

[54] **STAPLER DEVICE**

[72] Inventor: **Italo Caroli**, Westmount, Quebec, Canada

[73] Assignee: **DMS Industries Limited**, Lachine, Quebec, Canada

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[58] Field of Search72/410; 29/243-256, 212 R, 212 D; 227/19; 128/325, 326, 334

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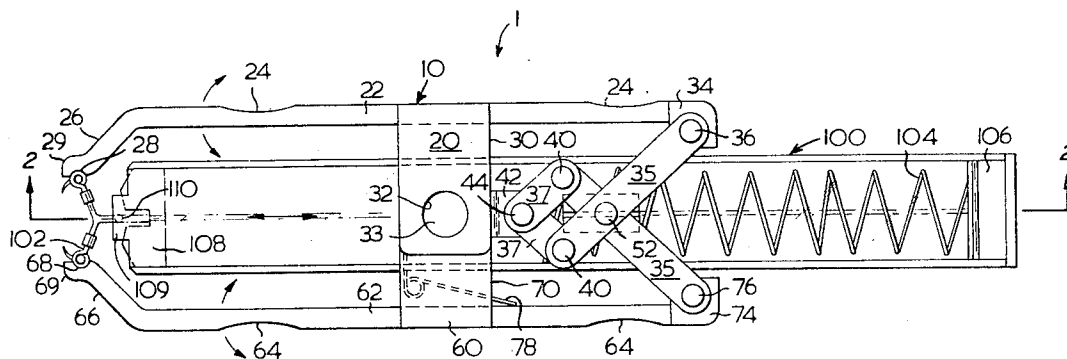
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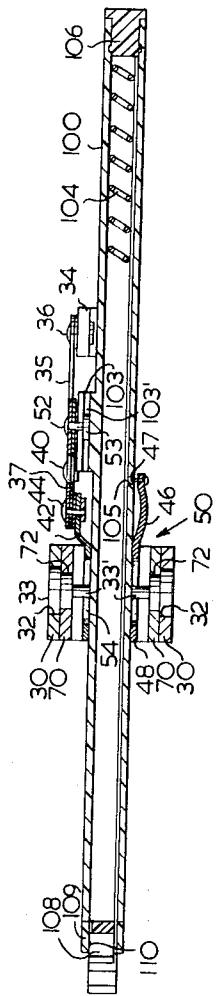
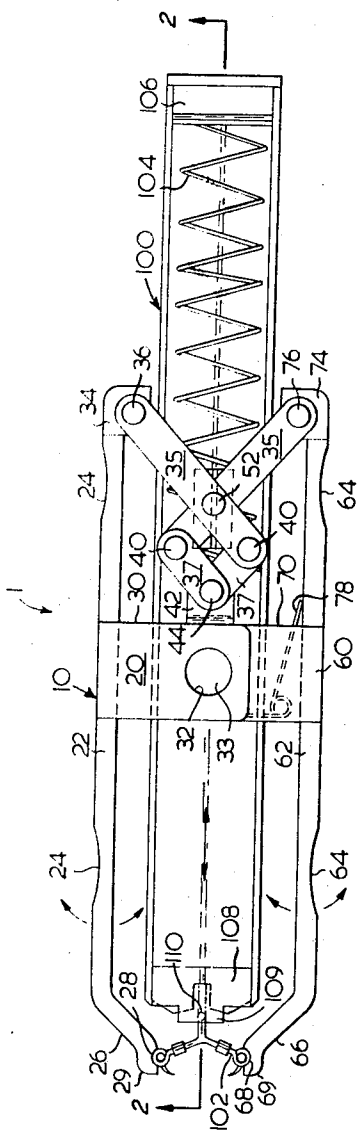
Primary Examiner—Charles W. Lanham
Assistant Examiner—Michael J. Keenan
Attorney—Cushman, Darby & Cushman

[57] **ABSTRACT**

A stapler device is described which can house a magazine containing surgical staples or clips for closing an open wound. Preferably the magazine will be disposable. The stapler device has two complementally formed jaws which have flanges thereon for enabling such jaws to be connected together so as to be pivotable about a common axis. A set of lever arms are joined at one end thereof to the two jaws, and at the other end to the magazine containing the surgical staples. These lever arms function to convert pivotal movement of the jaws about the common axis to reciprocal and preferably substantially linear movement of the magazine relative to the stapler device. This reciprocal movement of the magazine enables one surgical staple to be advanced at a time preparatory to application to the open wound. Receding of the magazine enables the staple-applying nose portion of the jaws to come substantially together to effect closing of the surgical staple as it is applied to the wound. A scissors-type spring can be provided, if desired, on the jaws to return the same to a neutral rest position, automatically. If this return spring is omitted, two positive squeezing actions are required, one to apply the surgical staple, and the other to open the jaws apart and advance the magazine forwardly to dispense the next surgical staple in readiness for application thereof to the wound. Either way, complete control over the operation of the stapler device remains with the person who is holding such device in his hand.

3 Claims, 3 Drawing Figures

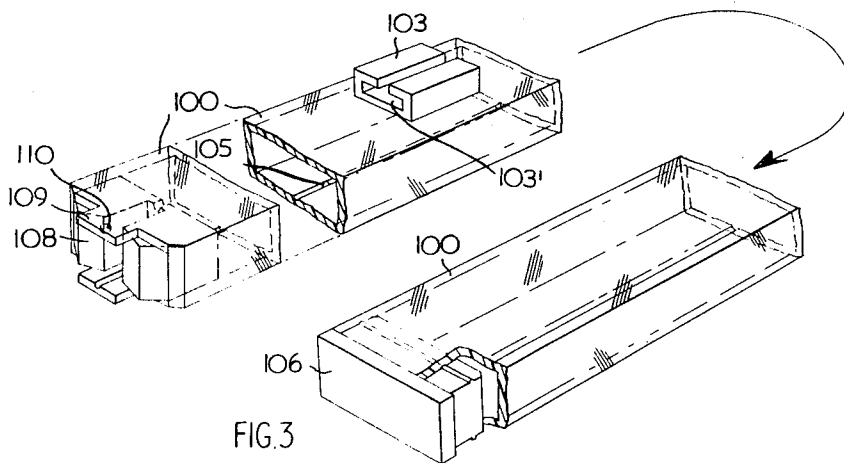




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STAPLER DEVICE

This invention relates broadly to a stapling device, and in particular, to a stapling device of the type which is adapted to receive and house a magazine containing surgical staples or clips that are to be dispensed one at a time for closing an open wound.

It has long been known that in order to enable a surgeon, a veterinarian, or other doctor to close an open wound, a tweezerlike clamping device has been used to pick up and squeeze shut the surgical staple or clip which is applied to the wound. Picking up and applying of the surgical clips was done one clip at a time, thereby resulting in a considerable expenditure of time as well as a considerable amount of handling. A nurse or other assistant normally picked up the single staple or clip with the tweezerlike clamping device, and then handed it to the doctor who subsequently applied the surgical clip to the wound. Depending upon the size of the wound to be closed, and perhaps on the environment in which this operation was taking place, any unnecessary delays incurred in closing the wound increased the potential hazard for bacteria or other infecting agents to get into the open wound. As a result, some attempts were made to improve on the basic tweezerlike clamping device originally used. One improved surgical clip applicator is described in U.S. Pat. No. 2,096,173 issued on Oct. 19, 1937 to Renzo Guerrini, while another such device is shown in U.S. Pat. No. 3,152,336 issued on Oct. 13, 1964 to James J. Brady. However, these prior art devices are relatively complicated and have met with only rather limited success.

It is an object of this invention, therefore, to provide an improved stapler device for applying surgical staples or clips which penetrate the skin and can be squeezed shut to close an open wound, which is relatively simple in construction and easy to operate.

It is also an object herein to provide an improved stapler device which is adapted to receive and house a magazine for dispensing surgical staples one at a time, with such magazine being retained in proper alignment relative to the stapler device, for advancing surgical staples in sequence and under the complete control of the doctor who is operating this stapler device.

It is yet a further object herein to provide an improved stapler device having two jaws which are spaced apart, but which are interconnected to be pivotable about a common axis. This pivotal motion of the two jaws is converted to reciprocal movement of the magazine containing the surgical staples or clips to enable applying such clips to close an open wound.

These and other objects and advantages of the present invention can be achieved by one broad form of the invention where, there is provided a stapler device adapted to receive and house a magazine for dispensing surgical staples to close an open wound, said device comprising; a first jaw and a second jaw, each jaw having flange means thereon for operatively joining the same together, the flange means on one jaw being receivable within the flange means on the other jaw, and each of the flange means having an aperture therein for receiving a connecting pin such that said first and second jaws are pivotable about a common axis; and lever arms mounted on the first and second jaws for operatively connecting said jaws to the magazine of surgical staples, the lever arms being so disposed as to convert pivotal motion of said jaws about the common axis to reciprocal movement of the magazine to advance one surgical staple at a time preparatory to application thereof to the wound.

In one preferred form of such a stapler device, a pair of flanges are provided on each of the jaws, extending outwardly from opposite sides thereof and being provided in each instance with an aperture such that all of the apertures are in alignment, when the stapler device is assembled, and coaxial with said common axis. In order to accommodate improved alignment of the magazine containing surgical staples, which is received and housed within the stapler device, a hub element is provided. This hub element is receivable within the flange means on each of the jaws when the latter are assembled.

Further, this hub element can have a slot therein for engaging the connecting pin of the stapler device so that, in one form, the hub element is guided by a pin-in-slot arrangement. The connecting pin of the stapler device engages, in a broad sense, guide means on the hub element which in turn guides the magazine to restrain the magazine in its reciprocal movement.

Further modifications and refinements of the above stapler device can also be made within the spirit of the present invention. Accordingly, there is provided in a more preferred form of the present invention, a stapler device adapted to receive and house a magazine for dispensing surgical staples to close an open wound, said device comprising; a first jaw and a second jaw, each jaw having flange means thereon for facilitating joining the same together, the flange means on one of the jaws being positionable within the flange means on the other jaw, with each flange means having an aperture therein for receiving a connecting pin that interconnects said jaws so as to be pivotable about a common axis; a hub element adapted to be housed within the flange means on said jaws, and serving to releasably retain said magazine of staples, the hub element having slot means therein for guided engagement thereof with one end of said connecting pin; and a plurality of pivotally interconnected linkages which are rotatably connected at one end thereof to said jaws for actuation by pivotal movement of the latter, with the other end of said linkages being movably connected to said hub element, such that the linkages are so disposed to convert pivotal movement of said jaws to reciprocal movement of the magazine thereby advancing one surgical staple at a time preparatory to application of the same to said wound.

The present invention will now be described in more detail with reference being made to the accompanying illustrative drawings, in which:

FIG. 1 is a plan view showing one preferred form of the stapler device of the present invention, in assembled form, housing a magazine containing surgical staples or clips;

FIG. 2 is a side elevation view, taken in section along line 2-2 of FIG. 1; and

FIG. 3 is a perspective view showing a magazine containing surgical staples or clips of FIGS. 1 and 2.

Turning now to FIGS. 1 and 2, the numeral one designates the stapler assembly overall, which includes a stapler device 10 and a magazine 100 containing a supply of surgical staples or clips 102. The stapler device 10 will preferably be made of stainless steel, while the magazine 100 will usually be made of a surgical grade of plastic. It will be recognized that because this stapler assembly 1 is going to be used in an operating theater, a doctor's office, or other such environment where sanitary conditions are to be maintained at as high a standard as is possible, it is necessary that the stapler assembly be capable of sterilization to kill any germs or bacteria thereon. This will enable one form thereof to be used again and again. Similarly, since the magazine 100 may be repeatedly used, i.e., requiring only a refill of surgical staples or clips 102, it too should be capable of sterilization to maintain a high degree of cleanliness. In other instances, however, the magazine 100 will be disposable and hence will be discarded after its supply of surgical staples or clips 102 has been used up. Accordingly, it will be recognized that the materials of which either the stapler device 10 and/or the magazine 100 can be made will be determined by the conditions and modes of operation under which it will normally be used. Clearly, a wide variety of materials can be used although some will be either cheaper and/or more suitable than others when all economic and use factors are taken into consideration.

With particular reference to FIG. 1, the stapler device 10 comprises complementally formed left and right jaws 20 and 60 which include body portions 22 and 62, gripping grooves or recesses 24 and 64, and nose portions 26 and 66. Each of the nose portions 26 and 66 is provided with a lip section 29 and 69, respectively, having a recess 28 and 68 therein for releasably engaging one surgical staple or clip 102 at a time. As suggested in FIG. 1, each surgical staple 102 has a knee or

ball joint arrangement therein which is releasably held in the recess 28 and 68 in order to effect application of such staple or clip to the open wound.

The body portions 22 and 62 of each jaw are provided with mounting flanges 30 and 70 extending outwardly from each jaw at opposite sides thereof. The particular embodiment shown in FIGS. 1 and 2 shows each mounting flange 30 and 70 to be generally L-shaped in section, taken transverse to the longitudinal direction of each jaw 20 and 60. Other suitable shapes can also be used, providing that each mounting flange will still enable the two jaws to be secured one to another so as to be pivotable about a common axis. It will be recognized from the drawings, that in the particular embodiment shown, the length of the upstanding leg portion of the mounting flanges 70 is less than the length of the corresponding leg portion on mounting flanges 30. Accordingly, the flanges 70 are capable of being disposed, in assembled form, within the flanges 30. All of the mounting flanges 30 and 70 are provided with apertures or orifices 32 and 72 which are in alignment one above another, again in assembled form, such that the orifices in cooperating pairs of the mounting flanges 30 and 70 will rotatably receive main pivot axles 33 whose axes are coaxial with a common axis about which each of the jaws 20 and 60 can pivot. FIG. 2 shows each of the main pivot axles 33 having an enlarged outer end and small inner end 33' whose purpose will be described below.

The end portion of each of the jaws 20 and 60 opposite the nose portions thereof is provided with a mounting shoulder 34 and 74 to which a pair of long lever arms 35 are pivotally connected, by means of pivot pins 36 and 76. The other end of each of the long lever arms 35 is also pivotally connected, to a corresponding one of a pair of short lever arms 37 by means of pivot pins 40. In addition, the other ends of the two short lever arms 37 are each rotatably connected to an upper extension flange 42 by means of a common pivot pin 44. This upper extension flange 42 is integrally formed on a hub element 50 whose body portion is indicated at 48. A lower extension flange 46 corresponds to the flange 42, and has a locking pin 47 therein for purposes to be described below. The lower extension flange 46 is also integrally formed on the body 48 of the hub element 50. The hub element 50 is shown as being tubular and generally rectangular in cross section in order to slidably engage and receive the magazine 100 of surgical staples 102. Moreover, this hub element 50 including the extension flanges 42 and 46 thereon are so dimensioned as to be receivable within the innermost mounting flanges 70. Since the mounting flanges 30 and 70 are generally L-shaped in section as noted above, so the hub element 50 must be rectangular in shape in order to be relatively closely received within such flanges. Since the mounting flanges 30 and 70 may have other shapes, i.e., other than L-shaped, so too can the hub element 50 be of various cross-sectional shapes. It is important, however, to recognize that the shape of the hub element 50 will be complementary with the shape of the mounting flanges 30 and 70 in order to provide a fairly tight-fitting arrangement which nevertheless still provides the required relative movement needed of the magazine 100.

It should be noted that an aperture is provided in each of the long lever arms 35 at a distance from the axis of pivot pins 40 substantially equal to the spacing between the axes of pivot pins 44 and 40 in the two short lever arms 37. These two apertures can then be brought into alignment to rotatably receive a common pivot pin 52. This pivot pin 52 has an enlarged inner end 53 which, as seen in FIG. 2, is adapted to slidably engage a retainer lug 103 on the magazine 100. A parallelogram interconnection is hence established between the lever arms 35 and 37, by the pivot pins 40, 44 and 52. It will hence be seen that one end of the two long lever arms 35 is pivotally connected to the two jaws 20 and 60, while one end of each of the two short lever arms 37 is pivotally connected to the hub element 50, with the other end of each of the short and long lever arms being pivotally connected one to another. Moreover, it will also be seen that because the retainer lug 103 has a length

dimension parallel to the longitudinal axis of the magazine 100, that motion of the pivot pin 52 will be restrained to a path generally parallel to the longitudinal axis of the magazine 100. Furthermore, it was previously mentioned that each main pivot axle 33 has a small inner end 33', and each axle also has a neck portion of sufficient length that it can slidably be received within a slot 54 in the body 48 of hub element 50. The small inner end 33' of the main pivot axle 33 is, in each instance, recessed in order to facilitate spreading apart of such end, in a rivetlike manner so that the overlapping flanges 30 and 70 can pivotally be interlocked together while simultaneously connecting the hub element 50 operatively to such overlapped flanges 30 and 70. It should also be noted that the slot 54 is disposed parallel to the longitudinal axis of the magazine 100 when it is received within the body of the hub element 50.

From the foregoing description, it will be noted that in assembled form, the magazine 100 is releasably held within the hub element 50, and because of the pin-in-slot connection of the neck portion of the main pivot axle 33 and the slot 54 in hub element 50, both the hub element and the magazine are slidable as a unit within the stapler device 10. The magazine 100 is held locked in position within the hub element 50 by means of the pin 47 engaging in an orifice or recess 105 in the magazine 100. This arrangement can be seen with reference to FIG. 2, and it is evident that other equivalent interlock arrangements can also be used. It will also be evident that each of the main pivot axles 33 in the cooperating pairs of mounting flanges 30 and 70 are so adapted as to allow the previously mentioned sliding action of the magazine 100 and hub element 50 within stapler device 10.

A scissor-type return spring is shown at 78 in FIG. 1, and can be provided if desired for returning the stapler device 10 to its normal rest position, automatically. Should this return spring 78 be omitted, the doctor merely adjusts his grip on the stapler device such that his fingers grasp the rear grooves 24 and 64 where, upon application of squeezing pressure the two jaws 20 and 60 will pivot to a rest position such as that shown in FIG. 1. Other types of return spring arrangements can also be used, and it will be noted, that whatever type of return spring is used, the jaws of the stapler device 10 will return to their normal rest position as soon as the squeezing pressure which was applied to close the surgical staple or clip 102, is removed or reduced.

As previously noted, the magazine 100 is adapted to contain and dispense a supply of surgical staples or clips 102, one at a time. Although the magazine 100 can have various tubular, cross-sectional configurations, the magazine shown herein is rectangular, and a supply of the surgical staples or clips 102 is placed into the magazine at the time of manufacture of the same. Moreover, it will in some instances be preferable to have a disposable magazine 100, with the same being filled with a supply of surgical clips 102 and sterilized at the time of manufacture. The sterilized magazine of clips is then wrapped in a sanitary package and sent out for distribution to doctors, hospitals and so on. Upon receipt of such a package, the magazine is simply unwrapped and placed into the stapler device 10. Thus the assembly is readied for use with a minimum of handling. This is important since virtually no one needs to touch the surgical staples, and hence any contamination hazard that might otherwise exist, is essentially eliminated. Also, when the staples are exhausted, the magazine, if disposable, can be thrown away and a new, clean magazine full of staples simply taken from the "supply room" and made ready for use. Since the actual construction of the surgical staples 102 is known, it need not be described further at this time.

It will be apparent from FIGS. 1 and 2, that after a predetermined supply of staples 102 is put into the magazine 100, a clip follower 108, a pusher spring 104 and an end cap 106 are inserted behind the staples. The spring 104 biases the staples 102 forwardly pushing the follower 108 against the supply of staples or clips 102, while the end cap 106 is in a resilient, rib-in-slot locking engagement closing the rear end of the

magazine 100. The forward end of the magazine 100 is provided with an upper tongue element 109 which has a retaining dimple 110 thereon for holding back the forwardmost staple 102 before application thereof to the wound. This retaining dimple 110 holds the leading staple 102 and hence prevents the spring 104 from pushing all of the staples 102 out of the magazine in an uncontrolled manner. The magazine 100 is normally made from a surgical grade of plastic, and for convenience is transparent. As mentioned above, a disposable magazine could also be used as an alternative. The outer surface of the magazine 100 is generally fairly smooth with the exception of the addition of the retainer lug 103 on one side thereof and the provision of the aperture 105 or some other equivalent structure on the other side, for receiving the pin 47 in the lower extension flange 46 of hub element 50. This pin 47 serves to lock the magazine 100 in position where it is properly located within the stapler device 10. At that location, the enlarged head 53 of pivot pin 52 is able to come into engagement with a slot 103' in the retainer lug 103. Other alternative positioning and guiding arrangements can also be used instead of those just described, for instance, a ratchet type of interconnection might be used with the hub element 50, and so on.

At the time of manufacture of the magazine 100, it is subsequently loaded with a charge of surgical staples 102, is completely sterilized and packaged in a sterilized container. This container is then shipped to the hospital or doctor's office wherever the present stapler assembly 1 is to be used. In using this stapler assembly 1, the magazine 100 is initially unwrapped or taken from the sanitary package in which it comes, and loaded into the stapler device 10, as shown in FIGS. 1 and 2, with the magazine being releasably locked in position by means of the pin 47 on the hub element 50. The doctor is then able to pick up the stapler assembly 1, and by exerting gripping pressure at the forward grooves 24 and 64, for instance, will bring the nose portions 26 and 66 of the jaws together. The leading surgical staple 102 which has been held in position by the retaining dimple 110, and in engagement with the recess 28 and 68 in the jaws 20 and 60, is hence applied to the open wound penetrating the flesh on both sides of the wound, and being collapsed to close the same. As the nose portions 26 and 66 of the jaws come together, the lever arms 35 and 37 cause the magazine 100 to be withdrawn rearwardly a short distance thus enabling the lip sections 29 and 69 to come quite closely together and fully collapse the staple 102. If the return spring 78 is provided, release of the gripping pressure by the doctor will allow such spring to return the jaws 20 and 60 to the normal rest position shown in FIG. 1.

If this return spring 78 is not provided, then as previously described, the doctor merely adjusts his grip on the stapler assembly 1, to grasp the same by the rear grooves 24 and 64 and exerts a slight pressure to open the nose portions 26 and 66. Regardless of whether gripping pressure is applied at either the forward or rear grooves 24 and 64, pivoting of each of the jaws 20 and 60 takes place about a common axis previously described. Also, regardless of whether opening of the nose portions 26 and 66 takes place either manually or automatically by virtue of the return spring 78, such opening motion will cause the magazine 100 to be driven forwardly, again by the action of the long and short lever arms 35 and 37. The magazine 100 will normally be driven forwardly until the neck portion of axle 33 reaches the end of slot 54 in the hub element 50. At this point, the next staple 102 being urged outwardly by the pusher spring 104 will have been advanced to a position being retained by the dimple 110, and in engagement with the recesses 28 and 68 in the lips 29 and 69 of the stapler jaws. The stapler assembly 1 is again ready for application of another staple 102 to the wound being closed.

As previously noted, the magazine and staples will usually be obtained from the same manufacturing source, and will be sterilized and packaged in a sanitary enclosure. Handling of the magazine and especially of the staples or clips by a doctor, nurse and so on, is therefore minimized, thus reducing both

the contamination hazard and the time element involved in the actual operation of closing an open wound. Moreover, good control over the operation of the stapler device 10 can very easily be achieved with little effort. Also, the potential hazards and nuisance of misalignment of the magazine within the stapler device 10 are reduced by the interconnection of the hub element to the stapler jaws 20 and 60, and by the retainer lug 103 guidingly engaging one end of the pivot pin 52. Finally, it will be recognized that because of the simple structural form and mechanical function of the various constituent parts of the present stapler device 10, a straightforward, easy to operate and reliable device is provided.

The present invention is therefore seen to provide a stapler device adapted for use with a magazine containing surgical staples, which is both easy to operate and easy to maintain. Some specific modifications have been suggested to the embodiment described in detail above, and other changes are also possible. The foregoing description should, therefore, be considered as being illustrative by way of example only, with the scope of the invention being defined in the claims below.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A stapler device adapted to receive and house a magazine for dispensing surgical staples to close an open wound, said device comprising:

a first jaw and a second jaw, each jaw having flange means thereon for facilitating joining the same together, the flange means on one of the jaws being positionable within the flange means on the other jaw, with each flange means having an aperture therein for receiving a connecting pin that interconnects said jaws so as to be pivotable about a common axis;

a hub element adapted to be housed within the flange means on said jaws, and serving to releasably retain said magazine of staples, the hub element having slot means therein which are in guided engagement with one end of said connecting pin; and

a plurality of pivotally interconnected linkages which are rotatably connected at one end thereof to said jaws for actuation by pivotal movement of the latter, with the other end of said linkages being movably connected to said hub element, such that the linkages convert pivotal movement of said jaws to reciprocal movement of the magazine thereby advancing one surgical staple at a time preparatory to application of the same to said wound.

2. The stapler device of claim 1, wherein spring means are provided on said jaws for returning the same to a normal rest position from either a staple-applying position or a staple-advancing position.

3. A stapler device adapted to receive and house a magazine for dispensing surgical staples to close an open wound, said device comprising:

a first jaw and a second jaw, each jaw having flange means thereon for operatively joining the same together, the flange means on one jaw being receivable within the flange means on the other jaw, with each of the flange means having an aperture therein for receiving a connecting pin such that said first and second jaws are pivotable about a common axis;

lever arms mounted on the first and second jaws for operatively connecting said jaws to the magazine of surgical staples, the lever arms being so disposed as to convert pivotal motion of said jaws about the common axis to reciprocal movement of the magazine longitudinally thereof to advance one surgical staple at a time preparatory to application to the wound; and

a hub element for guidingly engaging the magazine and being receivable within the flange means on each of the jaws when assembled, the hub element including guide means for engaging said connecting pin to constrain the magazine to said reciprocal movement, with the lever arms having two pairs of pivotally interconnected linkages, one end of each of one of said pairs of linkages

being pivotally joined to the jaws for actuation by pivotal movement of said jaws, and one end of each of the other pair of linkages being connected by a common pivot pin to said hub element, with the other ends of each pair of linkages being pivotally connected to one another by a common pin means, said linkages and the hub element cooperating to produce said reciprocal movement of the magazine of surgical staples.

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