THE NEW
AMERICAN VASCULAR STAPLER*
FOR BLOOD VESSEL ANASTOMOSIS

staples are preloaded

in a disposable

plastic bushing,

enabling assistant

to ready stapler

in seconds . . .

and with the size

staple desired.

Order Direct from Manufacturer and Distributor:

1838 1963 125TH ANNIVERSARY

CODMAN & SHURTLEFF, INC.

130 Auckland Street, Boston, Massachusetts 02125

AVS-7-63-2M

*Patent Applied For

Drawings by Courtesy of The Scientific American

What is new and different?

... *FIRST, the DISPOSABLE staple bushings*

- The hairfine staples need no longer be manually inserted in the tiny bushing slots by the surgeon.
- The staples are now preloaded at the factory in a disposable plastic bushing.
  These disposable bushings are packaged and sterilized at the factory ready for use.
- The nurse can load the stapler with the size of disposable bushing desired in a few seconds.
- This means there is no waiting time during the operation for reloading a bushing... no anxiety on the part of the surgeon that a staple may have been deformed during a manual loading operation. The surgeon can see the staple through the translucent bushing neck.

and – other new features in the American Vascular Stapler include:

A recommended for anastomosis of blood vessels... joining of severed nerves... anastomosis of the ureter

B bushing is designed so that there is no slippage of vessel

C when anastomosis is completed and instrument is withdrawn from the vessel, the bushings stay on the vessel – the surgeon can easily remove each bushing half from under the cuff – no tearing of the cuff is therefore possible during opening of the instrume

Photographs taken in the Department of Surgery at the Veterans Administration Hospital, Bronx, New York by the Medical Illustration Department during the testing period.

Printed in U. S. A.

The instrument

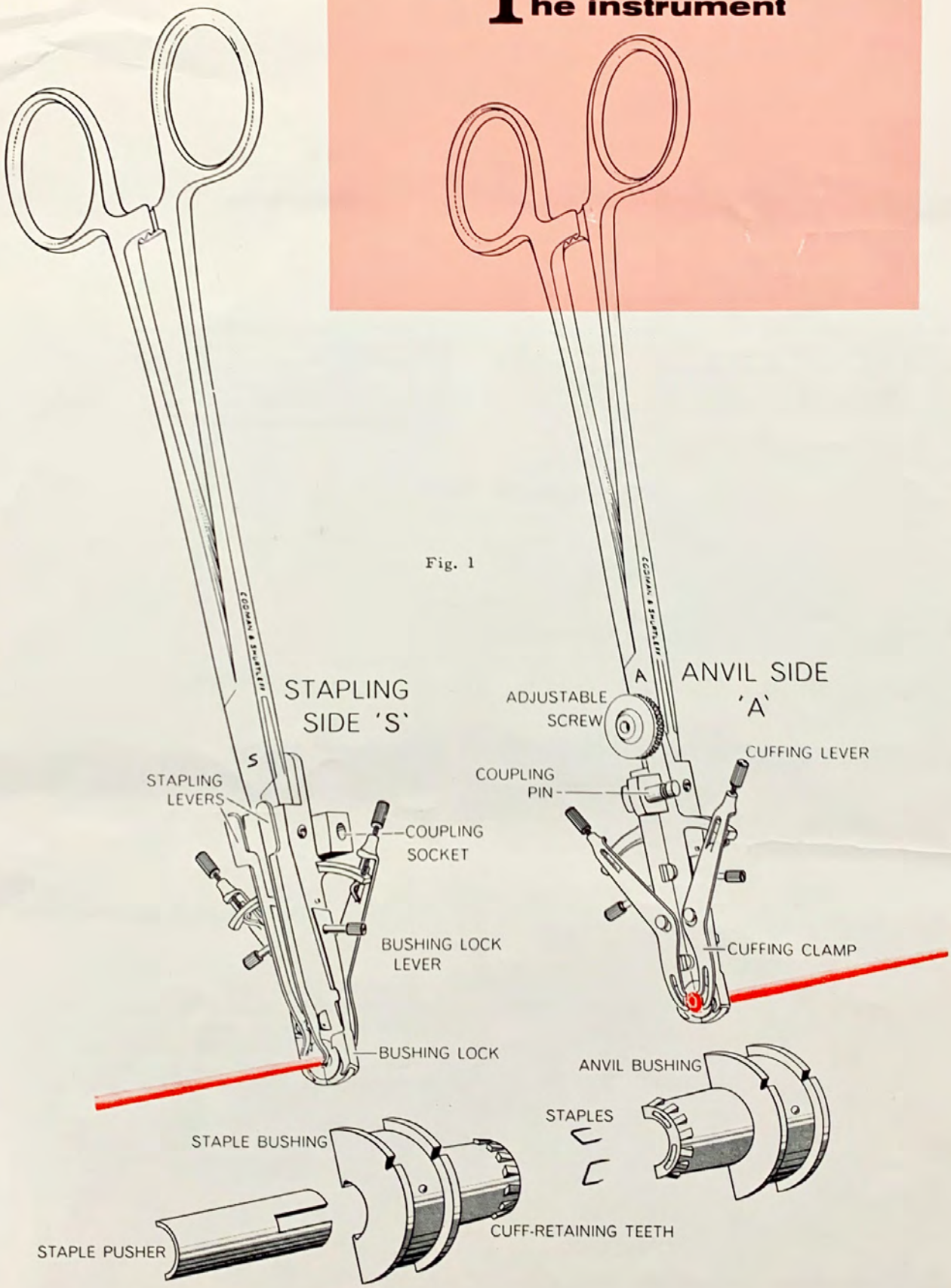

Fig. 1

Holding the cuff

The most difficult part of the surgeon's work when he performs an anastomosis is the making of a good cuff. To facilitate this operation the instrument was so designed that the cuff is held at three strategic points: (see Fig. 2)

- Two sharp prongs 1a and 1b on each cuffing clamp (see Fig. 7, page 7).
- A plurality of sharp cuff retaining teeth on the bushing rim (see Fig. 1, page 3).
- Internal bushing teeth A and B (see Fig. 2).

The internal bushing tooth does not perform a crushing action on the vessel but merely deflects the vessel several times. The geometric build-up of each deflection increases the resistance to axial slippage. The surgeon need no longer feel doubtful as to whether or not the cuff he succeeded in producing will really stay put.

The placing of the vessel clamp within the bushing rather than on the outside of the bushing has four more advantages:

- It narrows the instrument at the working end to a width of 15 mm. (see Fig. 11 and front page photo).
- It eliminates a costly spring operated outside clamp.
- It shortens the distance between an external clamp and the cuffing lever teeth. The potential energy stored up in the tensioned vessel is thereby reduced.
- It combines closing the instrument and closing the vessel clamp into one operation. The surgeon thus saves time.

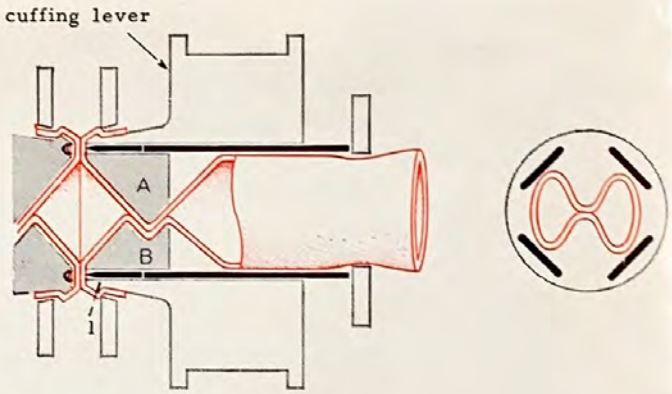

Fig. 2

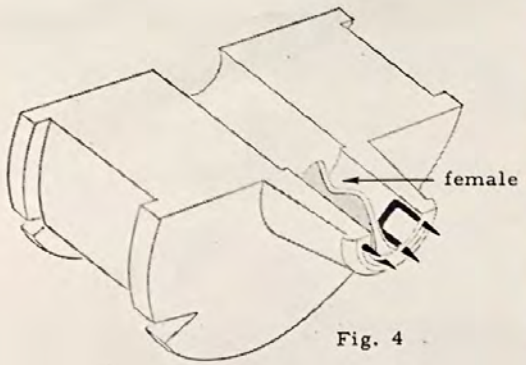

Fig. 4

Males and females

The bushing halves are not identical. The internal tooth which grips the vessel and holds it in place during the cuffing operation is a male tooth on one bushing half and a female tooth on the other bushing half. Fig. 4 shows a female tooth and Fig. 2 shows how tooth A and tooth B grip the vessel.

The staple bushings are color coded. The female is white and the male is blue. Always use the blue and white together. Never two white or two blue.

Staple bushings

The vascular stapler consists of two separate instruments: The Stapling Side stamped "S" and the Anvil Side stamped "A" (see Fig. 1). The staple bushing (with the staples and pusher) goes in the left instrument; the anvil bushing in the right instrument. The staple bushings are furnished from the supplier with the staples and staple bushings loaded. The loading of the miniature staples is done in the factory by means of automatic loading machines. The factory also inspects, sterilizes and packages each pair of bushing halves, Fig. 3a. When the nurse opens a package and takes out the two bushing halves (male and female), Fig. 3b, they are ready to be inserted (loaded) into the sterilized instrument. The instrument is then handed to the surgeon. When the operation is finished the two bushing halves with pushers are thrown away - they are disposable.

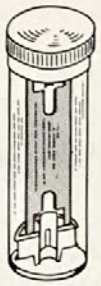

Fig. 3a

Fig. 3b

Anvil bushings

The anvil bushings, in contrast to the plastic staple bushings, are made of stainless steel and are not thrown away. Cleaning the anvil bushing is a simple matter since the small depression of the anvil cam is very shallow. If the staple bushings, with their tiny slits, would have to be cleaned it would be not only a very time consuming task but it would also be most difficult.

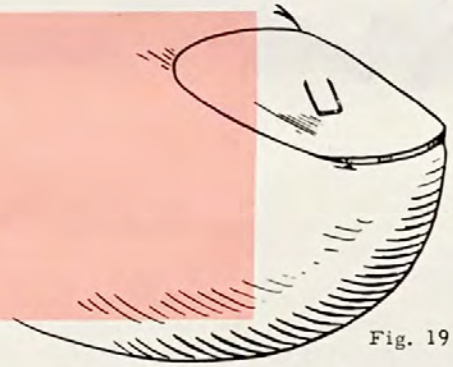

Fig. 19

Staples

The staples used in the six bushings are made of stainless steel suture wire. They are pointed at the tip to facilitate penetration of the vessel wall through the cuff (Fig. 17). The slant at the tip also conforms to the entrance angle of the anvil cams. Four staple sizes are used for the bushings. Their dimensions are shown in Figs. 17 and 20. The odd dimensions of staple width were chosen to make the increase from one bushing bore to the next to be about 20%.

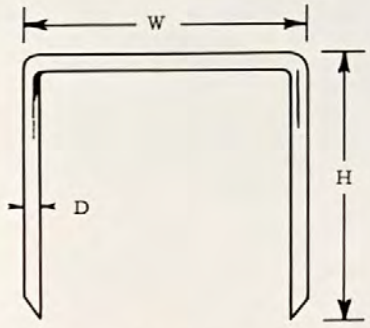

Fig. 17

Bushing No.	Bushing Bore mm	Bushing Bore in.	Width W	Height H	Wire Diameter D	No. of Staples
T-3021	1.5	.060	.048	.048	.004	4
T-3022	1.8	.072	.057	.057	.004	4
T-3023	2.2	.086	.043	.043	.004	6
T-3024	2.6	.104	.053	.052	.004	6
T-3025	3.1	.124	.043	.043	.004	8
T-3026	3.8	.150	.053	.054	.004	8

Fig. 20

The surgeon using the instrument

Generally speaking, one can say that an end-to-end anastomosis with the American Stapler requires 9 steps (See Figs. 6 to 14). It is understood that prior to using the stapling instrument, the two vessel ends must be occluded. A small tourniquet is used for that purpose or other suitable clamps.

One of the important factors in performing an anastomosis with a stapler is the choice of the right bushing bore, that is, the right inside diameter of the bushing. If, for example, the surgeon finds that cuffing is difficult with the bushing he has chosen, that is to say that he cannot stretch the vessel sufficiently to produce a good cuff, then he asks the nurse for the next smaller size. If a bushing is used for the anastomosis which is considerably smaller than the vessel there will be some bleeding in the gaps between the staples. The surgeon then waits until sealing takes place by coagulation.

When the surgeon decides which size anvil or staple bushing he needs for the anastomosis, he tells the nurse and she opens the jaws of the Anvil Side "A", takes the two sterile anvil halves out of the sterile container and inserts them into the semi-circular cutout of the jaws. Fig. 5 shows the anvil in the lower jaw (1) already locked in. The anvil in the upper jaw is ready to be placed in the semi-circular cutout (2) and locked in by the lever (3). When the lever is pushed forward in the direction of the arrow, the anvil or staple bushing half is locked in. When the lever is pulled backwards, the anvil or staple bushing half is ejected.

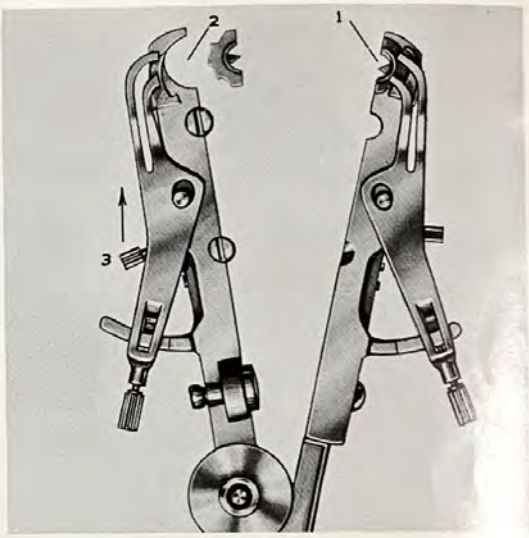

Fig. 5

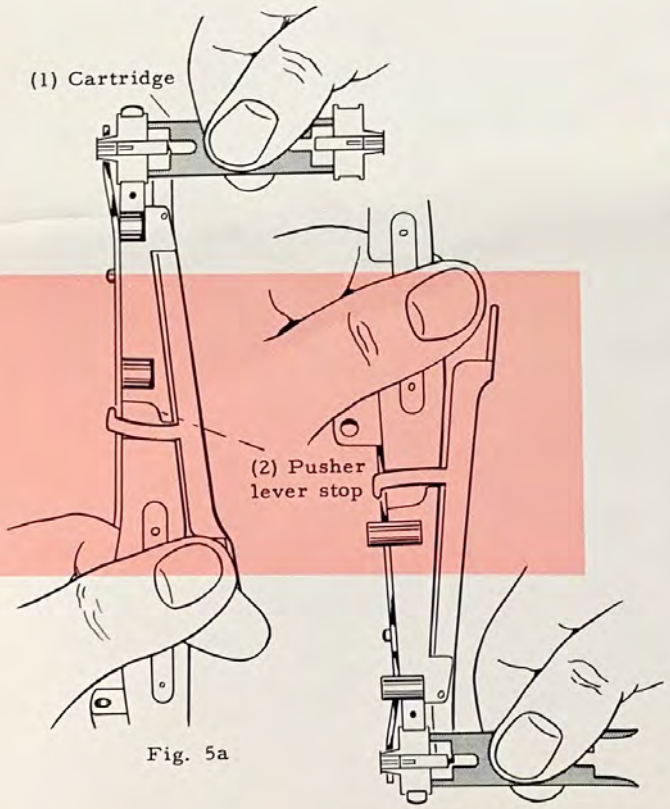

Fig. 5a

Fig. 5b

The loading of the staple bushing into the instrument is shown in Fig. 5a and 5b. The nurse takes the cartridge out of the sterilized bottle and inserts it into the semi-circular opening of the jaw. She holds the instrument with the left hand as shown in the drawing, always keeping the pusher lever to the right. The metal cartridge is held with the index finger and thumb of the right hand. When the bushing half is in place, the bushing release lever (2) Fig. 12 locks the bushing in. The cartridge (1) is now withdrawn to the right and the nurse can proceed loading the other bushing half by turning the instrument with a circular motion until the jaw to be loaded is facing the operator with the pusher lever to the right as in Fig. 5b.

The purpose of the cartridge is three-fold. It protects the staples within the bottle; it prevents the pusher from accidently being pushed in during the loading operation, and gives the nurse a large surface to hold between her fingers. One might also mention that the sterilized bushing is not being touched during the loading process.

Sequence of operations

1 The surgeon begins by opening the anvil side of the instrument. The anvil side is marked "A"; the staple side is marked "S" (See Fig. 11). The surgeon then lays the vessel in the lower bushing half as shown in Fig. 6. Some tension is applied to the vessel end to make sure that it hugs the semi-circular trough. The vessel must not be pinched by the upper bushing half when the instrument closes.

Note: The reason for beginning with the anvil side of the instrument is the fact that the surgeon often finds that there is not enough elasticity in the vessel to produce a good cuff. The surgeon then uses the the next size smaller bushing. Had he started with the disposable staple bushing rather than the anvil bushing, the staple bushing would no longer be sterile.

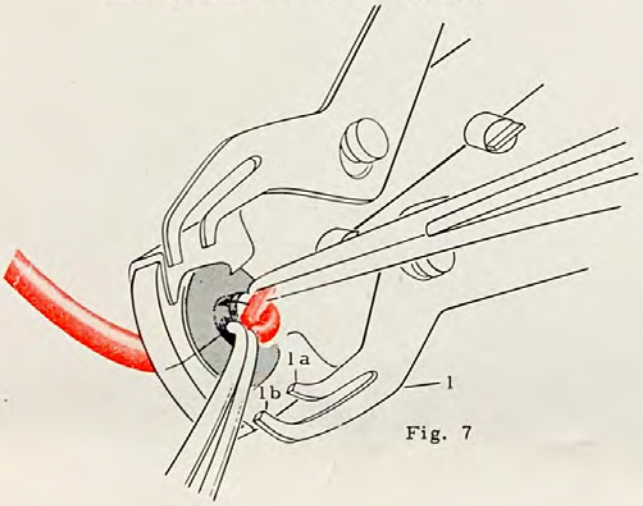

Fig. 7

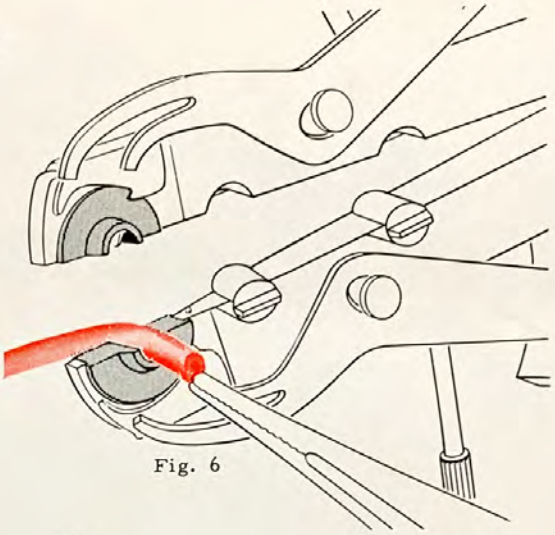
Fig. 6

2 The end of the vessel is now cuffed. Cuffing of the vessel is generally done on one side first, as shown in Fig. 7. The cuffing clamp (1) is then moved by the assisting surgeon toward the cuffed portion of the vessel and held in place by tightening lightly the cuffing lever thumb screw (3) Fig. 8. When the cuffing is completed on the second side the second cuffing lever is moved into the clamping position and secured by its thumb screw. The sharp edge of the cuffing clamp, together with the sharp teeth on the rim of the bushing neck, plus the teeth inside the bushing prevent the vessel from slipping and allow the surgeon to move the instrument freely without fear that the cuff may come off.

3 Fig. 8 shows how the cuffing levers are moved outwards by applying a gentle force on the thumb screw (3). This screw is tightened lightly and holds the lever firmly in position so that the surgeon need not fear that the cuff will slip off during manipulation of the instrument. The staple side "S" is done in a similar fashion. When cuffing is completed on both instrument halves, the surgeon is now ready to couple them for the purpose of approximating the two vessel ends.

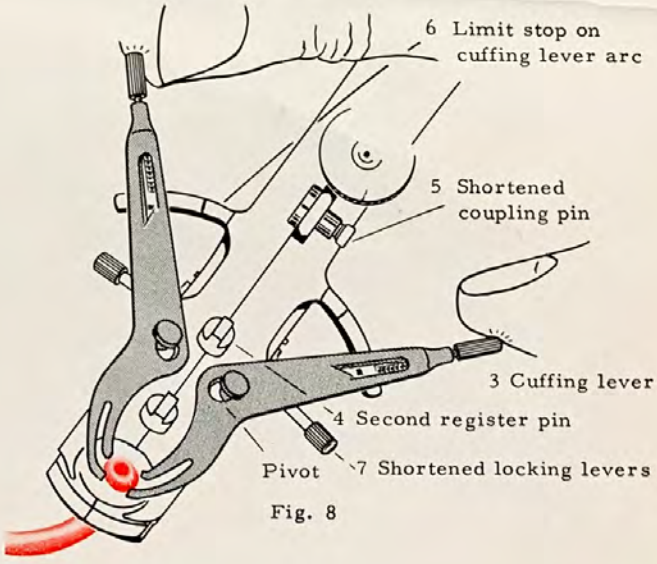

Fig. 8

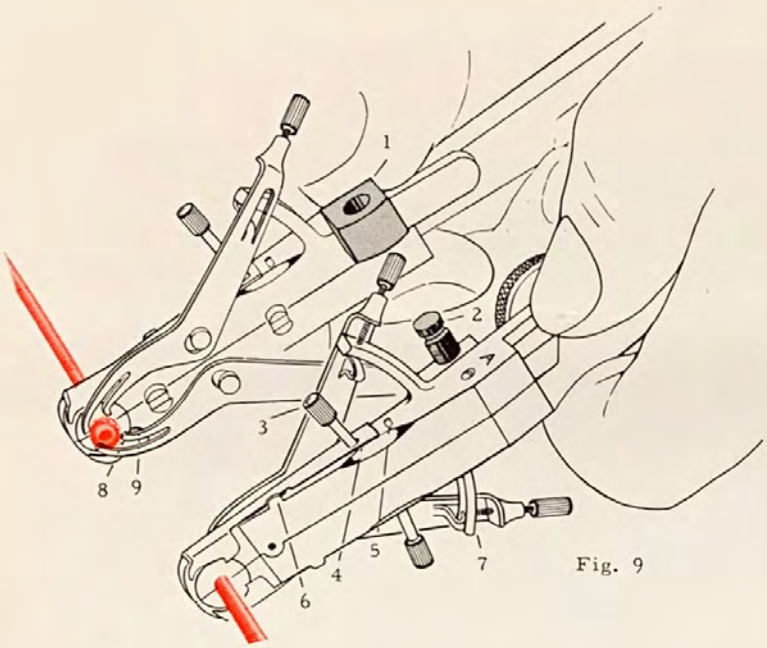

Fig. 9

4 To couple the stapling "S" side of the instrument to the anvil side "A" the surgeon grips the two halves, as shown in the figure, and brings the hole 1 over the coupling pin 2. The hole is now slipped over the pin and the vessel ends can be approximated for the stapling process. The pin acts as a pivot, in much the same way as the pivot in a pair of pliers.

5 When the two vessel ends touch each other a certain amount of pressure must be applied before the stapling levers are actuated. This is done by turning the serrated nut shown in the figure. The surgeon knows by experience and "feel" how much pressure he can apply on the different kinds of vessel walls.

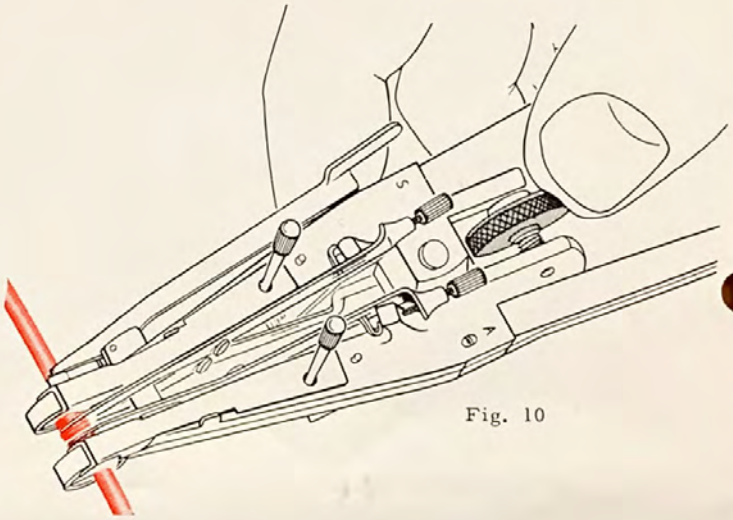

Fig. 10

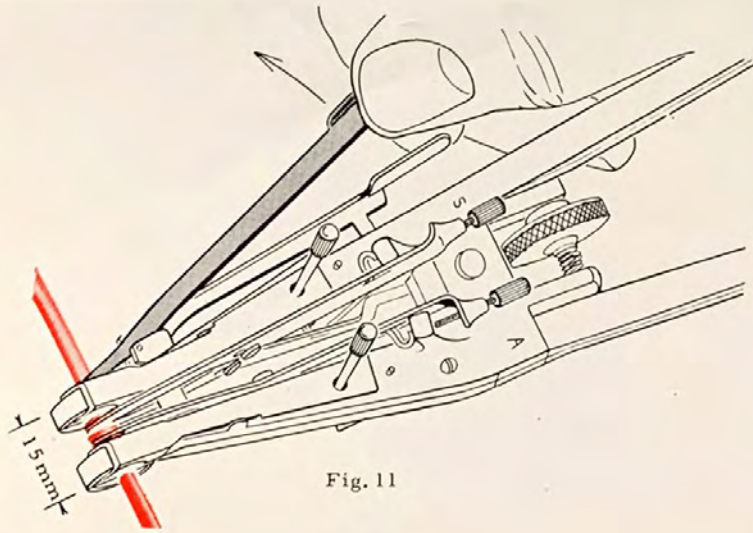

Fig. 11

6 The instrument is now ready for the surgeon to drive the staples through the two cuffs. The arrow in the figure shows the direction in which the upper cuffing lever is moved when the staples are driven through the upper bushing half. The lower staple lever is operated in the same way.

7 Before taking the instrument off the vessel the surgeon loosens the serrated nut 1 by turning it a few degrees. This relieves the axial pressure on the cuffs. He then unlocks the four bushing halves from their respective jaws. He does this by applying the index finger and the middle finger on the four release levers 2 as shown in the figure. Pulling the levers back in the direction of the arrow first unlocks the bushings and then exerts a gentle force by cams 3 on the bushing flange 4. When the forceps are opened there is now a positive force which pushes the four bushing halves out of the jaws.

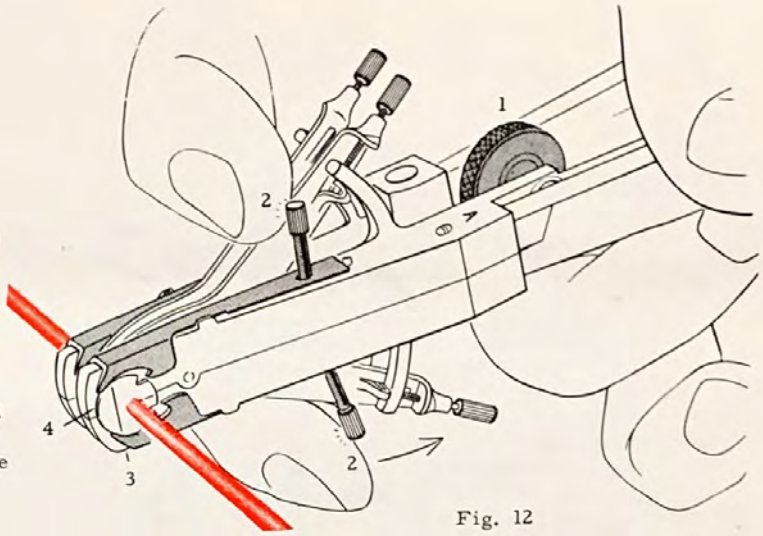

Fig. 12

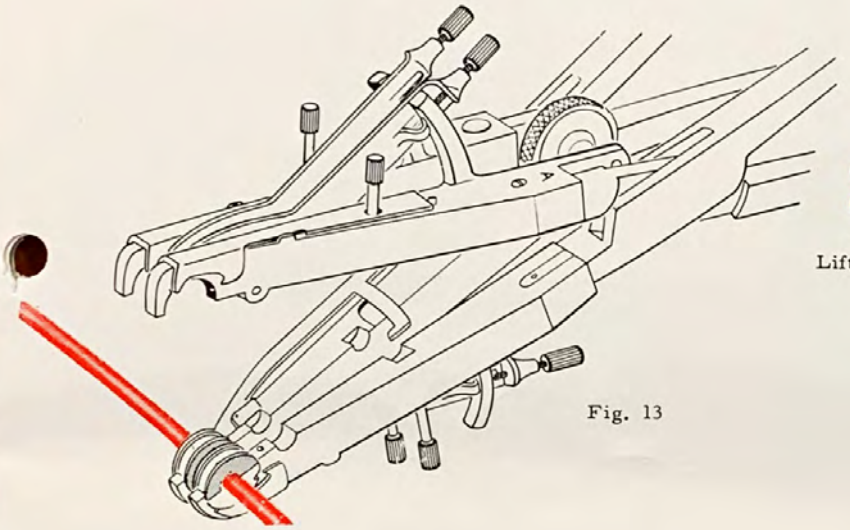

Fig. 13

8 The bushings and the anastomosed vessel now rest by gravity on the lower jaws. Lifting the vessel a short distance allows the instrument to be withdrawn without difficulty.

9 When the surgeon removes the bushing halves from under the cuffs he tilts them slightly with respect to the vessel axis and pulls them away from the cuff. The anvil halves are returned to the instrument tray, the staple bushings are discarded.

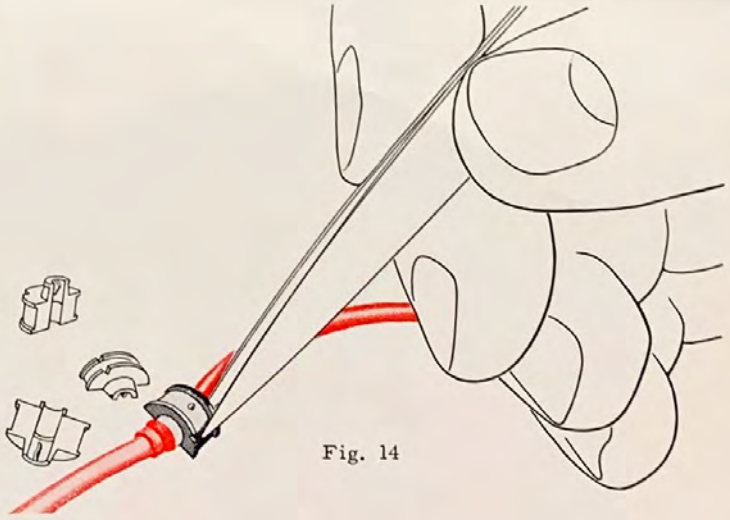

Fig. 14

End-to-end anastomosis

The basic structure of an end-to-end anastomosed vessel is shown in Fig. 15. Four staples connect the two cuffs in a way that the staples are not visible from the inside or outside. The advantage of the cuff connection lies in the fact that no foreign material is in contact with the blood stream. Fig. 15a shows a perspective view of the outside appearance of a symmetrical cuff anastomosis. The contacting surfaces are produced by the cuff-to-cuff structure, which means intima-to-intima. Healing in this type of structure takes place in a short time.

Fig. 15.

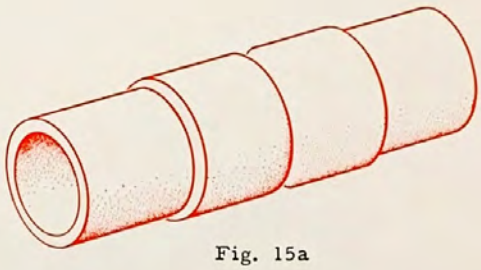

Fig. 15a

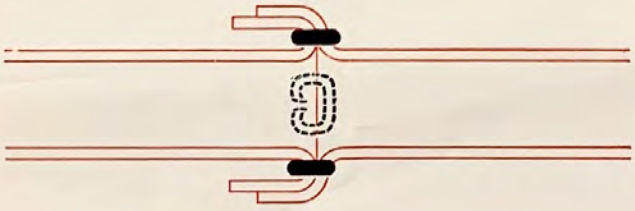

Fig. 16

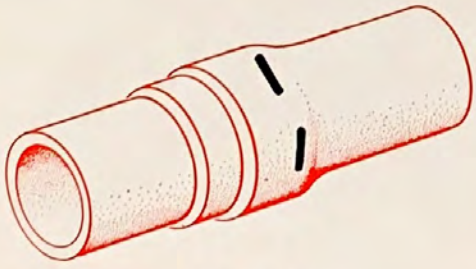

Fig. 16a

Intima-to-intima contact

A larger area of intima-to-intima contact can be obtained by flipping one cuff over the other. This is done after the anastomosis is completed. One must realize, however, that the double cuff also causes a certain amount of reduction in the lumen. The surgeon must choose which of the two methods is indicated for each specific case. Fig. 16 and Fig. 16a show diagrammatically the structure of the double cuff connection.

Cleaning the instrument

The instrument is so designed that it can be disassembled and assembled without the use of tools. The parts separate by a simple unhooking process.

In taking the instrument apart for cleaning there are only eight parts that have to be detached from the instruments. The staple bushings and the staple pushers are preassembled and therefore need not be cleaned. (Fig.18).

Each jaw of the instrument has only two parts that should be taken off for cleaning purposes, the cuffing lever and the bushing holding lever (bushing lock). Since the stapler has four jaws there is a total of eight parts that the nurse has to take apart when she cleans the instrument.

NOTE: DO NOT LOSE THE ANVILS

the cuffing clamp

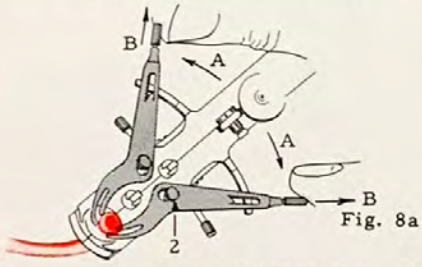

Fig. 8a

Of the four cuffing clamps there are two right hand ones and two left hand ones. The difference between the two clamps can be seen in Fig. 8a. To take the cuffing lever off the instrument it must be moved outwards as shown by the arrow A. When the cuffing lever slips off the curved support it is pulled back in direction B. Due to the elongated slit at pivot 2 it now is free from the jaw and can be taken off. Reassembly is done by reversing the sequence of operations.

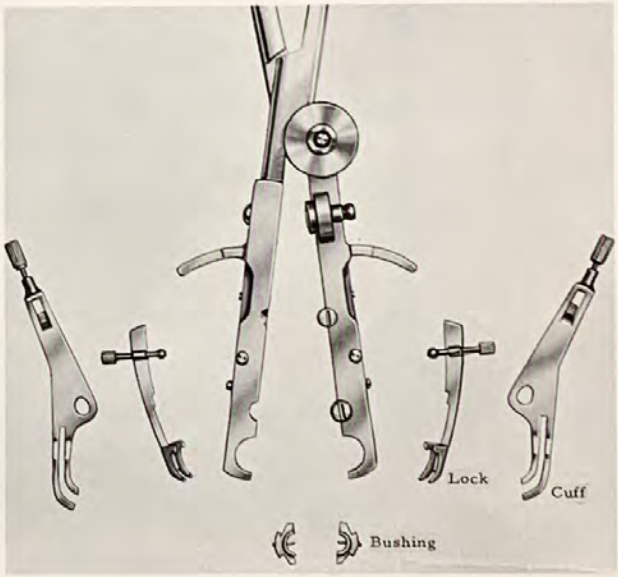

Fig. 18

the bushing lock

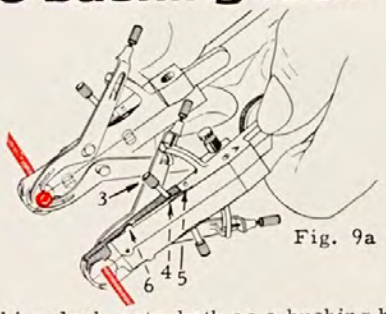

Fig. 9a

The bushing lock acts both as a bushing holder and a bushing ejector. To take it off the jaw (See Fig. 9a) the locking lever 3 is pulled backwards until the lock slide 4 hits the stop pin 5. If slide 4 is now lifted somewhat higher than the height of the pin, the slide can move farther back. It then disengages itself from slot 6 and comes off the jaw without difficulty. The lifting of the lock slide 4 over pin 5 is generally done by forcing the thumb nail between slide 4 and its support.

the anvil

The pair of anvil halves present no difficulty in cleaning. After the blood has been removed with a brush they are returned to their respective bottles in the case. Care must be taken that anvils do not get mixed up. Due to the smallness of the part it is not easy to see whether or not the pair is properly matched. To avoid confusion the anvils as well as the staple bushings are marked with numbers from 1 to 6. The corresponding inside diameters of the bushings are:

T-3011	No. 1	1.5 mm.
T-3012	No. 2	1.8 mm.
T-3013	No. 3	2.2 mm.
T-3014	No. 4	2.6 mm.
T-3015	No. 5	3.1 mm.
T-3016	No. 6	3.8 mm.

ANVILS ARE EXPENSIVE-DO NOT LOSE

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T-3000

American Vascular Stapler Set - complete in a leatherette case consists of:

T-3001 American Vascular Stapler

1 - T-3011 No. 1 Anvil - 1.5 mm. Bore
1 - T-3012 No. 2 Anvil - 1.8 mm. Bore
1 - T-3013 No. 3 Anvil - 2.2 mm. Bore
1 - T-3014 No. 4 Anvil - 2.6 mm. Bore
1 - T-3015 No. 5 Anvil - 3.1 mm. Bore
1 - T-3016 No. 6 Anvil - 3.8 mm. Bore
6 - T-3021 No. 1 Sterile Bushings - 1.5 mm. Bore
6 - T-3022 No. 2 Sterile Bushings - 1.8 mm. Bore
6 - T-3023 No. 3 Sterile Bushings - 2.2 mm. Bore
6 - T-3024 No. 4 Sterile Bushings - 2.6 mm. Bore
6 - T-3025 No. 5 Sterile Bushings - 3.1 mm. Bore
6 - T-3026 No. 6 Sterile Bushings - 3.8 mm. Bore
2 - G-835 Dressing Forceps - 1 mm. tip radius
2 - E-1890 Dressing Forceps - 1/2mm. tip radius
1 - T-3099 Leatherette Case - with removable Sterilizer Tray

The purpose of the lift out tray is to keep all parts together for sterilization. It is not necessary to keep the staple bushings in the nest since they come from the factory already sterilized. Some surgeons may prefer to have a spare set of anvils for reserve. The 1 mm. forceps are intended for the larger vessels and the 1/2 mm. forceps for the smaller vessels. A pad in the lid of the base keeps the instruments and bottles from falling off the posts. The case can therefore be stored in a vertical position. Its outside dimensions are letter size (8-1/2 x 11). It fits into any standard filing cabinet.

Cleaning the instrument

The instrument is so designed that it can be disassembled and assembled without the use of tools. The parts separate by a simple unhooking process.

In taking the instrument apart for cleaning there are only eight parts that have to be detached from the instruments. The staple bushings and the staple pushers are preassembled and therefore need not be cleaned. (Fig.18).

Each jaw of the instrument has only two parts that should be taken off for cleaning purposes, the cuffing lever and the bushing holding lever (bushing lock). Since the stapler has four jaws there is a total of eight parts that the nurse has to take apart when she cleans the instrument.

NOTE: DO NOT LOSE THE ANVILS

the cuffing clamp

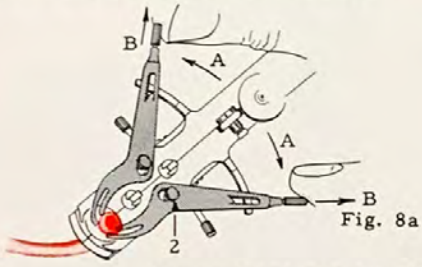

Fig. 8a

Of the four cuffing clamps there are two right hand ones and two left hand ones. The difference between the two clamps can be seen in Fig. 8a. To take the cuffing lever off the instrument it must be moved outwards as shown by the arrow A. When the cuffing lever slips off the curved support it is pulled back in direction B. Due to the elongated slit at pivot 2 it now is free from the jaw and can be taken off. Reassembly is done by reversing the sequence of operations.

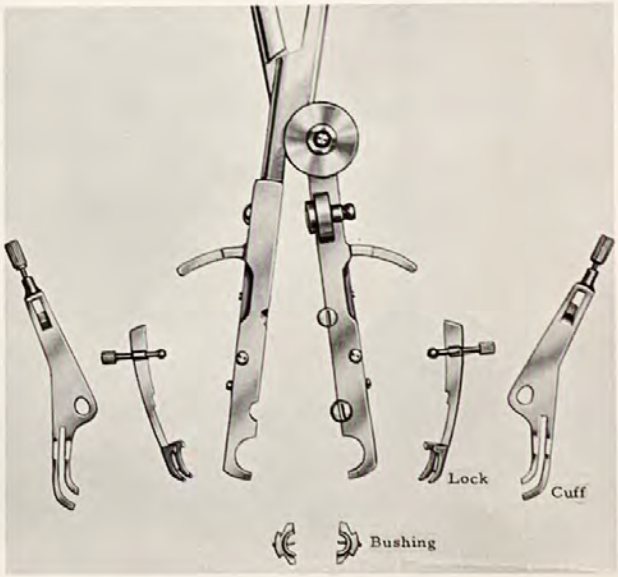

Fig. 18

the bushing lock

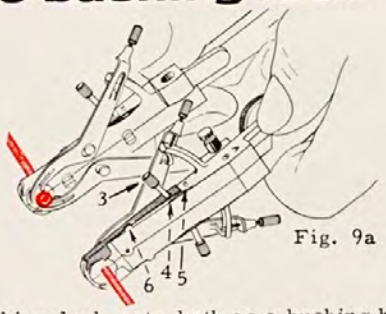

Fig. 9a

The bushing lock acts both as a bushing holder and a bushing ejector. To take it off the jaw (See Fig. 9a) the locking lever 3 is pulled backwards until the lock slide 4 hits the stop pin 5. If slide 4 is now lifted somewhat higher than the height of the pin, the slide can move farther back. It then disengages itself from slot 6 and comes off the jaw without difficulty. The lifting of the lock slide 4 over pin 5 is generally done by forcing the thumb nail between slide 4 and its support.

the anvil

The pair of anvil halves present no difficulty in cleaning. After the blood has been removed with a brush they are returned to their respective bottles in the case. Care must be taken that anvils do not get mixed up. Due to the smallness of the part it is not easy to see whether or not the pair is properly matched. To avoid confusion the anvils as well as the staple bushings are marked with numbers from 1 to 6. The corresponding inside diameters of the bushings are:

T-3011	No. 1	1.5 mm.
T-3012	No. 2	1.8 mm.
T-3013	No. 3	2.2 mm.
T-3014	No. 4	2.6 mm.
T-3015	No. 5	3.1 mm.
T-3016	No. 6	3.8 mm.

ANVILS ARE EXPENSIVE-DO NOT LOSE

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T-3000

American Vascular Stapler Set - complete in a leatherette case consists of:

T-3001 American Vascular Stapler

1 - T-3011 No. 1 Anvil - 1.5 mm. Bore
1 - T-3012 No. 2 Anvil - 1.8 mm. Bore
1 - T-3013 No. 3 Anvil - 2.2 mm. Bore
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