

Sept. 21, 1971

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3,606,888

STAPLING APPARATUS FOR ANASTOMOSIS OF HOLLOW VISCERA

Filed June 30, 1969

2 Sheets-Sheet 1

FIG. 1

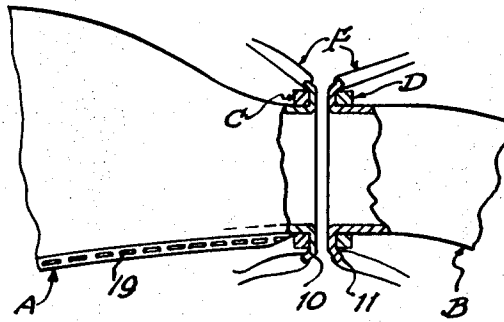


FIG. 2

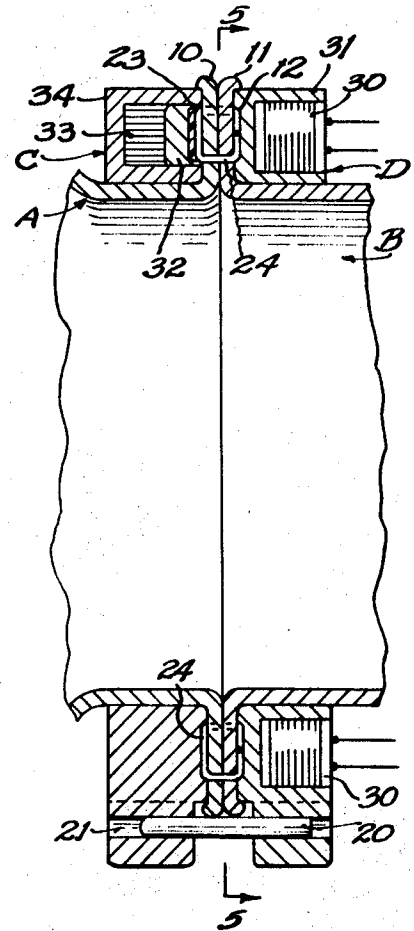


FIG. 4

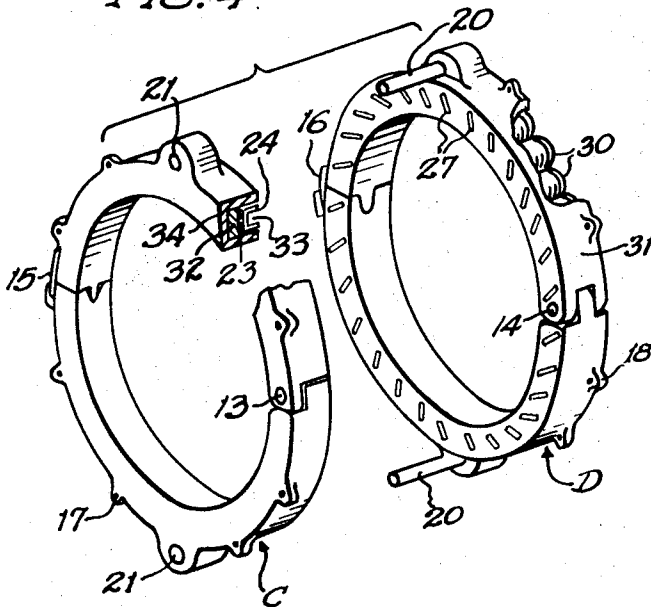
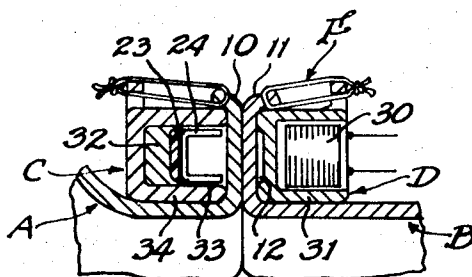


FIG. 3



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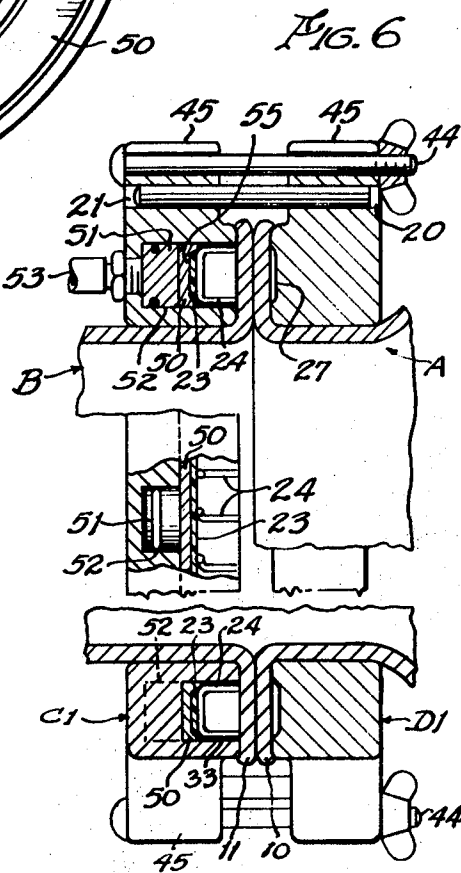
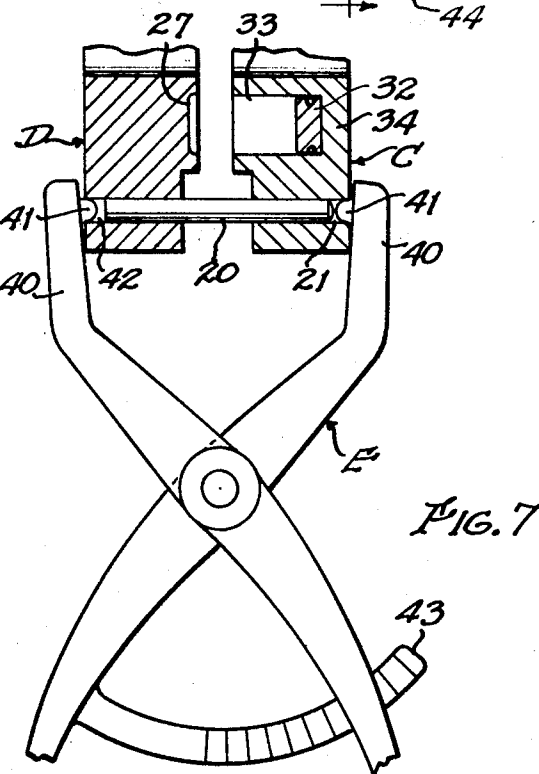
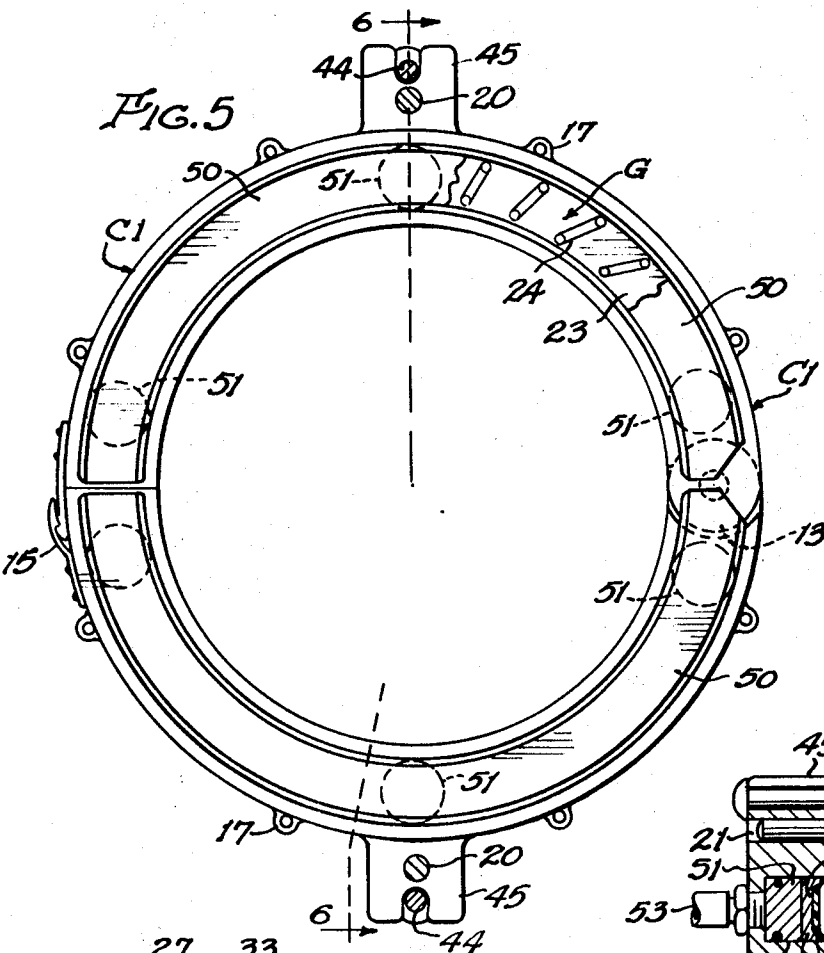
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2 Sheets-Sheet 2



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1

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STAPLING APPARATUS FOR ANASTOMOSIS OF HOLLOW VISCERA

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Int. Cl. A61b 17/11

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4 Claims

ABSTRACT OF THE DISCLOSURE

Anastomosis by simultaneous setting of a full 360° annular array of staples to join cut ends of a hollow viscus (i.e. intestinal tube or blood vessel) by everting the cut ends through and outwardly between a pair of opposed staple-setting split rings, operating the rings to staple the everted ends together, and opening the rings to remove them from the repaired viscus.

BACKGROUND OF THE INVENTION

A hand-operated stomach-stapling clamp having in-line jaws and handles in a tongs-type arrangement, has been in use in gastro-intestinal surgery for many years. Such clamps will perform a satisfactory closing job on tubular tissue (e.g. stomach or intestine) to the extent that the clamp can be maneuvered into a position in which the tissue is embraced between the jaws, but cannot be used for joining together the cut ends of a completely severed intestinal tract or other tubular member. Heretofore the only method actually used for joining cut viscera sections has been hand-suturing, a time-consuming operation.

OBJECT OF THE INVENTION

The invention has as its object to provide an anastomosis method and a stapling apparatus by which cut ends of a hollow viscus can be joined together by simultaneous stapling of a complete ring of staples through abutting everted ends of the viscus, and the apparatus can then be readily removed from encircling relation to the viscus. Specific objects are:

(a) To reduce the time required for an anastomosis to only a fraction of the time heretofore necessary for hand-suturing;

(b) To achieve uniformity of attachment throughout the full circumference of the anastomosed joint;

(c) To lighten the surgeon's load by eliminating the necessity for hand-suturing and allowing him to direct and concentrate his skills on other phases of a viscus resection operation.

These and other object will become apparent in the ensuing specifications and appended drawing, in which:

FIG. 1 is a side view of stomach and jejunum portions of an intestinal tract, severed from one another and with their cut ends everted preparatory to stapling them together;

FIG. 2 is an axial sectional view, on an enlarged scale, of a stapling apparatus of the invention immediately after being operated to join the cut ends of the tract;

FIG. 3 is a fragmentary axial sectional view of the same, in a preliminary stage of operation;

FIG. 4 is an exploded perspective view of the apparatus;

FIG. 5 is an end view of a staple-driving ring embodying a preferred form of the invention;

FIG. 6 is a fragmentary axial sectional view thereof, in a preliminary stage of operation; and

FIG. 7 is a fragmentary axial sectional view of a hand-operated clamp mechanism utilized by the invention.

2

DESCRIPTION

Referring now to the drawings in detail, and in particular to FIGS. 1-4 and 7, I have shown therein, as an example of one form in which the invention may be utilized, a method and suturing apparatus for joining the cut ends of a stomach outlet A and jejunum B after removal of a resected portion of the tract, joining being effected by using a pair of stapling ring members C and D, holding clamps E, and everting ties F.

Briefly describing the method, the cut ends of viscera A and B are inserted through the rings C and D after first loading an annular staple assembly G into ring C; the cut ends are then pierced, at spaced points around their peripheries, by ties F (which may be suture filaments); the ties F are then used to draw the cut ends outwardly between the rings C, D to develop the everted ends (flanges) 10 and 11; the rings C, D are then drawn together by clamps E so as to clamp and secure the everted ends 10, 11 in snug interengagement; the rings C, D are then utilized to drive the staple assembly G through the everted ends 10, 11 so as to form a closed joint secured by closed staples 12 between the viscera A and B; and the rings C and D, which are of sectional construction (split ring) are then opened and removed from the repaired viscus.

Where a substantial portion of a stomach is removed, with an attendant opening of one side (e.g. lower area) it is customary to close the open side by suturing or stapling together the cut margins thereof, as indicated at 19 in FIG. 1; and a new stomach outlet is everted at 10, for attachment to the everted end 11 of the intestine. The open side of the stomach may, for example, be stapled as disclosed in my pending application Ser. No. 759,273, filed Sept. 12, 1968.

Stapling rings C, D are each of sectional spit-ring construction, each comprising semi-circular sections joined at one side by a hinge (13 in ring C, 14 in ring D) and at the opposite side by suitable latch (15 in ring C, 16 in ring D). The latches are partially visible in FIG. 4. Such latches are shown more in detail in FIG. 5. By releasing the latches, the rings may be opened to remove them from the repaired viscus. Rings C and D have on their peripheries respective annular series of opposed integral eyelets 17, 18 to which ties F can be secured.

Ring D has a pair of diametrically opposite, axially-projecting guide pins 20 receivable in guide bores 21 in ring C for aligning the rings coaxially preparatory to a stapling operation. Ring C functions to hold and drive a staple assembly G comprising a backing 23 in the form of a thin flat washer of suitable plastic material, on which is mounted an annular array of open suturing staples 24 by means of a suitable cement or adhesive. As shown in FIG. 5 and indicated in FIG. 4, the staples, each comprising a pair of parallel prongs projecting at right angles from a back bar to which they are integrally joined, are arranged with their back bars parallel to the face of the backing ring 23 and secured thereto, in positions extending diagonally or respective radii of the ring, and in substantially equal circumferential spacing and approximately parallel relation around the ring. Ring D has, in its face confronting ring C, an annular array of staple-clinching slots 27. The apparatus is provided with staple-driving power means which, in FIGS. 1-4, may be a powerful electromagnet or series of electromagnets arranged in annular array in a housing 31 of non-magnetic material of channel section, constituting the annular body of ring D. Ring C then has an armature 32 of magnetic material such as iron, which will be strongly attracted to ring D when electric power is applied to electromagnets 30. Armature 32 comprises two semi-circular sections slid-

3

ably mounted in respective halves of an annular recess 33 defined within a channel section housing 34 composed of the two sections of ring C. The housing 34 is of non-magnetic material, and the staples 24, of iron wire, lead the magnetic field of force from the electromagnets 30 to armature 32 so as to attract it when power is applied. Armature 32 is axially slidable in recess 33 so as to drive the staples 24 through the everted edges 10, 11 when the magnets 30 are energized, and to clinch them in the slots 27.

Holding clamps E may be towel clip forceps as shown in FIG. 8, with jaws 40 provided with teeth 41 which can be engaged in the ends of bores 21 and bores 42 in which pins 20 are mounted; and with a handle-latching ratchet 43 for holding the jaws in clamping engagement with rings C, D. Other clamps of equivalent function may be employed, or wing bolts 44 may be inserted in radial slots provided in bifurcated projections 45 on the ring sections, and tightened to draw the rings C and D together (FIG. 6).

In the preferred form of the apparatus shown in FIGS. 5 and 6, ring C1 is provided with hydraulic staple-driving means comprising a pair of semi-circular driving heads 50 of half-washer form, three or more hydraulic pistons 51 in pushing engagement with each driving head 50, hydraulic cylinders 52 in which pistons 51 are slidable, and suitable hydraulic connections 53 to a source of hydraulic pressure fluid. As in ring C of FIGS. 1-4, ring C1 includes semi-circular recesses 33 in which driving heads 50 are axially slidable, and in which staple assemblies 23, 24 are received preparatory to being driven. Recesses 33 are located forwardly of the solid back web portions of the ring sections, in which cylinders 52 are bored. Recess 33 is continuous throughout the full circumference of ring C1 (and also in ring C) as shown in FIG. 5, so that pressure may be applied uniformly around the circumference of the staple assembly, in which backing ring 23 is an unbroken ring, continuous throughout its circumference.

Driving heads 50 are preferably provided with a shallow end face groove 55 to receive and position the staple assembly G in accurate concentricity with the ring C1, and to contain it radially as the assembly is driven.

OPERATION

In an anastomosis using the invention, ring C (or C1) is first closed and latched and then loaded with a staple assembly G, which is fitted against armature segments 32 (or driving heads 50) with the latter retracted in recess 33. After a required resection of a viscus, the cut ends thereof are inserted through respective rings C and D. Ties F are then threaded through the cut ends (e.g. by using a suturing needle) and by pulling on the ties, the cut ends are then everted around the rings C and D, so as to provide a pair of attachment flanges 10, 11. The ties F are then preferably threaded through the eyelets 17, 18, drawn tight, and tied as shown in FIG. 3, thus securing the cut ends 10, 11 in everted, confronting positions. This is a preferred alternative to having several attendants hold ties F under tension manually during the stapling operation. The everted ends are then brought together, face to face, as shown in FIG. 3. The rings C and D are then pressed against the everted ends in opposed positions as shown in FIG. 3, by means of clamps E (or bolts 44) and electromagnets 30 (or hydraulic-driven heads 50) are then operated to drive the staples 23, 24 through the contacting flanges 10, 11 and to close them against ring D (or D1). Rings C, D (or C1, D1) are then unlatched, opened, and removed from the repaired viscus.

I claim:

1. Apparatus for anastomosis of cut ends of a severed viscus, comprising:

a staple driving ring adapted to encircle one of said cut ends;

4

a staple-closing ring adapted to encircle the other cut end;

said rings being adapted to embrace between them an annular assembly of staples including a backing ring adapted to encircle said one cut end in abutting relation to said driving ring, with the prongs of said staples projecting toward said staple-closing ring;

means to clamp said rings against said cut ends with the latter in everted condition in the form of inter-engaging flanges engaged between said rings;

said rings each comprising a pair of semicircular sections;

means releasably connecting said sections in the form of a closed ring which can be opened by release of said connecting means for removal of the rings from a repaired viscus;

and means in said driving ring for driving said staples through said flanges and closing them against said closing ring;

said driving ring being of channel section defining an annular recess for receiving said staple assembly, said recess having an open side in opposed relationship to said closing ring;

said driving means comprising a pair of semicircular sections cooperatively constituting an annular driving head;

and including hydraulic cylinders in said driving ring, and pistons in said cylinder abutting the back side of said driving head, the front side of said head abutting said staple assembly backing.

2. Apparatus for anastomosis of cut ends of a severed viscus, comprising:

a staple driving ring adapted to encircle one of said cut ends;

a staple-closing ring adapted to encircle the other cut end;

said rings being adapted to embrace between them an annular assembly of staples including a backing ring adapted to encircle said one cut end in abutting relation to said driving ring, with the prongs of said staples projecting toward said staple-closing ring;

means to clamp said rings against said cut ends with the latter in everted condition in the form of inter-engaging flanges engaged between said rings;

said rings each comprising a pair of semicircular sections;

means releasably connecting said sections in the form of a closed ring which can be opened by release of said connecting means for removal of the rings from a repaired viscus;

and means in said driving ring for driving said staples through said flanges and closing them against said closing ring;

said driving ring being of channel section defining an annular recess for receiving said staple assembly, said recess having an open side in opposed relationship to said closing ring;

said driving means comprising a pair of semicircular sections cooperatively constituting an annular armature in abutting relation to said staple assembly backing;

and electromagnetic means in said staple-closing ring adapted when energized to attract said armature so as to draw it and said staples toward said closing ring.

3. Apparatus as defined in claim 1, including eyelets on the back sides of said rings for anchoring ties piercing said everted ends, said ties functioning to apply tension to said ends to maintain them in everted condition.

4. A staple assembly for anastomosis of cut ends of a severed viscus, comprising:

an annular backing ring of washer form, of non-toxic material;

and an annular array of staples each comprising a back bar attached to said backing ring parallel to the

5

face thereof in a position extending diagonally of a radius thereof, and a pair of prongs projecting from said back bar parallel to the axis of said ring; said staples being arranged in substantially equal circumferential spacing and approximately parallel relation around said ring. 5

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RICHARD A. GAUDET, Primary Examiner
J. C. McGOWAN, Assistant Examiner

U.S. Cl. X.R.

227—19