

[54] **PLIERS TYPE SURGICAL STAPLER FOR JOINING DISUNITED SKIN OR FASCIA**

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[51] Int. Cl. **B25c 5/02**

[58] Field of Search **227/19, 83, 85, 87, 108, 227/120, 121, 123, 124, 144**

[56] **References Cited**

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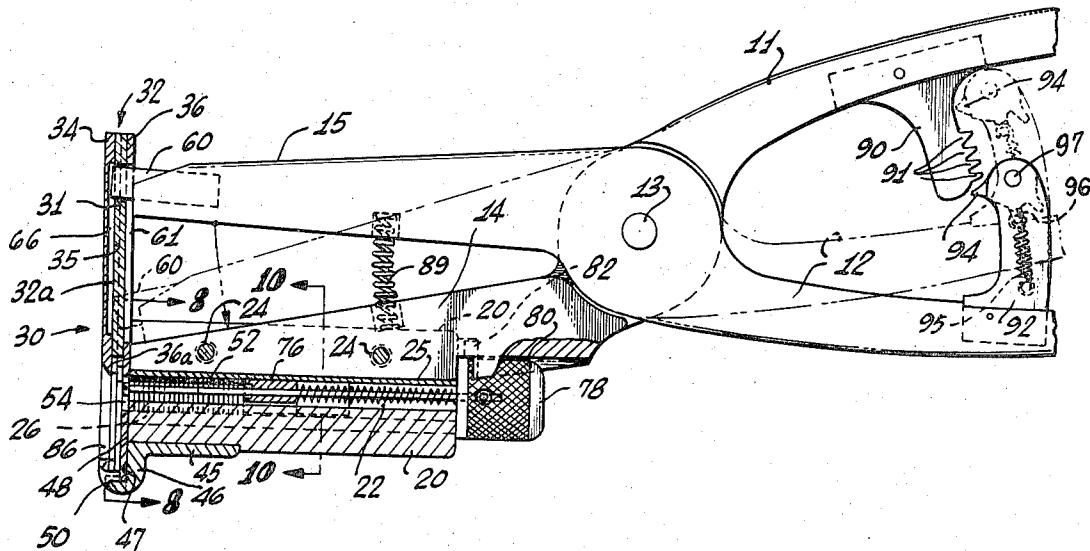
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[57] **ABSTRACT**

A plier-like implement for surgeon's use in stapling together disunited skin or fascia. The staple driving ram in a staple guide and an anvil operate from the outside of the severed skin. The ram is movable by jaws of a pliers-like instrument in a plane at right angles to the skin to drive the staple into the skin and thereafter close it.

A ratchet means is provided to prevent the pliers handles from reverse or opening movement once they have begun their closing movement, until the staple has been installed across the parted skin, at which time the staple is released by the implement, and the ratchet means then becomes inoperative to stop opening movement of the handles. This prevents the handles from opening, once a staple has been pushed a short distance down the guide, but is not yet ejected. Thus, a second staple is prevented from being fed into the guide while the one ahead of it is still in it.

10 Claims, 11 Drawing Figures



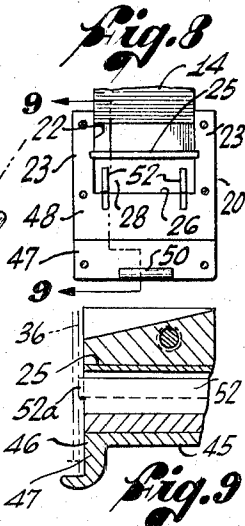
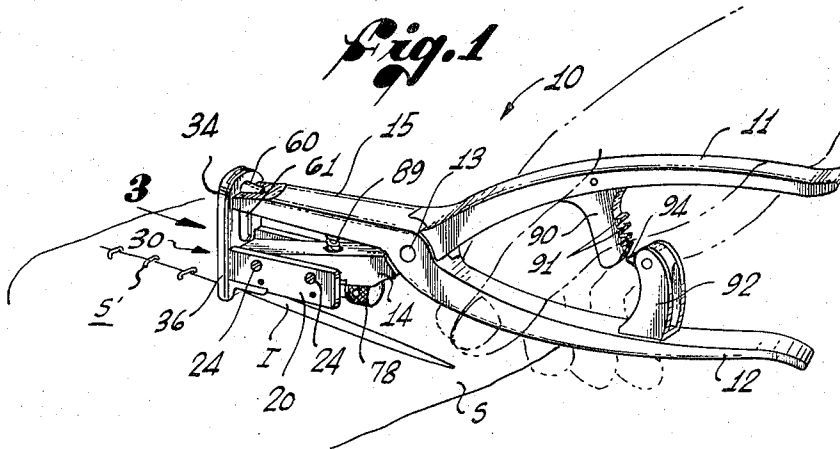


Fig. 7

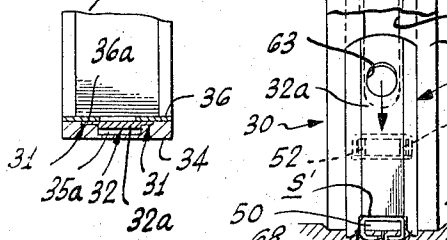


Fig. 5

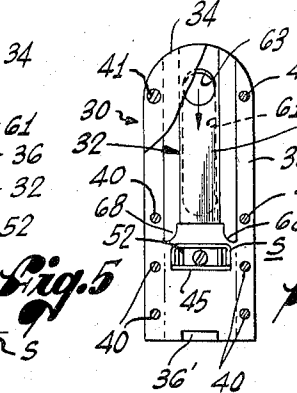


Fig. 4

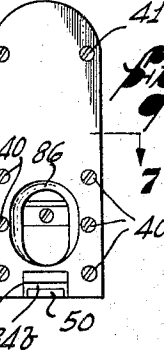


Fig. 9

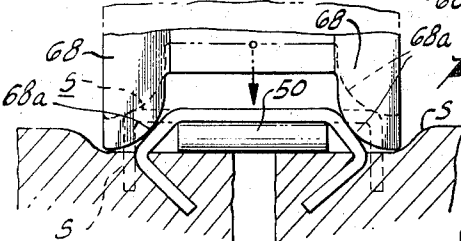


Fig. 6

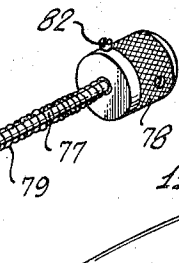


Fig. 11

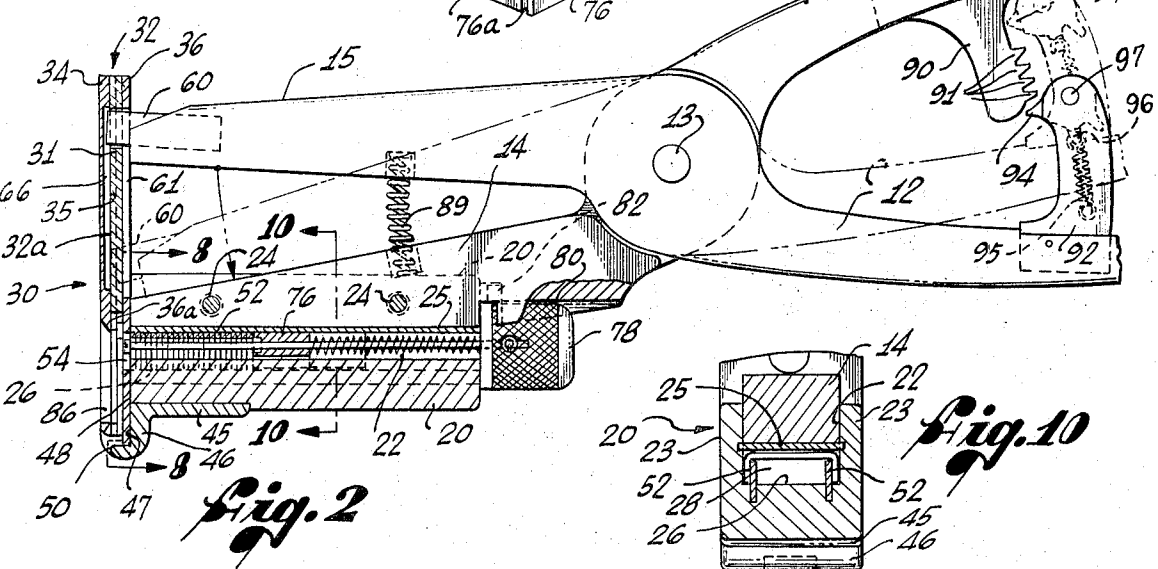


Fig. 2

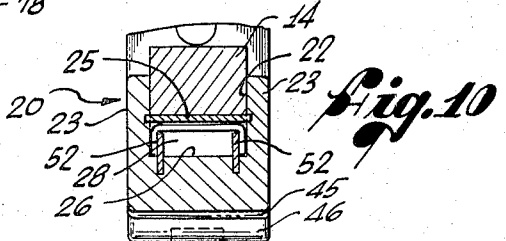


Fig. 10

PLIERS TYPE SURGICAL STAPLER FOR JOINING DISUNITED SKIN OR FASCIA

FIELD OF THE INVENTION

This invention relates to surgical instruments for joining disunited skin or fascia by means of staples, and particularly to such an instrument which is of a novel pliers-action type.

BACKGROUND OF THE INVENTION

Staplers for uniting sheets of stationery by staples have long been known. This type of device drives an open wire staple downwardly through the sheets of paper against an anvil on the under-side, designed to bend the penetrating legs of the staple to a closed position. This type of stapler is so well known as to require no further description, beyond to note that it is restricted to working from both sides of the media to be stapled. More recently, staplers capable of working from the same side of the media, and therefore basically adapted to insertion of staples to fasten adjoining but disunited skin or fascia have begun to appear. Those with which I am familiar are generally power operated, as by a pneumatic cylinder. A relatively recent gas-powered stapler employs an expensive disposable cartridge consisting of a complex staple transport mechanism, ram, and anvil which, on the release of the last staple, is thrown away. In addition, this instrument requires the use of a disposable gas cylinder to operate the ram, and, perhaps because of its complexity, is generally considered to be less than completely reliable in its operation.

A manual instrument of similar design also uses a complex and costly cartridge for advancing one staple per stroke, again with the disadvantage that the empty cartridge along with its internal components of ram and anvil, are disposed of after the last staple is expelled.

The purpose of the invention is to provide a stapling device, using a plurality of metal staples to join disunited skin or fascia, by means of a manually operated pliers type instrument with no disposable components other than the staples themselves, and with provisions for advancing one staple at a time, i.e., one staple per stroke of the ram, and further, means for preventing inadvertent placing of a second staple in the staple guide before the ram has completed its full stroke and formed the first staple.

BRIEF SUMMARY OF THE INVENTION

The instrument of the invention functions in a position adjacent one surface of the disunited skin, and inserts the staples across the incision line, forming the staple adjacent the one surface only.

The instrument is basically like a pair of pliers, in that it has two pliers type handle members pivoted together, each with a part extended forwardly of the pivot after the fashion of the jaws of a pliers.

Assuming that the staple is to be driven vertically downward, the instrument is held generally horizontally, in a vertical plane, the lower handle terminating in an upper "jaw," and the upper handle in a lower jaw. This upper jaw is operatively coupled to a vertically movable ram, and when the handles are compressed, drives the ram downward through a hollow staple guide fixed to and upstanding from the lower jaw to engage a staple which has been fed into the guide, forcing it downward through the hollow guide on the lower jaw,

until its crown engages a stationary anvil at the base of the guide. With continued downward motion of the ram, two legs at its lower end bend the crown of the staple around the anvil until, at the bottom of the stroke, the staple is fully formed into an approximately rectangular shape. To facilitate the staple-forming action, the inner faces of the two legs of the ram are either chamfered or radiused at the bottom. In either case the forming action is equally effective.

A row of staples is contained in and fed along a staple housing fixed to the lower jaw of the pliers-like configuration. The anvil is located at the outermost end of the staple housing and extends below the lower surface of the staple housing a distance compatible with the requirements of stapling either skin, or disunited fascia therebelow.

The staple housing is designed to hold a row of staples, either bonded together or in a cartridge. Two parallel grooves in the housing form guides to hold the legs of the staples in correct attitude, one staple against the other, to advance smoothly under the action of a pusher block under spring compression. The staples are now pushed by this spring to their most forward position, i.e., against the far inner surface of the hollow guide. The first staple passes through a slot into a guideway in the guide, ready to be advanced by the downward stroke of the ram, and, in the course of this advancement, to be formed by the anvil, projected into the skin or fascia in a partially open condition, and finally clinched.

Mounted on one of the inner faces of the spring-loaded plier handle is a ratchet, and on the opposing inner face is located a pawl, or similar device, to constrain the motion of the closing plier handles from any reversal of direction, whether inadvertent or by design, until the travel in the initial direction has been completed. By means of such or similar device, only one staple can advance per stroke or squeeze of the plier handles. It prevents a return of the ram or relaxation of pressure on the handles to their static position, and thus prevents introduction into the guide of a second staple, before the prior one has been completely formed about the anvil.

DESCRIPTION OF THE DRAWINGS OF A PREFERRED EMBODIMENT

FIG. 1 is a perspective view of the stapling instrument of the invention in a position of readiness for installing a staple;

FIG. 2 is a side elevational view of the instrument of FIG. 1, with parts broken away along a vertical medial plane;

FIG. 3 is a front elevational view as taken by the arrow 3 of FIG. 1;

FIG. 4 is a view similar to FIG. 3, but with the front plate largely broken away;

FIG. 5 is a view similar to FIG. 4, but showing the implement in a position wherein the staple has been inserted and closed;

FIG. 6 is an enlarged detail taken from FIG. 5, but with the staple shown additionally in an intermediate position;

FIG. 7 is a section taken in accordance with line 7—7 of FIG. 3;

FIG. 8 is a section taken on line 8—8 of FIG. 2;

FIG. 9 is a detailed section taken on broken line 9—9 of FIG. 8;

FIG. 10 is a section taken on line 10—10 of FIG. 2; and

FIG. 11 is a perspective view of the device for spring-urging the staples into the staple slideway.

DESCRIPTION OF A PREFERRED EMBODIMENT

In the drawings, the pliers-like staple insertion implement 10 of the invention is shown to embody a pair of upper and lower pliers-like handles 11 and 12, pivotally connected at a pivot 13, in a conventional pliers-like configuration, the upper and lower handles crossing at the pivot and therepast as lower and upper jaws 14 and 15, respectively. It will be understood that the parts 14 and 15 are sometimes herein referred to as jaws, not because they have functions of the jaws of a pair of pliers, but because they are oriented and move in the general fashion of pliers jaws.

It will be further understood that the drawings, for illustrative purposes, show the implement oriented to drive the staples straight downward, but that there is no limitation to this orientation. The lower jaw 14 in the assumed orientation, comprises a wedge-shaped beam, with a downwardly sloping upper surface and a horizontal lower surface. Fitted to the lower jaw is a generally rectangular staple feed housing 20, having a deep horizontal, longitudinal slot 22 affording two side flanges 23 which closely receive jaw 14 between them. The assembly is secured by screws 24.

Just below the horizontal lower surface of jaw 14, and acting as a part of the housing 20 to close the top of slot 22 there is fixed in the channel, between flanges 23, a horizontal partition plate 25. This partition plate 25, together with the bottom wall surface 26 between the flanges 23, and the intervening portions of the inner flange faces, define a rectangular, horizontally elongated staple feed slot or chute 28 that extends lengthwise entirely through the housing 20 in parallelism therewith.

In the operating position shown in FIG. 2, the housing 20 and feed slot 28 therein are in a horizontal position, and are at an acute angle, preferably about as illustrated, to the general direction line of the tapered jaw 14. The vertical right angularly faced-off end of the housing 20 is then in substantially a vertical plane, and is abutted by the lower end portion of a generally vertically projecting staple guide 30, which has a vertical ram slideway 31. The latter contains ram 32, which has the function of pushing and forming the staple against a presently mentioned anvil.

The staple guide 30 comprises a fairly heavy front plate 34, into whose inner surface is sunk the vertical ram slideway 31, and a thin abutting back plate 36 which covers the back of the front plate and encloses the back of the slideway 31. Screws 40 secure the front and back plates together and in tight engagement with the end of the housing 20, and screws 41 secure the upper end portions of the front and back plates together.

An angle plate 45 has a horizontal leg or base secured to the underside of the front end portion of the housing 20, and a depending leg 46 whose vertical front face 47 is flush with the flat, vertical front end face 48 on the housing 20. The front end faces of the housing 20, the partition plate 25, and the leg 46 are all flush with one another, and in a substantially vertical plane; and the back surface of the back plate 36 is secured directly thereagainst. Projecting forwardly from the central

portion of the lower end of the leg 46 is an anvil 50 which is of a horizontal dimension equal to that of the fully crimped staple, and whose contour as seen in a vertical transverse plane is as illustrated in FIG. 2.

5 Contained inside the slot or way 28 is a pair of parallel staple guide rails 52, preferably in the form of narrow plates which are set down into the bottom wall of the housing 20, below surface 26. These rails are spaced from the flanges 23 by a distance to freely receive and guide the original overhanging end legs of a staple, or staple preform *s*, and the upper edges of the rails are similarly spaced from the partition 25, so as to freely receive and to support the crown or span portions of the staple preforms.

15 The backplate 36 has a rectangular staple aperture or window 54 which substantially matches (or is slightly oversize of) the staple chute 28, and staples from said chute, under spring pressure from behind, are fed through this aperture into the aforementioned slideway 31. The guide rails 52 have end portions 52a which project forwardly out of the staple feed chute just through the backplate 36; and when the staples are pushed entirely through the window and fully into the slideway 31, they ride off these end projections 52a, and are hence able to be moved down to the anvil by the ram. The ram 32 thus works in the slideway 31, and staples are fed, as stated above, one after another, through the aperture 54 into the slideway 31 when the ram is retracted upward above the window 54. This slideway 31 is recessed up the middle, as at 35a, and a raised vertical guide rib 32a on the front surface of the ram 32 is received in and guided for vertical sliding movement by the slideway recess 35a. With the ram elevated, a single staple is thus pushed through the aperture 54 and is pressed, by a later described spring, against the rearwardly facing slideway surface 36a (FIG. 7).

On the subsequent downstroke of the ram, it engages the staple, still in the original preform *s* seen in FIG. 4, and lowers the staple and forms it against the anvil, as presently described in more particular.

25 The ram is lowered as the handles are squeezed together by the upper jaw 15 on the end of the lower handle 12. The extremity of jaw 15 carries a pin 60 which projects through an elongated slot 61 in backplate 36 and reaches with a loose fit into a slightly vertically elongated hole 63 in the top of ram 32. Compression of the handles accordingly moves the ram downwardly in its slideway from its uppermost position (FIG. 4) to its lowermost position (FIG. 5). The extremity of the pin 60 is accommodated by a deep recess 66 in the front plate 34. The ram will be seen to move vertically in a vertical plane. The pin 60, however, moves in an arc, as permitted by its loose coupling to the ram, and the recess 66 in the front plate 34.

35 The lower end of the backplate 36 has a notch 36' at the bottom to pass with a close fit the forwardly projecting anvil 50. Referring now to FIG. 3, the lower edge of front plate 34 is also notched around anvil 50, as at 34a, but this notch is oversize relative to the anvil, so as to afford a front opening slot 34b through which the upper portion of the closed staple can be emitted.

40 The lower end of the ram is bifurcated to provide two depending prongs 68. These prongs are rounded, or may be chamfered, at their lower inner corners, as at 68a. They engage the outer corners of the staple in the slideway after a short downward travel of the ram from

the position of FIG. 4, and then lower the staple, in its original preform, until the staple legs have emerged below the anvil 50, and punctured the skin S, as shown in phantom lines in FIG. 6. Continuing downwards, from the phantom to the full line position of FIG. 6, the ram bends the crown of the staple over the anvil 50, bending it at two new points spaced inward of the original staple legs. Still further movement of the ram closes the staple, as seen at s' in FIG. 5. A slight backward movement of the stapler disengages the anvil from the staple, and leaves the staple in its final position as seen in FIG. 1. This general method of closing a staple is old per se and will not be further described.

It will be understood that in surgical use, the lower end of the depending anvil-carrying leg 46 is pressed down across the incision I in the skin S, the incision being held temporarily closed by conventional procedures. Or it may be placed adjacent fascia to be joined (not shown) beneath the skin, through an incision. It is for the latter purpose that the leg 46 carrying the anvil is given some substantial length, depending upon circumstances. The handles being then squeezed gradually together, the phantom line position of FIG. 6 is reached, in which the two still unbent legs of the original staple form have been driven by the ram into the skin or tissue S. Thereafter, as explained above, the staple is bent by the descending ram prongs first to the full line position of FIG. 6 and then on to the final closed position of FIG. 5.

The means for feeding the staples through the staple feed slot 58 under spring pressure may be very generally conventional, though some unique features have been incorporated. Thus, a stack of staples is backed up by a pusher head 76, slotted as at 76a to ride on rails 52. This pusher head is drilled to receive with a sliding fit a shaft 77, headed on its forward end so the latter cannot pass through the pusher head. The rearward end of the shaft 77 is tightly fitted to an exterior knob 78, and a coil spring 79 encircles shaft 77 between the pusher head 76 and the knob 78. The staples are loaded into the feed slot 28 first, and the assembly of pusher head 76, shaft 77, spring 79, and knob 78 then installed afterwards. The knob abuts the rearward end of the housing 20, and is accommodated by an arched recess 80 in the underside of the jaw 14. The wall portion forming this arched recess is notched on one side to receive a radial pin 82 projecting from knob 78, and by turning the knob, this pin enters said notch, which holds the assembly of parts 76-78 in place against the compression of spring 79. The pressure of the spring is thus exerted against the staples.

It will be seen that one staple will be advanced by this spring pressure each time the ram is raised above the window 86.

The window 86 seen in the front plate 34 is not essential, but useful in viewing the ram as it comes down to see that a staple is coming down ahead of it, thus signifying that the implement is loaded.

The jaws are equipped with a yieldable coil spring 89 to load or bias the jaws toward their open position. To prevent these jaws from coming apart once the handles have been squeezed to start a staple down by the ram, particularly when the staple has been lowered far enough for another staple to be advanced into the slide-way, I provide some form of ratchet which prevents the jaws, once started toward one another, from re-opening until they have completed their closing stroke.

In the particular device here shown, a ratchet bar 90 depends from the underside of the upper handle, and has upwardly directed ratchet teeth 91 along its rearward edge, along an arc struck from the axis of the handle pivot as a center. A double-armed pawl mounting bracket 92 is mounted on and extends upwardly from the upper side of the lower handle, and a pawl 94 is pivoted on and between the upper ends of the arms of this bracket, the pawl pointing normally toward the pivot 13. It is yieldably held in this normal position by a small coil spring 95 connected at one end to the bracket 92 and at its other to a tail piece 96 on the pawl. The two connection points of the spring are of course normally aligned with the pivot axis 97 of the pawl 94.

Assume the handles have been squeezed together until, for example, the point of the pawl is engaged between the second and third ratchet teeth from the bottom. The pawl has been rocked counter-clockwise, so it is pointing downward, and the connection point between the tail of the pawl and the upper end of the spring 95 has been deflected to the right. The spring 95 is then exerting force to move the pawl in a clockwise direction, back up to its position pointing to axis 13. The upwardly directed ratchet teeth, however, prevent the point of the pawl from elevating sufficiently (clockwise) to reach the position pointing directly at the pivot axis 13, and the pawl is hence locked in its downwardly pointing position. The handles are thus prevented from moving in the re-opening direction. In another manner of description, the distance from the bottom of the notch between the two teeth engaged by the pawl is too great for the pawl to return to its neutral position, and the spring 95 keeps it engaged between the pawl teeth. Continued squeezing of the handles, however, is permitted as there is nothing to prevent the pawl from making successive arcuate counter-clockwise motions as the pawl rides upward over the ratchet teeth under the force of the tautened spring 95.

Once the handles have been closed, the pawl clears the upper ratchet teeth. The pawl again points toward the pivot 13, the handles 11 and 12 being released, spread apart under the influence of the spring 89. In this spreading motion, the pawl engages the ratchet teeth progressively in a downward direction. As the point of the pawl engages each ratchet tooth, the pawl swings clockwise, and the point of connection of the pawl's tail piece 96 to the spring 95 deflects from its normal position a short distance to the left, so there is a counter-clockwise spring restoring moment on the pawl. In this situation, point of the pawl can swing upwards and clockwise to permit it to pass the successive ratchet teeth.

It will be seen that the novel staple inserting implement of the invention is relatively simple and inexpensive to manufacture, involves no expensive throw-away parts, such as cartridges, and is of improved simplicity and control in many cases from the standpoint of the surgeon. Being operable by pliers-like handles, the surgeon is enabled to position the implement very accurately with reference to the tissue to be stapled, and then to apply the staple under closely controlled conditions as he squeezes the handles.

For convenience, in the drawings, specification and in the claims, the implement is described with reference to such terms as horizontal, vertical, upper and lower, but it will be understood that these references are for convenience of description only, and that the

implement may be used in any orientation depending upon the location of the incision. No limitation to any particular orientation is accordingly to be implied.

It will be understood that the present embodiment is for illustrative purposes only and is subject to various changes in design, structure and arrangement without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A surgical stapling instrument for applying staples to unite skin or fascia, comprising:

a pair of horizontally elongated pliers-like members pivoted together between their ends at a horizontal pivot axis and formed to provide on one side of said axis upper and lower pliers-like handles and, on the other side of said axis, corresponding lower and upper jaw-like arms which close and open with jaw-like movements as the handles are closed and opened;

a staple housing fixed on said lower arm generally longitudinally thereof having a staple feedway extending longitudinally therethrough, said feedway terminating in an exit aperture facing generally in a direction away from said pivot axis;

spring means for urging a stack of staples along said feedway and out of said exit aperture;

an elongate, generally vertical staple and ram guide mounted on said lower arm over said feedway exit aperture and extending upwardly from said lower arm adjacent and past the extremity of said upper arm,

said guide having opposed, spaced, forward and rearward walls defining a generally vertical guideway for a single staple and a ram thereabove, said exit aperture of said feedway opening into said guideway in opposition to the inner face of said forward wall, whereby staples from said feedway may be moved by the pressure of said spring through said exit opening and into said guideway and be spring-pressed against said inner face,

a ram vertically reciprocable in said guideway, an operative connection between said upper pliers arm and said ram, whereby closure of said handles drives said ram downwardly in said guideway to engage and lower the staple,

said guideway extending downwardly through the lower end of said guide,

a staple forming anvil supported on said end of said lower arm in alignment with said guideway; and

forming means on the lower end of said ram cooperable with said anvil to progressively close said staple around said anvil as said handles are closed, said anvil being dimensioned for disengagement from within the staple when the staple has been closed thereabout.

2. The instrument according to claim 1, wherein:

said forward wall of said guide has said guideway sunk therein immediately inwardly of a substantially plane backface thereof, and said ram is flat and of a thickness to be slidably receivable in said guideway inside the plane of said substantially plane back face of said forward wall, and

said rearward wall of said guide being substantially the thickness of a staple wire, and substantially flat, and having a staple passing window registered with said exit aperture of said housing to pass staples

from said exit aperture to said guideway, and to contain one staple until the staple ahead is displaced below said window by said ram and the ram is retracted above said window.

3. The subject matter according to claim 1, including: an extension arm supported by said lower arm and housing for positioning said anvil a predetermined distance downward therefrom.

4. The subject matter of claim 1, wherein said operative connection between said upper pliers arm and said ram comprises a pin projecting from the extremity of said upper arm engaged loosely in an aperture in said ram.

5. The subject matter according to claim 1, wherein the staple feedway in said staple housing is substantially perpendicular to said vertical guideway, and at an acute angle relative to a line from said exit aperture of said feedway to said pivot axis.

6. The instrument according to claim 2, wherein said rearward wall and said forward wall extend downwardly to the lower boundary of said anvil, and have notches in their lower edges to accommodate said anvil, said notch in said forward wall being spaced from said anvil by a clearance distance sufficient for passage of the upper portion of a closed staple therethrough.

7. The instrument according to claim 2, including also:

parallel staple support rails positioned in the staple feedway for engaging staple preforms consisting of a crown and legs bent at right angles thereto, said rails having end portions projecting outside said feedway and terminating within the confines of said staple passing window in said rearward wall.

8. The instrument according to claim 1, including also ratchet means acting during closing of the handles to permit reverse travel of the handles sufficiently for a retraction of the ram to a position clearing the exit aperture of the staple feedway.

9. The instrument according to claim 1, including a ratchet means on one of said handles affording a succession of ratchet teeth, and a spring biased pawl pivotally mounted on the other of said handles engageable successively with said ratchet teeth as the handles are closed, in order to lock said handles against opening movement after engagement with said ratchet teeth, said pawl being rockable, after clearing the last of said succession of ratchet teeth, to pass each of said teeth in succession upon subsequent opening of said handles.

10. The instrument according to claim 1, wherein: said forward wall of said guide has said guideway sunk therein immediately inwardly of a substantially plane backface thereof, and said ram is flat and of a thickness to be slidably receivable in said guideway inside the plane of said substantially plane back face of said forward wall, and said rearward wall of said guide being substantially the thickness of a staple wire, and substantially flat, having a staple passing window registered with said exit aperture of said housing to pass staples from said exit aperture to said guideway, and to contain one staple until the staple ahead is displaced below said window by said ram, and means for constraining said ram to complete its ram driving and forming stroke before it can be retracted above said window.

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