

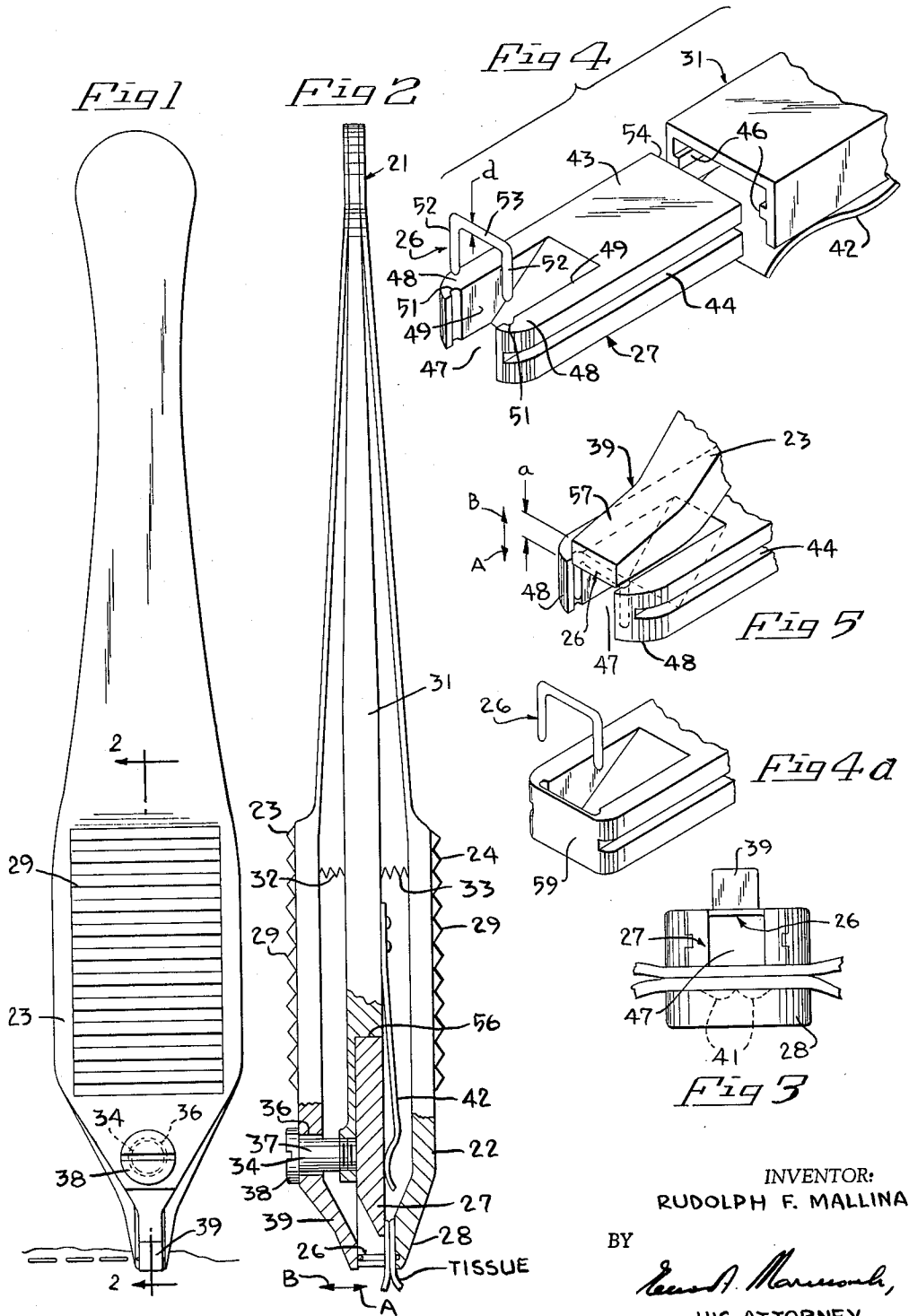
Dec. 28, 1965

R. F. MALLINA  
INDIVIDUAL STAPLER

3,225,996

Filed July 2, 1963

4 Sheets-Sheet 1



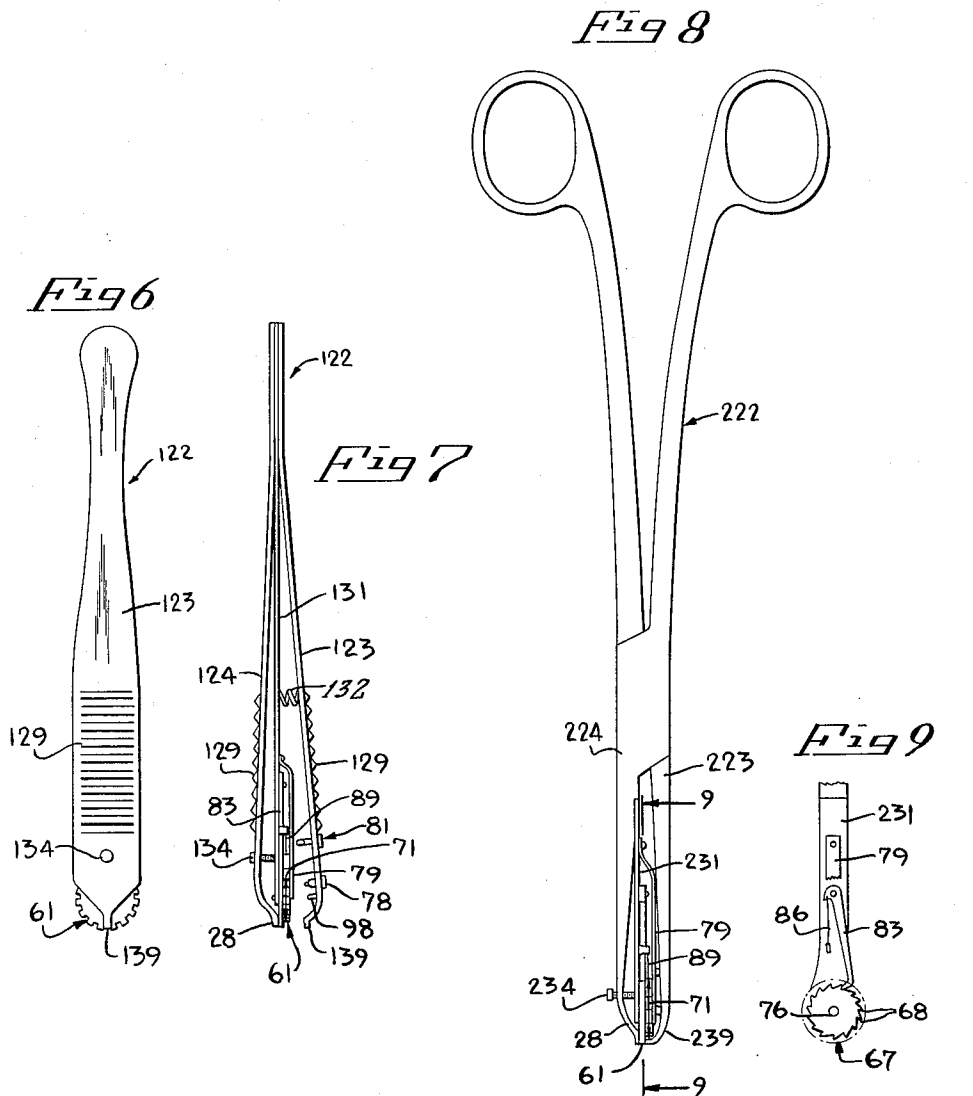
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4 Sheets-Sheet 2



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Fig 11

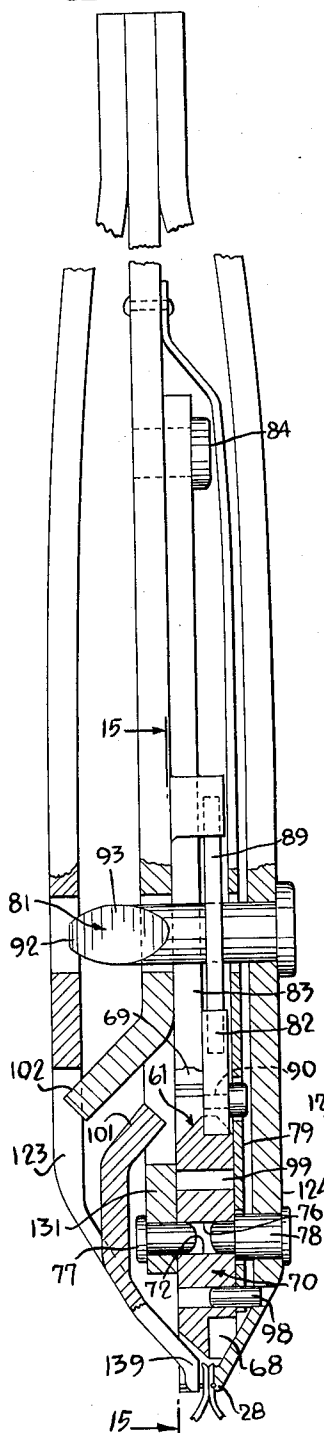


Fig 16

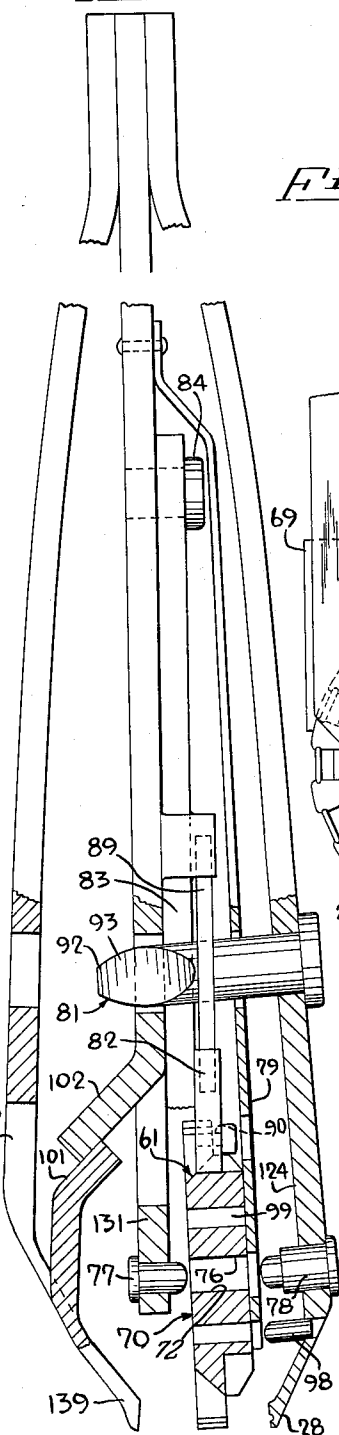


Fig 10

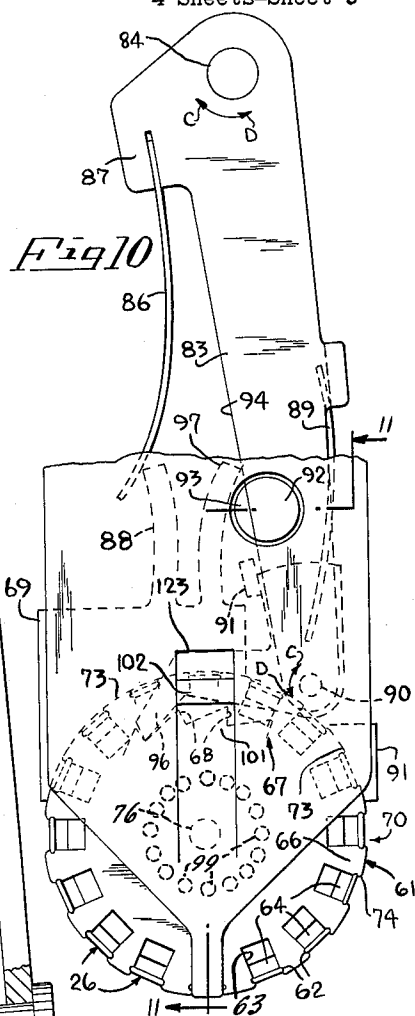
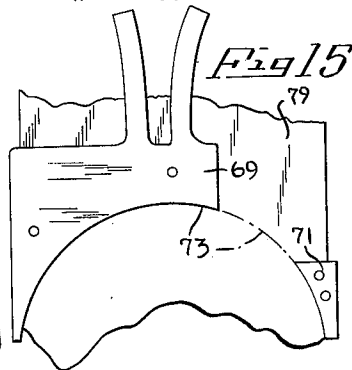


Fig 15



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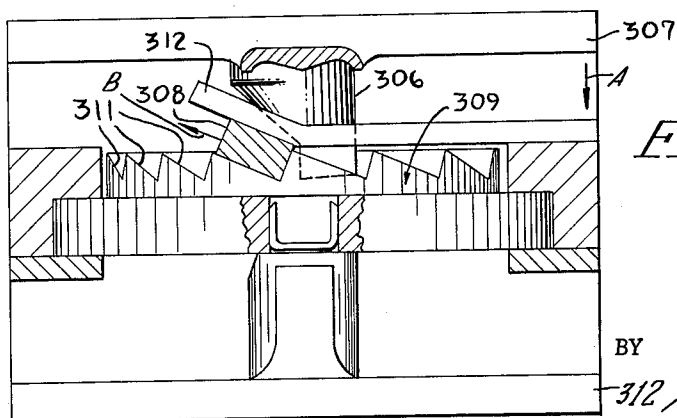
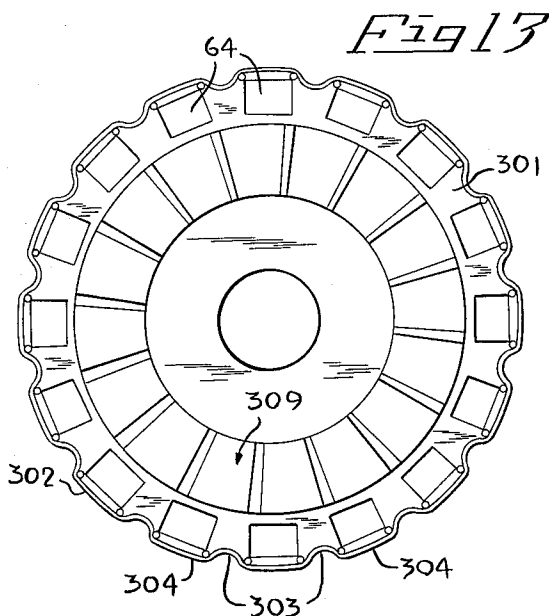
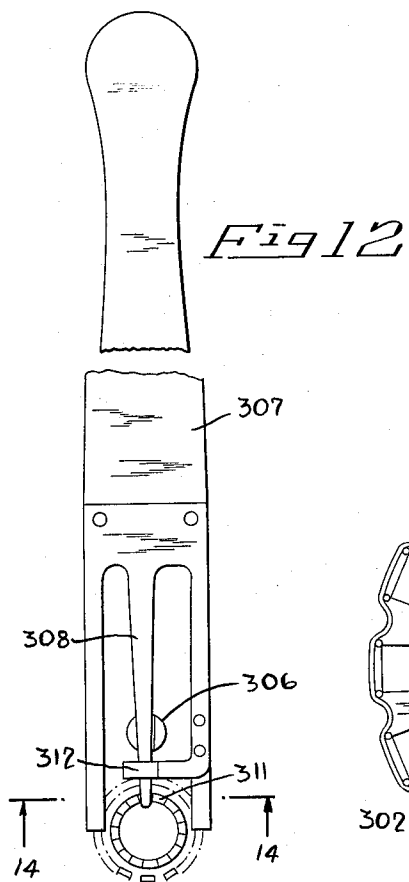
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*Fig 14*

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3,225,996

## INDIVIDUAL STAPLER

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Filed July 2, 1963, Ser. No. 292,498  
16 Claims. (Cl. 227—137)

The invention relates to staplers, and relates more particularly to miniature staplers of the type used for medical stapling of tissue, and to exchangeable cartridges for such staplers. Reference is had to the co-pending patent application Ser. No. 224,816 filed September 19, 1962, now Patent No. 3,176,896, issued April 6, 1965.

The instant invention has for its principal object the provision of a stapler which will connect two or more layers of tissue, by stapling with one staple at one time.

Complicated surgical operations on blood vessels, bronchia, large pulmonary blood vessels, intestines, and so forth, require immediate application of suture. The application of single-staple instruments to place a single staple whose quality does not depend upon the experience or skill of the surgeon, considerably reduces the time, and raises the quality, of surgery. The suture obtained results in a reliable hermetic union, and makes for better healing of the suture.

Such staplers, for fastening of single suture staples, have been described in the literature, see, for instance the Russian publication "Suturing Instruments" V/O "Sojuchimexport," Moscow, U.S.S.R. (No. 071483), and such described single staple instruments generally would appear to give good results. These known instruments are, however, deficient therein that they are designed like a conventional office stapler, where one staple at a time is sliced off a bar of staples that stick together. The size of the wire from which the staples are made is small, and may be only .004 in. in diameter. At such a small gauge wire, slicing of single staples off a staple bar appears to be difficult, if not impossible.

A further drawback of these described earlier staplers resides therein that the driver which separated each staple off the bar as it drove it through the tissue to the anvil, included like an office stapler a blade that needed to be about as thin as the wire of the staple. Such a hair-thin blade, however, is liable to be bent or to break during stapling, with attendant disastrous effects of strewing parts of such a knife into the open wound of the patient on whom the stapler is used. Furthermore, a blade of this type needed to be at least as high as the height of the staple itself, resulting in a large overall height near the tip of the stapler—at the very point where the need for good visibility during the surgical stapling would, instead, require the lowest possible height.

It is therefore another object of the instant invention to provide a stapler that avoids the drawbacks of the prior art.

It is still another object of the invention to provide a stapler of this type that is accurate and foolproof and reliable in its use.

It is another object of the invention to provide a stapler in which the thickness of the driver is greater than the thickness of the staple wire.

It is a further object of the invention to provide a stapler that has a magazine or cartridge suspending one staple at one time between the driver and the anvil.

Another object of the invention is to provide such a magazine that is disposable and interchangeable.

It is a still further object of the invention to provide such a magazine that is angularly movable by each stapler actuation, so as to suspend each time a new single staple between the driver and the anvil.

Further objects and advantages of the invention will

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be set forth in part in the following specification and in part will be obvious therefrom without being specifically referred to, the same being realized and attained as pointed out in the claims hereof.

The foregoing and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawings, wherein:

FIG. 1 is a plan view of a stapler for dispensing single miniature staples individually, in accordance with a first embodiment of the invention;

FIG. 2 is an elevational view, partly in section taken on the line 2—2 of FIG. 1;

FIG. 3 is an end elevational view thereof;

FIG. 4 is a fragmentary extended view, in perspective;

FIG. 4a is a fragmentary perspective view, showing a modified part of FIG. 4;

FIG. 5 is a large scale fragmentary perspective view showing a detail;

FIG. 6 is a plan view, similar to FIG. 1, but showing a modification;

FIG. 7 is a side elevational view thereof;

FIG. 8 is a side elevational view similar to FIG. 7, but showing a different type of forceps;

FIG. 9 is a fragmentary elevational view, partly in section, taken on the line 9—9 of FIG. 8;

FIG. 10 is a fragmentary large scale plan view similar to FIG. 6, with some parts broken away showing a modification;

FIG. 11 is a large scale fragmentary sectional view taken on the line 11—11 of FIG. 10;

FIG. 12 is a plan view, similar to FIG. 6, but embodying further modifications;

FIG. 13 is a large scale detail view of a modified circular staple dispenser;

FIG. 14 is a fragmentary large scale sectional view taken on the line 14—14 of FIG. 12,

FIG. 15 is a schematic plan view, taken on the line 15—15 of FIG. 11; and

FIG. 16 is a large scale fragmentary elevational view, partly in section, showing a detail of FIG. 7.

### Single staple dispenser

In carrying the invention into effect in the embodiments which have been selected for illustration in the accompanying drawings and for description in this specification, and referring now particularly to FIGS. 1, 2 and 3, there is provided a stapler generally indicated at 21 that comprises a pair of forceps generally designated 22. The forceps 22 include upper and lower arm portions, such as a driver arm portion 23 and, an anvil arm portion 24. These arm portions 23, 24 are movable towards and from each other for driving a staple 26 that is held in a magazine or cartridge 27 towards the anvil 28. Both arms are provided on the exterior with knurling 29 for easier manual grasping.

A cartridge holder 31 is secured to the forceps 22, for instance bolted or otherwise rigidly secured to the forceps 22 between the arm portions 23 and 24 thereof.

Each of the arm portions 23 and 24 is resilient and forms a leaf spring, and the cartridge holder 31 is elongated and resilient and forms a leaf spring therebetween. In addition to, or in lieu of, the resilience of the arm portions 23, 24, a driver compression spring 32 may be provided between the arm portion 23 and the holder 31, and an anvil compression spring 33 be provided between the holder 31 and the arm portion 24. The springs 32 and 33 will normally press apart the two arm portions 23 and 24.

A limit stop, such as a screw 34, is provided to limit the upward movement of the upper arm portion 23 relative to the cartridge holder 31. The screw 34 is surrounded by an opening 36 that is formed in the arm portion 23 and

which is larger than the shank 37 of the screw 34, but smaller than the head 38 of the screw 34. By this means, the driver arm portion 23 is pre-tensioned.

As usual in connection with staplers, the lower or anvil spring 33 is weaker than the driver spring 32; so that, when the two arms 23, 24 are pressed towards each other, the anvil 28 will first be placed into a position close to the staple 26 where the tissue is engaged between the cartridge 27 and the anvil 28, and only thereafter will the driver 39 make contact with the staple 26 and subsequently drive the staple through the tissue.

The anvil 28 includes two clinching grooves 41, and the holder 31 includes a hollow front section and a spring 42 which is apt to engage a flat prismatic body 43 of the cartridge 27. The cartridge 27 has two lateral grooves 44 which engage corresponding elongated tenons 46 that are formed inside the holder 31 (FIG. 4). Near the front end, the cartridge 27 has a recess or opening 47 that is defined between two projections 48. Each of the projections 48 has an inner lateral surface 49, that confines the opening 47, and in which there is formed a straight groove 51. The two grooves 51 are opposite, and parallel to, each other, and have a length that exceeds the length of the leg 52 of the staple 26. The legs 52 will be held frictionally in the two grooves 51, so that the staple 26 will be held suspended frictionally, with the legs 52 in the grooves 51 and the free ends of the legs 52 pointing towards the anvil 28; the crown 53 that connects the legs 52 of the staple 26 will be disposed across the opening 47. Thus, the staple 26 is held suspended by friction in the cartridge 27, ready for removal by the driver 39.

Each cartridge 27 may be loaded manually, or preferably with the aid of a loading machine. Each cartridge 27 suspending its staple 26 will be sterilized in any suitable manner, and will be kept in sterilized condition until used.

When a new staple is needed, the nurse will insert a new sterilized staple-holding cartridge 27 into the holder 31.

As best shown in FIG. 2, the rear edge 54 of the cartridge 27 abuts against a forward face 56 of the holder 31, to limit the movement of the cartridge 27 and to determine the position of the cartridge 27 when emplaced in the holder 31. The spring 42 owing to its frictional engagement with the cartridge 27 will retain the cartridge 27 in that position, until it is removed manually by the nurse.

As best shown in FIG. 1, the driver 39 may form an integral part of the driver arm portion 23, and be movable therewith. It is, of course, not necessary that the driver 39 is formed in one piece with the driver arm portion 23, and may instead be formed as a separate piece in driven connection from the arm portion 23. The driver 39 includes a plate element 57 (FIG. 5) that has a width slightly smaller than the width of the opening 47 and which has a small, thickness "a," and is capable of engaging the crown 53 of the staple 26 and to move it in the direction A towards the anvil 28. Owing to the attachment of the arm 23, at its other end, to the arm 24 the plate element 57 will describe a wide arc; it will thus move slightly tangentially relative to the crown 53 when it drives the staple 26 in the direction A. After the stapling, the spring 32 will return the arm 23, and thereby return the driver 39, in the opposite direction B.

To give the surgeon good visibility at the field where the staple enters the tissue, the thickness "a" of the plate element 57 should be as small as possible. The staple 26 may be made of wire of an inert material, such as tantalum or stainless steel, but may also be made of any other suitable material, for instance plastic or the like, which lends itself to stapling and to being sterilized.

The cartridge 27 is preferably disposable, for instance made of inexpensive plastic or the like, so that the re-loading of staples becomes unnecessary.

While the thickness "a" of the plate element 57 may be greater than that of the staple crown 53, it is still considerably less than the height of the staple leg 52.

The instant small overall height thus provides an additional advantage over the previous medical staplers.

Regarding the staple sizes that may be used where minimization is important, the following are examples of desirable sizes:

|                                      |              |      |
|--------------------------------------|--------------|------|
| Diameter of wire                     | -----inches  | .004 |
| Length of crown 53 (width of staple) | -----do----- | .050 |
| Length of leg 52 (height of staple)  | -----do----- | .050 |

As shown in FIG. 4a, the opening 47 may be closed in front by a thin protecting wall 59 that interconnects the projections 48 and may be integral therewith. The wall 59 serves to protect the staple 26 from being accidentally touched with the fingers, and perhaps thereby dislodged from its position of suspension, during insertion of the cartridge 27 into the holder 31.

#### Multiple staple dispenser

In order to avoid re-loading after each stapler actuation, a modification is provided, shown in FIGS. 6-11, of a staple cartridge that carries several staples, as well as means to shift the cartridge angularly for one notch upon each stapler actuation, so that there will always be a staple suspended between the driver and the anvil until the supply of staples in the cartridge has been used up.

The stapler of FIGS. 6 and 7 provides for a pair of forceps 122 that in its major aspects is like the previously described pair of forceps 22. It includes a driver arm portion 123 and an anvil arm portion 124 which have knurling 129.

In FIGS. 8 and 9, a different type of forceps 222 is shown. It is of the scissors type, and differs from the modification of FIGS. 6 and 7 in the shape of the forceps and accordingly in the location of the spring 132. It will be noted that in most other respects the multiple staple dispenser of FIGS. 8 and 9 looks like that of FIGS. 6 and 7. For the parts that are alike, there will therefore be used herein the identical reference numerals, while merely corresponding parts have different prefix numerals.

A holder is provided, namely a center leaf holder 131 (FIGS. 6, 7) which is connected between the arm portions 123, 124 of the forceps 122 and, respectively, a center leaf holder 231 (FIGS. 8, 9) which is connected to one arm portion 224. As in the previous embodiment, the driver 139 (FIG. 7; 239, FIG. 8) is movable by the driver arm 123 (FIG. 7; 223, FIG. 8).

The other arm 124 carries the anvil 28, which is like that of FIGS. 1-3. A pre-tensioner 134 provides for limit of opening movement, and for spring pre-tensioning.

A cartridge 61 for the staples 26 is provided, which is preferably disposable, and may be made of plastic or other inexpensive suitable material that lends itself to being sterilized, such as for instance plastic known under the trademark "Delrin."

The cartridge 61 in certain aspects is similar to the cartridge 27 of FIGS. 1-3, and in other aspects deviates therefrom. The suspension of the staples 26 in the cartridge 61 is similar to the suspension of the staple in the preceding cartridge 27; the cartridge 61, however, carries in suspension not only one staple but an entire series of staples 26, for example sixteen staples, as shown in FIG. 10. Each staple 26 is held with its legs 52 in opposite parallel grooves 62 which are formed in lateral side surfaces 63 which form part of the openings or recesses 64. There are thus in the instant example sixteen recesses 64 which are formed by sixteen projections 66.

The cartridge 61 carries, either integrally (as shown in FIG. 11) or otherwise connected thereto, a ratchet wheel 67 which has teeth 68. The ratchet wheel 67 will have as many teeth 68 as there are openings 64 in the cartridge 61; thus, in the instant example there will be sixteen teeth 68.

A magazine assembly 70 is thus provided which is comprised of the cartridge 61 and the ratchet wheel 67.

The same magazine assembly is utilized in the modifications of FIGS. 6-7, 8-9, 10-11-15-16.

Either the cartridge 61 or, as shown in FIGS. 10, 11, the magazine assembly 70 is movable in and out of the position of emplacement shown in FIGS. 10 and 11, 15 and 16. Guiding means are provided guiding the cartridge 61 and wheel 67 to the position of emplacement and during rotation thereof, including guide plates 69 and 71 which are mounted on the holder 131, and centering means generally indicated at 72 (see FIG. 16).

Each guide plate 69, 71 includes an arcuate edge 73 which corresponds to the periphery 74 of the cartridge 61. The centering means 72, on the other hand, include a central recess or passage 76 that is formed on the cartridge-ratchet wheel aggregate 61, 67, and pins 77 and 78.

The holder is designated 131 in FIG. 11, assuming that the forceps has the shape of FIGS. 6 and 7; it will be understood, however, that the forceps may instead have the shape of FIG. 8, or any other suitable well-known forceps shape. The guide plates 69 and 71 (see FIG. 15) are secured to the holder 131. The pin 78, on the other hand, is secured to the anvil arm portion 124.

When the stapler is open, and the arm portions 123 and 124 are spread apart (FIG. 7), the pin 78 will be out-of-engagement with the passage 76, and only the pin 77 will engage the passage 76 to center the cartridge 61. The pin 77 is mounted on the holder 131; a bracket 79 is provided that extends for a portion parallel to the holder 131 and is secured (FIG. 7) to the holder 131, and extends between the holder 131 and the anvil arm portion 124. When inserted (see FIG. 16), the magazine assembly 70 will rest between the bracket 79 and the holder 131. The pin 77 is sufficiently rounded at its free end, to permit easy insertion of the magazine assembly 70, there being a certain springiness between the holder 131 and the bracket 79.

As stated before, the pin 78 does not engage the passage 76 when the stapler is unused. During actuation of the stapler, on the other hand, the two arm portions 123, 124 will be moved toward each other and thus the pin 78, which is mounted on the anvil arm portion 124, will engage the central passage 76 and the cartridge 61, all as shown in FIG. 11, for securely centering the cartridge 61.

Shifting means are provided, generally indicated at 81, for shifting the cartridge 61 angularly upon each stapler actuation. This shifting means 81 includes the aforesaid ratchet wheel 67, a pawl 82 that is journaled about a pin 90 on a step lever 83 that is pivoted at 84 to the holder 131. A step lever spring 86 is connected to a shoulder 87 of the step lever 83 and bears on an extension 88 that is formed on the guide 69.

The step lever 83 is movable in opposite arcuate directions C (clockwise in FIG. 10) and D (counterclockwise in FIG. 10) about the pivot 84. Similarly, the pawl 82 is movable about the pin 90 in these directions C and D; the pawl 82 thus performs a planetary motion, namely with the step lever 83 about the pivot 84, and about the pin 90 against the step lever 83. The step lever spring 86 normally urges the step lever 83 in the direction C; the pawl spring 89, on the other hand, is carried by and normally urges the pawl 82 in the direction D towards a stop 91 that is formed on the step lever 83.

A cam 92 is secured to one of the arm portions, for instance to the anvil arm portion 124, and has an inclined cam surface 93, that co-operates with a cam follower surface 94 on the step lever 83.

This operates as follows: when the stapler is actuated (FIG. 11), the arm portions 123 and 124 will be moved towards each other. The cam 92 of the arm portion 124

will thus move towards the other arm portion 123, and its cam surface 93 will wedge against the surface 94 of the step lever 83. By this interengagement of the surfaces 93 and 94, the step lever 83 will be moved in the direction D about the pivot 84 against the tension of the spring 86. The pawl 82 will be taken along in that movement about the pivot 84. The pawl 82 has a tip 96 that engages one of the teeth 68 of the ratchet wheel 67. During the aforesaid movement in the direction D about the pivot 84, the tip 96 will click over the next tooth 68 and come to rest against the flank of that next tooth.

After the stapling has been completed, the operator will release the arm portions 123 and 124 and, as previously explained, the arm portions will be spread apart by spring action. During this movement apart, the cam 92 will be retracted, thereby releasing the step lever 83. The spring 86 will thereupon return the step lever 83 in the direction C. During this return movement, the tip 96 of the pawl 82 will turn the ratchet wheel 67 for one tooth, thereby putting into the proper position the next staple 26. Thus at each actuation of the stapler, the cartridge 61 in the instant exemplification will be turned for an angle of  $22\frac{1}{2}^\circ$ , there being sixteen teeth 68. Means may be provided, such as a stop 97 that is formed on the guide plate 69, to limit the movement of the step lever 83 in the direction C, thereby limiting the angular shifting of the ratchet wheel 67.

An index pin 98 may be provided and for instance secured to the anvil arm portion 124, to arrest the cartridge 61 in an arcuate angular position after each angular shifting thereof, for proper indexing. The pin 98 co-operates with a series of (sixteen) elongated holes 99 which are formed in the aggregate 70. The index pin 98 will engage a hole 99 only when the arm portions 123, 124 are pressed towards each other (FIG. 11), but the pin 98 will release the hole 99 in all other positions; thus, the accurate indexing will occur only shortly before a staple 26 will be engaged by the driver to be driven into the tissue. The engagement between the tip 96 of the pawl 82 with the ratchet wheel 67 may, however, in most instances be sufficient for indexing, without any need for the indexing pin 98 and the holes 99.

Limit stop members 101 and 102 may be provided, the member 101 forming part of the arm portion 123 and the member 102 forming part of the holder 131.

The expulsion of the staple 26 by the driver 139 and the anvil 28 proceeds in the same manner as was previously described in connection with FIGS. 1-5.

It will be understood that a multiple cartridge of the instant type could have fewer, or more, than sixteen staples, the number of staples in the cartridge 61 having been given herein as a sixteen merely for illustration and not in any limiting sense.

In the modified construction shown in FIGS. 12, 13 and 14, the disk shaped carrier or cartridge 61 is surrounded by a ring 302. The ring 302 may be made of metal or plastic, and may have a circular contour or, as shown in FIG. 13, may be provided with notches 303 between the openings 64.

At each opening 64 the ring 302 forms a wall portion 304 for the opening, similar to the previously described wall 59 of the cartridge 27.

The cam and cam follower means are formed in this modification by a cam 306 that is connected to the anvil arm portion 307. A pawl 308 acts as a one-piece spring and cam follower for the cam 306. The ratchet wheel 309 has a circular contour, and its teeth 311 extend parallel of the axis of the ratchet wheel 309. Another cam 312 is provided crosswise of the pawl 308 guiding the end of the pawl 308 up and down to engage succeeding teeth 311. The driver arm portion is designated 312.

The ratchet wheel 309, as shown in FIG. 14, may have a smaller diameter than the disk shaped carrier

301. As in the previously described embodiment, the carrier 301 and the ratchet wheel 309 may be made of one piece, if desired, or of two or more pieces connected together.

The notches 303 (FIG. 13) facilitate the grasping of the disk-shaped carrier 301.

Again there may be eight (8), or sixteen (16), openings and notches 303, or any other suitable number thereof.

The operation of the modification of FIGS. 12-14 is as follows:

When the anvil arm portion 307 closes, namely is moved by the surgeon's finger pressure in the direction A towards the driver arm portion 312, the cam 306 will push the pawl 308 outwardly in the direction B, until the pawl 308 will drop into the next tooth 311, to the left (FIG. 14) of the tooth with which the pawl 308 has previously been engaged. During this motion, the ratchet wheel 309 remains stationary. Continuous compression of the arm portions 307 and 312 towards each other will, as explained in connection with the previous embodiments, complete the stapling. After the stapling is done, the surgeon will release the compression on the arm portions 307 and 312 sufficiently so that they will move back to their original position shown in FIG. 14. During this return movement following the stapling, the pawl 308 will move to the right (FIG. 14) and will turn the ratchet wheel 309 for one tooth.

Some of the advantages of the instant invention have already been alluded to earlier herein. At this point, attention is called to some additional advantages. For instance, the multiple cartridge 61 may not only be disposable but may also be loaded by a suitable machine. Thus, the hospital will have available a whole supply of pre-loaded and pre-sterilized cartridges 61 (301) or magazine assemblies 70 which, when needed, will be inserted by a nurse or a nurse's assistant into the stapler. The insertion is simple. The nurse will push the magazine assembly 70 into the open mouth of the forceps until the periphery 74 of the cartridge 61 strikes the arcuate edges 73 of the guide plates 69 and 71; in that position, the pin 77 will engage the central recess 76. The stapler is thus loaded. After all the staples (sixteen in the instant example) have been used, the nurse will remove the cartridge 61 or 301 and toss it into the waste basket, and insert a new pre-loaded, pre-sterilized cartridge 61 (301), as previously described.

It will be apparent to those skilled in the art that the novel principles of the invention disclosed herein in connection with specific exemplifications thereof will suggest various other modifications and applications of the same.

It is accordingly understood that I do not desire to be limited to the exact details of construction shown and described.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent is as follows:

1. A stapler, for use in fastening at each actuation a single miniature staple having two legs and a crown connecting the legs, comprising in combination,

- (a) a pair of forceps including two arms movable relative to each other,
- (b) a cartridge holder mounted between said two arms on said forceps, and
- (c) a cartridge removably emplaceable in predetermined position on said holder, said cartridge defining an opening having two opposite straight parallel grooves each adapted to receive the leg of a staple pointing with its free end in one direction, the grooves being spaced apart from each other for a distance comparable to the width of the staple thereby engaging frictionally the legs of the staple suspending the staple with the crown extending across said opening, one of said arms comprising
- (d) an anvil adjacent the position of the free end of the legs of said suspended staple when the cartridge

is emplaced and having two curved clinching grooves, the other arm comprising

- (e) a driver adjacent the position of said staple crown when said cartridge is emplaced and including a plate element movable arcuately oppositely towards and from said anvil and operable to abut, and to press against, said crown thereby to drive the staple in a straight movement in said direction towards said clinching grooves,
- (f) said plate element having a width greater than the thickness of said crown.
- 2. A stapler, as claimed in claim 1, the thickness of said plate element being at least twice the thickness of said staple crown.
- 3. A stapler, as claimed in claim 1, and means operable at each actuation of the stapler for suspending in said predetermined position a new staple after the preceding staple has been removed from said straight grooves.
- 4. A stapler, as claimed in claim 1, together with, means connected to at least one of said arms and operable to guide said cartridge to said predetermined position and to hold it releasably in that position.
- 5. A stapler, as claimed in claim 1, said cartridge including two projections defining therebetween said opening constituting a path for the movement of said plate.
- 6. A stapler, for use in fastening to tissue an individual miniature staple formed of one piece having two legs and a crown connecting the legs, comprising in combination,
  - (a) a pair of elongated forceps including two movable arm portions actuatable to be moved towards and, respectively, away from each other, spring means urging said arm portions apart, whereby when said arm portions have been moved towards each other and subsequently been released, the spring means will return them to the spread-apart position thereby finishing a complete actuation of said arm portions for stapling,
  - (b) a cartridge holder mounted on said forceps between said arm portions, and
  - (c) a cartridge releasably emplaceable on said holder and including means adapted for suspending removably in a predetermined position and guiding, a staple, said cartridge when emplaced on said holder being held immovably with respect to the longitudinal direction of the forceps and thereby suspending said staple immovably with respect to the longitudinal direction of the forceps and guiding the staple at right angle thereto, said cartridge being shiftable angularly to suspend in said predetermined position another staple after the preceding staple has been removed from said cartridge,
  - (d) driver and anvil means connected to said arm portions and being operable for engaging and removing from the cartridge a staple suspended in said predetermined position and adapted to fasten it to said tissue, and
  - (e) means operable for shifting said cartridge angularly to suspend in succession single staples in said predetermined position.
- 7. A stapler, for use in fastening to tissue an individual miniature staple formed of one piece having two legs and a crown connecting the legs, comprising in combination,
  - (a) a pair of elongated forceps including two movable arm portions actuatable to be moved towards and, respectively, away from each other, spring means urging said arm portions apart, whereby when said arm portions have been moved towards each other and subsequently been released, the spring means will return them to the spread-apart position thereby finishing a complete actuation of said arm portions for stapling,
  - (b) a cartridge holder mounted on said forceps and extending between the arm portions thereof and comprising guiding means, and
  - (c) a cartridge releasably emplaceable on said holder



and being shiftable angularly rotatably, guiding means guiding said cartridge to its emplacement and during rotation thereof, said cartridge including means adapted for carrying angularly off-set from each other a plurality of said staples and for suspending removably and guiding, one of said staples in a predetermined position, said cartridge when emplaced on said holder being held immovably with respect to the longitudinal direction of the forceps and thereby suspending said one staple immovably with respect to the longitudinal direction of the forceps and guiding the staple at right angle thereto, (d) driver and anvil means connected to said arm portions and being operable, by each complete actuation of said arm portions, to engage and to remove from the cartridge the single staple suspended in said predetermined position and adapted to fasten it to said tissue, and (e) shifting means connected to at least one of said arm portions and being movable to engage said cartridge for shifting said cartridge angularly upon each actuation of said arm portions.

8. A stapler, as claimed in claim 7, said guiding means including means operable for centering said cartridge for rotation on said holder.

9. A stapler, as claimed in claim 7, said cartridge having a central recess, said guiding means including a pin engaging said recess for centering said cartridge, and means operable for releasably latching said cartridge after each shifting.

10. A stapler, as claimed in claim 7, said shifting means including a ratchet rigidly secured to said cartridge for joint rotation of said cartridge and said ratchet, said ratchet having one tooth for every staple adapted to be carried in said cartridge, a pawl connected with relation to said holder and being movable in opposite directions and operable to engage and to shift said ratchet for one tooth when moved, cam and cam follower means between said one arm portion and said pawl and operable to move said pawl in opposite directions in succession at each complete actuation of said arm portions, whereby said ratchet will be shifted angularly for one tooth at each actuation.

11. A stapler, as claimed in claim 7, said staple carrying means comprising a plurality of projections formed on said cartridge, each projection having a lateral surface, each pair of opposite lateral surfaces defining an opening and adapted to engage frictionally the legs of a staple to suspend the staple with the crown extending across said opening.

12. A cartridge, for use in suspending a single miniature staple having a crown and two legs for removal by a stapler, comprising in combination, an elongated block including at one end two projections defining a recess, the height of said cartridge being adapted to have at least the height of said staple, each projection having a straight groove at right angle to the longitudinal extension of said block, said grooves being disposed opposite each other and parallel and opening into and merging with said recess and adapted to receive the legs of a staple.

13. A disposable cartridge, for use in a stapler having a pair of forceps with movable driver and anvil means for one-piece miniature staples, comprising in combination, a disk revoluble about its center axis and including a plurality of projections defining therebetween a plurality

of openings, each projection having a lateral surface, each opening being confined between the pair of opposite lateral surfaces of two adjoining projections, each two lateral surfaces being spaced apart for an unchangeable distance and adapted to engage frictionally the legs of a staple to suspend and to guide in a direction parallel to said axis of the disk the staple in the opening.

14. A disposable cartridge, as claimed in claim 13, each lateral surface having a straight groove adapted to receive the leg of a staple, the grooves of each of said pairs of lateral surfaces being parallel, the width of a staple being comparable to the distance between said projections.

15. A cartridge holder for a single miniature staple cartridge, for use in connection with a stapler having a pair of forceps comprising, in combination, an elongated member adapted to be removably connected to said forceps and including a hollow front section, said section having a bottom, sidewalls and an end wall and being open at one end and on top and including a retaining spring engaging said section for retaining it, and lateral elongated guides formed on said sidewalls inside said section adapted to guide said cartridge through said open end to and from a position of emplacement in said cartridge.

16. A stapler, for use in fastening at each actuation a single miniature staple having two legs and a crown connecting the legs, comprising in combination,

(a) a pair of forceps including two arms movable relative to each other,

(b) a cartridge holder mounted between said two arms on said forceps, and

(c) a cartridge removably emplaceable in predetermined position on said holder, said cartridge defining an opening having two opposite straight parallel grooves each adapted to receive the leg of a staple pointing with its free end in one direction, the grooves being spaced apart from each other for a distance comparable to the width of the staple thereby engaging frictionally the legs of the staple suspending the staple with the crown extending across said opening, one of said arms comprising

(d) an anvil adjacent the position of the free end of the legs of said suspended staple when the cartridge is emplaced and having two curved clinching grooves, the other arm comprising

(e) a driver adjacent the position of said staple crown when said cartridge is emplaced and including a plate element movable arcuately oppositely towards and from said anvil and operable to abut, and to press against, said crown thereby to drive the staple in a straight movement in said direction towards said clinching grooves,

(f) said plate element being operable to engage said crown and having a thickness only slightly larger than the thickness of said crown.

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