of a staple in the invention;

Fig. 16 is a side elevational view of a staple;

Fig. 17 is a side view of the tightening device; and

Fig. 18 is a bottom view of the tightening device.

In the accompanying drawings like reference numerals are used to designate similar parts throughout the various views. The surgical instrument according to the present invention includes a pair of forceps A, B which have nippers 1, 1' and looped grips 2, 2', which open and close with the pins 3, 3' as pivot points.

The tips of the nippers 1, 1' are bent slightly forward and a pair of the stitching heads lie opposite to each other. To each forceps A, B is detachably attached a pair of pincers a, b by screws 35, and each pincers may be opened and closed separately. Each forceps has a connecting bar 4 or 4' at the tip of the root of the nippers, respectively, and the bar 4 is made to project out behind the nippers through the hole 5 when the two pairs of forceps are assembled together, with the bar 4', at the root of the nippers 1', projected out forward through the holes 5' of the nippers 1. A threaded pin provides with a scale 7 penetrates across the bar 4', and is engaged with a nut 6 which is held in the slot of the nippers. This pin is threaded on an end thereof, and the other end of the pin is slightly tapered. As the faces of the forceps, between which the taper pin is positioned, are inclined parallel to the taper of the latter the distance between the two forceps can be adjusted by pushing out or withdrawing the taper pin with the nut 6, and the forceps are kept parallel to each other.

A sliding tighter 10 with two guide holes 9 is attached to the nippers 1' with two set screws 36 and is longitudinally adjustable. The tighter has a fork at the tip, and this part is tapered to form wedge 12. A wedge shaped notch 13 fitted with the fork end is cut on the end of the connecting bar 4. After the bar is inserted through the hole 5 so that the end of the bar projects out of the rear face of the nippers, the fork 12 of the tighter 10 is hooked and tightened, holding the forceps A, B at proper distance from each other.

The stitching head and the anvil are separately attached at the tip of each nippers of the forceps. The head C has a semi-cylindrical form, and two symmetrical head clamps are provided on the ends of the nippers 1, 1' respectively. By closing the nippers, the heads are coupled together, and a cylindrical hole 14 is completed. Each head C has a semi-cylindrical slide 15 in it, and holds a reciprocating plunger respectively.

The chambers of the slides 15 in the heads C are connected to the segmented openings 17 which are bored through the end surface of the heads against the anvils, and through these openings extend projections 18 which push the stitching staples 19 in the chamber of the slide out of the openings.

The reciprocating motion of the plungers is obtained by gripping the levers 20. The tips of the levers are bent in the shape of the letter L and projected inward a short distance, and the points of the L-shaped lever 21 are disposed against pins 22 of the plungers. The plungers 16 are moved to-and-fro parallel to the axis of the cylinder in the chambers of the slides 15 by the swinging motions of the operating levers 20 and the L-shaped points 21.
The anvils d each have a semi-cylindrical form, and each anvil is fixed on the end of nipper 1' of the forceps B, and as the two anvils d cooperate to make a cylindrical hole 14' similar to the hole that is made by the stitching head 14 and in alignment therewith.

On the face of the anvils d several segmental pits 25 are engraved to receive the staples 19 which are pushed out by the plungers through the openings, and to bend the legs of the staples after stitching the blood vessel. The semi-cylindrical necks of the heads and anvils which are fixed on the tips of the nippers of forceps A and B are exposed between the two forceps, and clamps 27 provided with semi-circular jaws fitted with the outer surface of the necks are pivoted on the inside of the nippers 1 and 1' by screws 29.

The other ends of the clamps have slots 30, and the clamps are opened and closed by crank pins attached to the small bell-cranks which are supported swing-free on the nippers 1 or 1' respectively. As these jaws are fitted with the outer surfaces of the necks, the ends of the blood vessels e and e' which are developed between the faces of the heads and the anvils after guided through the cylindrical holes and turned over the necks, can be clamped or released at will.

The operations and actions of a constructed practical example of this invention are as follows:

The forceps A, a and B, b are opened separately. The staples 19 shown by Figs. 15 and 16 are charged in the openings 17 of the clamps C. The ends of the blood vessels to be joined e, e' are guided through the cylindrical holes 14, 14' which are formed by the heads c, c' and the anvils d, d', and held tightly with the pincers a, a' and each end is developed over the openings 17 of the heads or over the pins of the anvils respectively. The border of each blood vessel is turned over the flange 26 or the anvil, and in this state, is clamped firmly by the clamps 27 around the necks 26 in turning the handles 32 of the bell-cranks 33.

The forceps A and B are assembled together by inserting the connecting bar 4 and 4' through the holes 5 and 5'. The distance between the heads and the anvils is adjusted by screwing the taper pin 7 forward and backward using the nut 6, and in sliding the tighten 18 the fork 12 is hooked on the bar, fitting with the wedge-shaped notch, to fix the forceps A and B firmly (Fig. 1). After this, the plungers 16 are pushed along the slides in the chambers 15 by gripping the handles 24 and 24' of the operating levers 20 and 20' simultaneously. The staples are pushed out by the projections 18 at the end of the plungers, through the overlapped walls of the blood vessels e and e', and bent inward by the pins 25 engraved on the faces of the anvils d, and bind the two blood vessels together. After the blood vessels are joined, the clamps 27 on the forceps A, B, a and a' are opened, and the joined blood vessels e and e' are released as shown in Fig. 10.

The joining of the blood vessels by this invention is performed without using needle or sewing thread. The end of the blood vessels are developed over the faces of the stitching heads and anvils which make the cylindrical patterns for the blood vessels to be joined, and turned over the flanges of the blood vessels, and clamped firmly with the jaws of the claws about the necks.

The faces of the heads and the anvils are pressed to each other with the tighteners, and the staples are pushed out by the plungers and stitched the developed flanges of the blood vessels and join them together. By the removal of the clamps and the anvils from the joined blood vessels, both are separated in two pieces in opening the forceps. The operation is pursued very easily and surely, and the time required to join the blood vessels is quite short compared to the usual hand-sewing method. As the operation of this instrument is very easy, and yet the purpose described above is achieved, it can make a great contribution to medical science.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that such obvious changes and modifications be embraced by the annexed claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent, is:

1. An instrument for joining blood vessels, comprising two pairs of forceps, one of said pairs of forceps having nippers each provided with a stitching head of semi-cylindrical cross section at the end thereof, each stitching head having plungers by which staples are pushed out, operating lever means engaging said plungers to reciprocate said plungers, the other pair of said forceps having nippers each provided with an anvil of semi-cylindrical cross section on the end thereof, and means connected to said pairs of forceps for adjusting the distance between said stitching heads and said anvils.

2. Instrument for joining the blood vessels described in claim 1, said last recited means including a sliding tighteners provided with a fork on the end thereof, and a taper pin inserted between said pair of forceps, connecting bars attached to said pair of forceps, said tighteners engaging said connecting bars to hold said pair of forceps in spaced relationship determined by the position of said taper pin.

3. An instrument for joining the blood vessels described in claim 1, said nippers of said pairs of forceps being provided with clamps pivoted thereto, said clamps having semi-circular jaws, and bell-cranks pivoted to said nippers and said clamps for opening and closing said clamps.

4. A surgical instrument comprising two pairs of forceps, one of said pairs of forceps being provided with semi-circular stapling heads, the other of said pairs of forceps being provided with semi-circular anvils, means for holding said anvils in aligned spaced relationship to said stapling heads, and means for actuating said stapling heads.

5. The surgical instrument of claim 4, including clamping means pivoted to said pairs of forceps for clamping a blood vessel and holding the blood vessel for stapling.

6. The surgical instrument of claim 5, including means on said pairs of forceps for separately actuating said clamping means.

No references cited.