The present invention relates to medical instruments, and more particularly to instruments for stitching, through a stapling process, hollow organs as for example, the bronchial stump, by means of a U-shaped staple.

The invention has, as a particular object, the incorporation of readily removable cartridges of novel construction which contain the staples, as a magazine and is an improvement over the removable cartridge instrument of United States Patent No. 3,080,564, for "Instruments for Stiching Hollow Organs" to Strekopolov et al.

In the referenced patent, the cartridge is replaceable, but requires the disassembly of the instrument to remove the same. A disadvantage attendant with such structure resides in the time consumed in changing cartridges, during the actual stitching portion of an operation, in which a greater number of staples is required than are contained in a single cartridge.

Briefly, the invention comprises a staple-carrying cartridge equipped with rails adapted to fit grooves of the instrument which rather snugly receive the cartridge; in addition, the instrument is provided with pin retaining means in alignment with recesses in the cartridge such that a pin may fix the cartridge to the instrument in precise alignment in its operative or suturing position. Removal of the cartridge is readily effected by withdrawing the pin and extracting it from the instrument guide-way.

In a further embodiment of the invention, the cartridge is arranged to be locked into the aligned position by pin means which protrude beyond the cartridge to serve as flesh retaining means in co-operation with a fixed jaw serving as the anvil for the staple clinching operation.

With the foregoing in mind, it is an object of the invention to provide an instrument for stitching hollow organs with staples, which instrument incorporates a readily replaceable staple magazine or cartridge.

Another object of the invention is the provision of readily replaceable staple cartridges of the disposable type, if desired, which may be factory loaded and sterilized.

An additional object of the invention is the provision of such a cartridge adapted for positive positioning in a surgical stapling instrument to close tolerances.

It is a further object of the invention to provide such an instrument which may be inserted through relatively small incisions and manipulated to grip the parts to be sutured, and thereafter operated by one hand to drive and clinch the staples in place.

Further objects and advantages of the invention will be apparent from the following description, when taken in conjunction with the accompanying drawing, wherein:

FIG. 1 is a view in perspective of an instrument incorporating a replaceable cartridge in accordance with the present invention;

FIG. 2 shows the staple driver which is contained internally of the structure of FIG. 1;

FIG. 3 is a front view of the cartridge of FIG. 2;

FIG. 4 shows the cartridge of FIG. 1, in perspective;

FIG. 5 shows, in perspective, a modification of the forward end of the instrument of FIG. 1, incorporating a modified cartridge, which includes a flesh retaining feature;

FIG. 6 is a view similar to FIG. 4, with the cartridge partially inserted;

FIG. 7 shows the structure of FIGS. 5 and 6, with the cartridge fully seated, in its aligned position;

FIG. 8 is a front elevational view of the anvil;

FIG. 9 is a front elevational view of the cartridge;

FIG. 10 is a plan view of the cartridge of FIG. 8; and,

FIG. 11 shows a sectional view of a portion of the anvil of FIG. 8.

With reference to the drawing, there is shown in FIG. 1 an instrument for stitching hollow organs with staples, which comprises an elongated body 10. The body portion 10 is generally rectangular in section and terminates at its forward end in a jaw portion 11.

The elongated body portion 10 terminates at its rear end in an enlarged, generally rectangular yoke 12, having side walls 13 and 14 disposed outwardly of the body portion 10. The yoke 12 is provided with a rear end wall 17, spaced from the body portion 10, to provide a vertical passage through which a threaded portion 18, associated with internal structure, is adapted to move.

The body portion 10 is provided with an upwardly-opening channel 21, extending between the jaw portion 11 and the yoke 12, through which an elongated bar 33 is adapted to move in a reciprocating fashion.

The jaw portion 11 comprises an elongated member 24 fixed, or integrally formed at an angle, with the forward lower edge of the body portion 10. This member 24 terminates in an upwardly fixed jaw 26, the rear surface of which is provided with a plate or the like 27, which, in turn, is provided with a plurality of spaced staple clinching anvil in the form of spaced apart grooves adapted to receive the edges of staples for turning the same inwardly in a clinching motion. FIGS. 8 and 11 illustrate typical grooves for a modified form of the invention.

The forward end of the body portion 10 is equipped with a spaced elongated ears 29 and 30, which ears include inwardly-opening grooves, such as 31.

The elongated bar 33 includes an internal bore (not shown) extending through, which is adapted to receive the shaft 32 (FIG. 2) incorporated in the staple driver assembly. The elongated bar 33 is also moveable longitudinally within the body portion 10 to translate its rectangular hollow head 35 relative to the fixed jaw 26. The head 35 is open at its forward end and is equipped with guides 34 and 36, adapted to receive the staple magazine or cartridge 42 (see FIG. 4).

The lower edge of the head 35 is provided with a groove (not shown) for slidably receiving the rib 28, which up-rises on the elongated member 24 of the jaw portion 11. The elongated bar 33 is equipped with projections or lugs, such as 57, which fit the grooves, i.e. 31, to confine reciprocating movement of the bar 33 relative to the instrument. Lugs, such as 56, located near the rear of the instrument also serve to locate the member 10.

The staple magazine 42 of FIGS. 3 and 4 comprises a U-shaped body portion 43 including outwardly-extending rails 44 and 45. In addition, a planar plate 46 is attached to the body portion 43 in spaced apart relation to the rail 44 and 45, to form grooves therebetween, and it generally overlaps or extends beyond the body portion 43. The U-shaped body portion 43 is provided with a plurality of vertically spaced grooves 47 for receiving staples 46, and the grooves 47 terminate in slots 50, which penetrate the face or planar plate 46 (FIG. 3). The staples 45 may be of tantalum wire or other suitable material.

The anvil plate 27 includes spaced apart grooves, generally conforming to the opposed extremities of the slots 49, to receive the staple ends and turn them inwardly when the cartridge 42 is in proximity with the fixed jaw.
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3. The staple driver 32 (FIG. 2), which is adapted to receive the upper extremity or camming portion 54 of a trigger 67.

It may be appreciated that rotation of the wing nut 51 will operate to move the bar 33 toward the actuating end thereof longitudinally of the body 10, to a suitable flesh clamping position preparatory to stitching.

Adjacent to the rear end of the bar 33, there is provided a downward-projecting fixed handle 55, shown disposed at an angle convenient for use. The handle 55 may be formed integrally with the bar 33 or rigidly secured thereto. The oppositely extending projections, such as 56, are provided on the handle 55 to slantly support the lower edge of the body 10, relative to the handle, as explained. Similar projections communicate with the grooves 51 (for example, see projection 57), to orient the body 10 to the bar 33 on longitudinal movement relative thereto, also as discussed previously.

Downward-extending spaced plates 59 and 60 are provided forwardly of the handle 55 and include opening aligned slots, such as 61. These slots receive the projections, such as 52, on the trigger 67 when its upper portion 54 (see FIG. 2) is guided into the slot 53 of the staple driver 32; the trigger 67 is held in this interlocked or operative position by an elongated leaf-type return spring 72 bearing against the rigid post 73, fixed on the handle 55.

The staple driver 32, illustrated in FIG. 2, comprises an elongated rod 63 adapted to be slidably receivable in the bore (not shown) of the bar 33. The forward end of the rod 63 includes a generally rectangular driver member 64, adapted to be slidably received in the head 35 on the forward end of the bar 33. The forward edge of the driver member 64 is provided with a glURATION of spaced spaced apart staple driving blades or fingers 65 adapted, respectively, to fit into the slots 47 of cartridge 42 (FIG. 4) and force the staples, such as 48, out of the cartridge.

In order to prevent inadvertent movement of the actuating handle or trigger 67 toward the fixed handle 55, there is provided an abutment 74 on the fixed handle 55 and a stop member 75 pivotally engaging the handle 67. The stop member 75 may be moved downwardly by handle 76 pivoting about pivot axis 77, to strike against abutment 74 to preclude triggering of the device.

In utilizing the instrument for stitching hollow organs, it is assumed that the staple magazine 42 has been filled with staples, under sterile conditions, and is in proper position on the instrument, as shown in FIG. 1. The jaw portion 11 of the instrument is inserted through the incision (not shown), and the fixed jaw 26 is engaged with one side of the organ to be stitched. Thereafter, wing nut 51 is employed to move the head 35 and staple magazine 42 toward the fixed jaw 26 into engagement with the opposite sides of the organ or organs to be stitched, thereby clamping the same between the magazine 42 and the fixed jaw 26.

The finger engaging member or crank 76 is operated to move the stop member 76 out of engagement with abutment 74 to permit operation of the actuating handle or trigger 67, which is then free to move the fixed jaw 26 forward through camming action of the stop portion 54 of trigger 67 against the forward end of slot 53 in driver 32 (FIG. 2). The blades or fingers 65 eject the staples 48 from the magazine 42, simultaneously, to pierce the walls of the organs to be stitched, and the staples thereafter engage the anvil plate 27 (better illustrated, for a different embodiment, in the detailed diagram of FIG. 11) to clinch the same and complete the stitching operation. The nut 51 may then be operated to retract the head 35, and the magazine 42 from the fixed jaw 26, and the instrument removed from the incision.

In order immediately, to replace the unloaded cartridge 42 with a fully loaded and sterilized cartridge, it is only necessary to retract the pin 81 from its seat in the two apertures 83 and 85 (FIGS. 1 and 4). This permits the cartridge 42 to be slid out of head 35 with its rills 44 and 45 disposed inwardly of guides 34 and 36 and its planar plate 46 disposed outwardly thereof, thereby utilizing a guideway principle. The guideway facilitates the immediate insertion of a loaded and sterilized cartridge and it is readily locked into its aligned position by forward motion of the pin 81 to seat in the recesses 83 and 85 (FIG. 4).

It will be appreciated, of course, that the tines of the pin 81 are preferably resiliently biased apart, the pin being of spring steel, or the like, such that it locks itself into the position where placed. Thus, the tines not only serve to preclude removal of the cartridge 42, but also serve, rather snugly, to fix it in the aligned position because of the alignment of the stepline apertures (not shown) through head 35 with the apertures 83 and 85 of the cartridge 42, as well as the resiliency exhibited by the pin 81 in pressing outwardly against the inner portion of rails 44 and 45 of the cartridge 42.

A modification of the invention relating to the jaw portion 11' of the instrument, as well as the cartridge 42', is shown in FIGS. 5-11. In these views, the pin 81' is adapted to serve the dual-fold functions of retaining the cartridge 42' in precise alignment while also providing a flesh retaining structure, because the pin 81' extends beyond the cartridge 42' and engages notches 101 and 103, carried by the upper end of the fixed jaw 66'.

More particularly, the modifications which permit the foregoing attendant functions reside in the provision of ears 104 and 105 (FIG. 5) formed on the upper extremity of the head 35', which ears include the passageways 106 and 107 for the tines 108 and 109 of pin 81'.

While the cartridge 42' is readily removable and replaceable in similar manner to that of cartridge 42, as is apparent from a consideration of FIGS. 5, 6 and 7, where a cartridge 42' is being inserted into the instrument, nevertheless, it will be appreciated that certain changes have been made. In the first place, the staple slots or apertures, such as 49', are now arranged vertically spaced apart positions and, preferably in staggered deployment. This is best shown by viewing the face plate 46' of the cartridge 42' as illustrated in FIG. 9, wherein it will be noted that the slots 49' include a thicker central opening portion 110 with apertures 111 on each end to facilitate loading. The staples (not shown) actually fit within the apertures 111, but may be introduced through the thicker opening 110 to speed up loading. The right hand row of staple slots 49' is adapted to mate with the left hand row of anvils 113 in anvil plate 27' when the cartridge is in its opposed relation to the anvil plate 27', the latter being adapted to be incorporated on the inner side of the fixed jaw 26'. Thus, two anvils or indentations, as best shown in the detailed view of FIG. 11, are provided for each staple, such that the ends thereof are intertured, during the clenching operation.

Although this particular configuration for the staple slots is illustrated, it will be appreciated that the configuration previously described can be employed with the cartridge 42', or the slots and anvil configuration of FIGS. 8 and 9 can readily be employed with the cartridge 42' previously described.

Also, from FIGS. 9 and 10, it may be appreciated that the apertures or openings 106 and 107 in the cartridge 42' to accommodate the tines 108 and 109 of pin 81' are
formed in the opposed peripheral edges of face plate 46', as at 106' and 107' (FIG. 10). In this embodiment, the lines actually wedge the cartridge 42' to the head 35 by filling the described embossments, and also extending antusirely therebeyond to perform the flesh retaining function with respect to the tissue to be joined.

It will be obvious to those skilled in the art that various changes can be made in the invention without departing from the spirit and scope thereof, and therefore, it is intended that the invention not be limited by the illustrated embodiments, but rather by the appended claims, wherein:

What is claimed is:

1. A staple cartridge, comprising a body portion of generally U-shaped cross section; a plurality of aligned staple retaining slots penetrating the body portion; a pair of rails disposed in spaced apart relation along the body; and a planar plate affixed to the body portion in spaced apart relation with the rails and protruding beyond the lateral dimension of the body portion to form grooves between it and each of the rails, said body portion being recessed to receive pin means.

2. A staple cartridge comprising an elongated body portion of generally U-shaped cross section; a plurality of aligned slots penetrating the body and each adapted to receive and retain a staple; a pair of rails oppositely disposed along the body portion in spaced apart relation with the rails and protruding beyond the lateral dimension of the body portion to form grooves between it and each of the rails, said body portion being recessed to receive pin means.

3. A staple cartridge, comprising an elongated body portion, said body portion including a plurality of aligned slots penetrating it with certain of said slots adapted to receive and retain staples, respectively; a pair of rails oppositely disposed along the body portion; a planar plate comprising one face of the body portion in spaced apart relation with the rails and protruding beyond the lateral dimension of the body portion to form grooves between it and each of the rails, at least one of said slots in said body portion being adapted to receive pin means.

4. A staple cartridge, comprising an elongated body portion of generally rectangular cross section; said body portion including a plurality of aligned slots, each spaced from the other, penetrating the body portion with each slot adapted to receive and retain a staple; a pair of rails oppositely disposed along the body portion and extending the length thereof in spaced apart relation; a planar plate comprising the face of the body portion in spaced apart relation with the rails, and extending the length thereof, and protruding beyond the lateral dimension of the body portion to form grooves between it and each of the rails, said body portion being apertured to receive pin means adapted to penetrate the cartridge.

5. A staple cartridge, comprising an elongated body portion of generally rectangular cross section; said body portion including a plurality of aligned slots, each spaced from the other, penetrating the body portion with each slot adapted to receive and retain a staple; a pair of rails oppositely disposed along the body portion and extending the length thereof in spaced apart relation; a planar plate comprising the face of the body portion in spaced apart relation with the rails, and extending the length thereof, and protruding beyond the lateral dimension of the body portion to form grooves between it and each of the rails, said body portion being apertured to receive pin means, and said face being peripherally grooved in alignment with the body portion apertures to extend the same to penetrate the cartridge, and pin means adapted to extend through the apertures and extend beyond the cartridge.

6. An instrument for stitching hollow organs with staples, comprising an elongated body terminating at the forward end in a jaw portion and at the rear end in an annular generally rectangular yoke having side walls disposed outwardly of the side walls of the body and a rear end wall spaced from the rear end of the body to provide a vertical passage through said yoke, said rear end wall having an upwardly opening notch, said body having an upwardly opening channel extending between said jaw portion and said yoke, the bottom wall of said channel having a slot communicating with the passage in said yoke, said jaw portion comprising an elongated member fixed to the lower forward edge of said body and terminating in an upstanding fixed jaw, staple clinching anvils on the rear surface of said fixed jaw and an upstanding longitudinal rib on said member between said body and said fixed jaw, upstanding spaced elongated ears on the upper edge of said body adjacent said jaw portion, said ears having opposed inwardly opening grooves, an elongated bore containing bar removable and slidably received in said channel, said bar terminating at the forward end in an enlarged, generally rectangular head, open at the forward end and received in said jaw portion and having a groove in the lower edge slideably receiving said head slideably received in the grooves in said ears, said head including a vertical recess in its forward end with opposed slots in communication with the recess to serve as a guideway, a staple magazine comprising an elongated block having a plurality of spaced apart slots therethrough for receiving staples, said block being received in the forward end of said head in said guideway, said head including spaced apart apertures therethrough opening into the guideway, staple magazine including recesses in alignment with said openings, pin means adapted to extend through the head and into said recesses to lock the cartridge in the passageway, the slots in said block being disposed opposite said anvil, the rear end of said bar terminating in a threaded portion, a nut on said threaded portion, a portion of said nut being received in said notch and having an annular groove receiving the side wall of said notch, whereby rotation of said nut will move said head toward or away from said fixed jaw, a fixed handle on said bar projecting downwardly through said vertical slot in said body, projections on said handle slideably engaging the lower edge of said body, said lugs and said projections serving to retain said bar in said channel, downwardly-opening spaced plates on said bar adjacent said handle, downwardly-opening aligned slots in said plate, said bar having a vertical aperture between said plates, a staple driver comprising an elongated rod slidably received in said bar and terminating at the forward end in a driver member slidably received in said head, a plurality of staple driving fingers on said driver member aligned with the slots in said magazine, the rear end of said rod having a vertical slot in alignment with said aperture, an actuating handle having a pivot pin removably received in the slots in said plates, the upper end of said actuating handle extending through said aperture and opening, and a return spring on said actuating handle engaging an obstruction on said fixed handle, whereby upon operation of said actuating handle said fingers will simultaneously eject staples from all of the slots in said magazine.

7. The instrument of claim 6, wherein the recesses of said magazine do not penetrate the magazine and said pin in its locked position enters the magazine.

8. The instrument of claim 6, wherein said recesses penetrate the magazine and said pin has a length sufficient to extend through and project beyond the block and magazine to serve as flesh retaining means in conjunction with the fixed jaw.

No references cited.

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