

PATENT SPECIFICATION

(11)

1 583 767

(21) Application No. 30881/77 (22) Filed 22 July 1977

(31) Convention Application No.

742843

(32) Filed 18 November 1976 in

(33) United States of America (US)

(44) Complete Specification Published 4 February 1981

(51) INT. CL.³ A61B 17/10 B25C 5/11

(52) Index at Acceptance
B4C 104 B1A

(72) Inventor: CARL THEODORE BECHT



(54) SURGICAL STAPLING INSTRUMENT

(71) We, SENCO PRODUCTS, INC.,
8485 Broadwell Road, Cincinnati, Ohio 45244,
United States of America, a corporation
organized under the laws of the State of Ohio,
5 United States of America, do hereby declare
the invention, for which we pray that a patent
may be granted to us, and the method by
which it is to be performed, to be particularly
described in and by the following statement:-
10 The invention relates to a surgical stapling
instrument, and more particularly to such an
instrument which may be of a single-use,
disposable nature.

While the stapling instrument of the pre-
15 sent invention may have many applications,
it is particularly adapted for use as a surgical
stapling instrument and will, for purpose of
an exemplary showing, be so described.

While the instrument may be so constructed
20 as to be reusable, its nature is such that it
may be readily produced as a single-use,
disposable instrument and again will be so
described for purposes of an exemplary
showing.

25 Recently surgeons have come more and
more to the use of staples, rather than con-
ventional thread sutures, for closing wounds
or incisions in the skin and fascia of a patient.
This is true largely because the use of staples
30 is a far easier procedure and, of even greater
importance, is very much faster. The use of
staples substantially reduces the time
required for suturing and thus the length of
time the patient must be maintained under
35 anaesthesia.

Prior art workers have developed various
types of surgical stapling instruments,
examples of which are taught in United States
Letters Patent 3,618,842; 3,643,851;
40 3,717,294; 3,837,555 and 3,873,016. In
general, the prior art instruments are complex
in construction and expensive to manufacture.
The instruments do not lend themselves to a
disposable construction. Prior art surgical
45 staplers generally require a magazine or cart-
ridge for the staples and a portion of the
force required to actuate these instruments is
expended in shifting a staple to an anvil
means prior to the formation of the staple
50 about the anvil means. As a result, some prior

art surgical staplers require upwards of 20
pounds force to form and implant a staple.

The present invention provides a surgical
stapling instrument of such simplicity that it
may, if desired, be fabricated in such a way as
to constitute a single-use, disposable instru- 55
ment. The instrument is light weight, easy to
use and requires very little force to operate it.
This is true by virtue of the fact that the
staples are supported by and fed along an
anvil plate. No force is required on the part of
the operator to shift a staple from a cartridge
or magazine to the anvil about which it is
formed. In addition, bending of the crown of
the staple during the forming step is con- 60
trolled. The surgical stapling instrument will
hold more staples than those requiring a staple
cartridge.

According to the invention there is provided
a surgical stapling instrument for forming and 70
implanting a staple in the skin or fascia of a
patient, said instrument comprising a handle
portion and a nose portion, said nose portion
having an anvil plate at the bottom end
thereof, said anvil plate terminating at its 75
forward end in an anvil surface, said anvil
plate being adapted slidably to mount a row
of staples, means constantly to urge and
advance said row of staples along said anvil
plate to place a forwardmost staple of said 80
row on said anvil surface, a staple former
mounted in said nose portion and shiftable
vertically between a normal upper position
closely adjacent said forwardmost staple of
said row and a lower position wherein it 85
forms and implants the forwardmost staple
about said anvil surface, and means to shift
said staple former between said upper and
lower positions thereof.

One embodiment of the invention is now 90
described by way of example, with reference
to the accompanying drawings, in which:-

Figure 1 is a side elevation of the surgical
stapling instrument;

Figure 2 is a cross-sectional elevational view 95
of the instrument;

Figure 3 is a front view of the nose casting
of the present invention;

Figure 4 is a side elevational view of the
nose casting of Figure 3; 100

Figure 5 is a rear elevational view of the nose casting;

Figure 6 is a plan view of the nose casting;

Figure 7 is a cross-sectional view taken
5 along section lines 7-7 of Figure 3;

Figure 8 is a fragmentary elevational view of the rear surface of the nose casting as seen perpendicular thereto;

Figure 9 is a plan view of the anvil plate of
10 the present invention;

Figure 10 is a cross-sectional view taken along section line 10-10 of Figure 9;

Figure 11 is a cross-sectional view taken along section 11-11 of Figure 9;

Figure 12 is a front elevational view of the
15 former of the present invention;

Figure 13 is a top view of the former of Figure 12;

Figure 14 is a fragmentary cross-sectional
20 view taken along section line 14-14 of Figure 2;

Figure 15 is a fragmentary cross-sectional view taken along section line 15-15 of Figure 2;

Figure 16 is an enlarged fragmentary cross-sectional view of the nose portion and the lower handle portion of the surgical instrument, illustrating the parts thereof in their normal positions;

Figure 17 is a fragmentary cross-sectional view similar to Figure 16 and illustrating the parts in their respective positions immediately after the forming of a staple;

Figure 18 is a fragmentary elevational view, partly in cross-section, of the nose portion of the instrument, illustrating a staple in fully formed condition;

Figure 19 is a fragmentary front elevational view of the nose portion of the surgical
40 stapling instrument;

Figure 20 is a fragmentary front elevational view of the handle portion and actuator of the surgical stapling instrument;

Figure 21 is a cross-sectional view taken
45 along section line 21-21 of Figure 1;

Figure 22 is a fragmentary cross-sectional view similar to that of Figure 21 and illustrating the latch means in its unlatched condition;

Figure 23 is a fragmentary elevational view, partly in cross-section, of the handle portion illustrating a part of the latch means of the present invention;

Figure 24 is a fragmentary elevational view of the actuator illustrating another portion of the latch means;

Figure 25 is a plan view of the feeder shoe of the present invention;

Figure 26 is a cross-sectional view taken along section line 26-26 of Figure 25;

Figure 27 is a rear elevational view of the feeder shoe;

Figure 28 is a front elevational view of the feeder pawl of the present invention;

Figure 29 is a side elevational view of the
65 feeder pawl of Figure 28.

Throughout the various figures, like parts have been given like index numerals. For an initial, basic understanding of the surgical instrument of the present invention, reference is first made to Figures 1 and 2. The instrument is generally indicated at 1 and comprises a handle portion generally indicated at 2 and a nose portion generally indicated at 3. The nose portion 3 is captively mounted in the handle portion 1 and is preferably rotatable with respect thereto. The handle portion 1 is hollow and an actuator 4 is pivotally mounted therein. The actuator 4 is shiftable between a normal position as shown in Figures 1 and 2 wherein the majority of the actuator extends outwardly of handle portion 2 and a working position wherein the majority of the actuator is located within handle portion 2. The actuator 4 cooperates with a spring loaded plunger 5 to which a staple former 6 is operatively connected. Thus, shifting of the actuator 4 from its normal to its working position will result in the depression of plunger 5 and, as a consequence, the shifting of the staple former 6 from a normal retracted position downwardly to a staple forming position.

The bottom end of nose portion 3 supports an anvil plate 7 which, at its forwardmost end, provides an anvil surface with which the staple former cooperates to form a staple thereabout. A row of staples straddles and is supported by the anvil plate. The staples are urged toward the forward end of anvil plate 7 by a feeder shoe 8 which also straddles the anvil plate behind the row of staples and a cooperating, spring-loaded feeder pawl 9.

In the disposable version of the surgical stapling instrument of the present invention, the handle portion 2 may be made up of two halves 2a and 2b. The halves may be moulded of any appropriate plastics material characterized by sufficient strength and the ability to withstand appropriate sterilization techniques. Handle halves 2a and 2b are essentially mirror images of each other and may be permanently joined together in any suitable manner including well known welding techniques applied to plastics materials. In use, the operator will grasp handle portion 2 about the body thereof with the enlarged upper end of the handle portion (see Figures 1, 2 and 20) extending above his hand.

When the handle halves 2a and 2b are joined together, the handle portion itself is substantially hollow. Along one side of the handle portion, the handle halves are so configured as to define an elongated opening 10 through which actuator 4 extends.

The actuator 4 comprises an integral, one-piece, moulded member which may be of the same plastics material as that used for handle halves 2a and 2b. The actuator is provided with mould cavities 11, 12, and 13, separated by integral reinforcing ribs 14 and 15 (see Figure 130

2). At its upper end, the actuator has an up-
standing lug 16 which will cooperate with the
inside surface of handle portion 2 at the
uppermost end thereof to determine the
normal position of the actuator. This is illus-
trated in Figure 2. At its lower end, the actu-
ator 4 is provided with a transverse perforation
17 adapted to receive a pivot pin 18. The
pivot pin 18 may be a separate member,
having one end received in a bore in a boss 19
formed on the interior of handle half 2a and
its other end received in a similar bore in a
similar boss (not shown) formed on the
inside surface of handle half 2b. Alternatively,
pivot pin 18 may constitute an integral part
of one of the bosses of one of the handle
halves with its free end received in a bore in
the boss of the other handle half. At their
upper ends, handle halves 2a and 2b will have
integral, internal ribs 20 and 21, respectively,
(see Figures 2 and 23) which will guide the
upper end of actuator 4, preventing lateral
shifting or wobbling thereof. The lowermost
end of actuator 4 has an arcuate nose 22
adapted to cooperate with plunger 5, as will
be described hereinafter.

At the lower end of handle portion 2, the
handle halves 2a and 2b are so configured as
to provide, when assembled, a bore 23 having
an annular rib 24 formed therein. The bore
23 is adapted to receive the upper end of nose
portion 3 which is held therein by rib 24, as
will be described hereinafter.

Attention is now directed to Figure 3
through 8 which illustrate the body element
25 of nose portion 3. As in the case of actu-
ator 4 and handle portion 2, the nose body
element 25 may, when the surgical stapling
instrument is intended to be a single-use
instrument, be moulded of an appropriate
plastics material, which may be the same
material from which the actuator 4 and handle
halves 2a and 2b are moulded. The nose
body element 25 has an upper portion 26 of
cylindrical configuration. The portion 26 has
an outside diameter so sized as to be received
within the bore 23 of handle portion 2. The
cylindrical portion 26 is rotatable within the
bore 23 with a frictional engagement such that
the nose portion 3 may be turned to any
angular relationship with respect to handle
portion 2 (throughout 360°), and will remain
at the desired angular relationship. Cylindrical
portion 26 has a groove 27 thereabout,
adapted to receive the annular rib 24 of
handle portion 2, rendering nose portion 3
captive with respect to handle portion 2.

Beneath cylindrical portion 26, the nose
body element 25 comprises a pair of down-
wardly depending walls 28 and 29 in parallel
spaced relationship. The walls 28 and 29 are
joined together near the bottom front portion
of nose body element 25 by an integral web
30. As is most clearly shown in Figures 4 and
5, the bottom edges of walls 28 and 29 slope

upwardly and rearwardly. The rearward edges
of walls 28 and 29 slope upwardly and
forwardly while the forward edges of these
walls are substantially vertical, except near
the bottom where they slope downwardly and
inwardly as shown in Figure 4. Wall 28, on its
inside surface, has an upwardly and rearwardly
extending flange 31 which constitutes a con-
tinuation of web 30. As is most evident from
Figures 5 and 8, the flange 31 is spaced up-
wardly from the bottom edge of wall 28 and
extends parallel thereto. Wall 29 has a corres-
ponding flange 32. The flanges 31 and 32
define a channel 33 therebetween.

Referring primarily to Figures 4, 5 and 8,
the wall 29 has a portion of thinner dimension
34 along its bottom edge. The portion 34
extends from the rear of nose body element
25 to a stop surface 35. The portion of lesser
thickness 34 is separated in part from the
remainder of wall 29 by a notch 36 which
extends from the rear surface of nose body
element 25 downwardly and forwardly to the
stop surface 35.

The exterior surface of wall 28 is substan-
tially a mirror image of the exterior surface of
wall 29. To this end, wall 28 has a thinner
portion 37 corresponding to the portion 34 of
wall 29. The wall 28 also has a stop surface 38
corresponding to stop surface 35 and a notch
39 corresponding to notch 36.

Referring particularly to Figures 3, 4, 6 and
7 the forward or front end of body element
25 is provided with an inset planar surface 40
which extends from the web 30 near the
bottom of body element 25 up walls 28 and
29 and along the majority of cylindrical
portion 26. As is most clearly seen in Figures
6 and 7, the planar surface 40 is flanked by
vertically extending walls or shoulders 41 and
42. The shoulders 41 and 42 are of a width
slightly greater than the thickness of the
former (to be described) and they, together
with the planar surface 40 and the front
cover of the nose (to be described) define a
former track 40a within which the former 6
may shift vertically.

Adjacent shoulders 41 and 42, the forward
portions of walls 28 and 29 are provided with
coplanar surfaces 43 and 44, these surfaces
also extending upwardly along a majority of
the cylindrical portion 26. The coplanar sur-
faces 43 and 44 are, themselves, flanked by
vertical wall portions 45 and 46, respectively,
formed on walls 28 and 29 and oriented
perpendicular to the coplanar surfaces 43 and
44. The coplanar surfaces 43 and 44 and the
flanking walls 45 and 46 define an elongated
socket into which the front cover 47 of nose
portion 3 is located. The front cover 47 is
clearly shown in Figures 2, 16, 17 and 19. The
cover may be moulded of the same plastics
material as is handle portion 2, actuator 4 and
nose body element 25 and may be perma-
nently attached to the nose body element

25 by any suitable means including welding or the like. As is shown in Figure 19, the front cover 47 has a rectangular notch 48 formed in the bottom edge thereof through which a fully formed staple may be released from the surgical stapling instrument, again as will be described hereinafter.

Figures 9 through 11 illustrate the anvil plate 7 of the instrument. The anvil plate 7 is preferably made of metal such as stainless steel and has a longitudinal planar central portion 49. Longitudinally extending portions 50 and 51 depend downwardly from the central portion 49 to coplanar portions 52 and 53 which are parallel to central portion 49. The portions 52 and 53, in turn, are flanked by upstanding portions 54 and 55 which terminate in intumed portions 56 and 57, respectively.

The central planar portion 49 is extended as at 58 and terminates in a slightly upturned, narrower portion 59 constituting the anvil surface about which the staples are formed by the former. The planar portion 49 may be provided with an elongated depression or dimple 60 to strengthen the structure. As is most evident from Figures 9 and 10, the upstanding portion or side wall 55 of the anvil plate terminates at the forward end of the anvil plate in a downwardly and forwardly sloping surface 61. The upstanding portion or side 54 of the anvil plate terminates in a similar downwardly and forwardly sloping surface 62.

A comparison of the shape of the nose body element 25 as revealed in Figure 8 and the configuration of the anvil plate 7 as shown in Figure 11 will make it immediately clear that the anvil plate is adapted to slip onto the bottom end of the nose body element 25 as shown in Figure 15. Thus, intumed flange 57 of anvil plate 7 is adapted to be received in the slot 39 of wall 28. The portions 51, 53, 55 and 57 surround the narrower portion 37 of wall 28. In similar fashion, the anvil plate intumed flange 56 is adapted to be received within slot 36 of wall 29, the anvil plate portions 50, 52, 54, and 56 surrounding the narrower portion 34 of wall 29. The central planar portion 49 of the anvil plate lies in parallel spaced relationship to the interior flanges 31 and 32 of the nose body element 25. The flanges 31 and 32 are spaced above the anvil plate portion 49 by an amount slightly greater than the diameter of the staples.

When the anvil plate 7 is fully seated on the nose body element 25, the forwardly and downwardly sloping edge 62 of the anvil plate will abut the stop surface 35 of wall 29. This is illustrated in Figure 1. In similar fashion, the downwardly and forwardly sloping edge 61 of the anvil plate will abut the stop surface 38 of wall 28. Thus, the fully seated position of the anvil plate is predetermined in such a way that the anvil surface 59 under-

lies the former track and hence the former, as will be described hereinafter. The nose body element 26 may be provided with a rear cover plate, again moulded of the same material as the nose body element 25, itself. Once the anvil plate 7 is properly located on the nose body element 25 and the staples are mounted on the anvil plate, the rear cover, shown at 63 in Figures 1, 2, 16 and 17 may be permanently affixed to the rear of the nose body element 25 again by any appropriate means such as welding or the like. The rear cover 63 may be hooked-shape at its bottom edge as at 64 to underlie the anvil plate 7 to assure that it is properly secured in place.

The individual staples are located in a row one-behind-the-other on the anvil plate, straddling the central portion 49 thereof. As is evident from Figure 15, the staples underlie the flanges 31 and 32 of walls 28 and 29 of the nose body element 25. The clearance between the flanges 31 and 32 and the central portion 49 of the anvil plate is such that the staples may be advanced forwardly toward the front of the surgical stapling instrument therebetween. The row of staples is generally indicated at 65 in Figures 16 and 17. As is most clearly shown in Figure 16, the forwardmost staple 65a is located on the anvil forming surface 59 of anvil plate 7. Further forward movement of staple 65a is precluded by the fact that the staple, in its unformed condition, is too wide to pass through the notch 48 in the front cover 47 of the nose portion 3 (see Figure 19). It will be noted from Figure 16 that the front cover 47, on its rearward face has an extension 47a which is directed inwardly and is of a thickness approximating that of the staple former. The extension 47a is spaced upwardly from the anvil forming surface 59 of anvil plate 7 by a distance approximately 25 per cent greater than the wire diameter of the crown of the staple 65a so that it will control the amount of bending of the staple crown during the formation of staple 65a, as will be described hereinafter.

The feeder shoe 8 and feed pawl 9 (see Figures 2 and 16) are provided to assure that the row of staples 65 is constantly urged toward the anvil forming surface 59 and that the staples are advanced after each staple forming operation. The feeder shoe 8 is most clearly shown in Figures 25 through 27. The feeder shoe comprises a planar body portion 66 with downwardly depending edge portions 67 and 68. As a consequence, the feeder shoe 8 has an inverted U-shaped configuration closely approximating the configuration of the staples themselves. The forwardmost ends of the downwardly depending edge portions 67 and 68 slope downwardly and forwardly as at 67a and 68a so that the legs of the row of staples 65 will be vertically oriented and in proper position for forming when each staple

(13)

reaches the anvil forming surface 59. The forwardmost edge of the planar portion 66 is similarly sloped as to 66a, but the central portion thereof is additionally provided with a reverse slope as at 66b to accommodate the anvil forming surface 59 when the feeder shoe is in its forwardmost position. The feeder shoe will straddle the central portion 49 of the anvil plate 7 as shown in Figure 15. At its rearward edge, the planar portion 66 of the feeder shoe is provided with an integral, upstanding lug 69. A gusset 70 is formed at the juncture of lug 69 and planar surface 66 to strengthen the upstanding lug 69. Preferably, the feeder shoe 8 is made of metal such as stainless steel or the like, as is true of the anvil plate 7.

The feeder pawl 9 is illustrated in Figures 28 and 29. The feeder pawl comprises an elongated member the body of which has a width substantially equal to the slot 33 defined by flanges 31 and 32 of the nose body element 25 and the bottom end of the pawl is receivable therebetween. The bottom end terminates in a foot 71 adapted to contact the rear surface of the upstanding lug 69 of the feeder shoe.

On either side, the feeder pawl is provided with extensions 72 and 73 so that, at the position of these extensions, the feeder pawl will have a width substantially equal to the distance between the inside surfaces of the walls 28 and 29 of the nose body element 25. At its upper end, the feeder pawl is provided with a transverse perforation 74, surrounded on either side of the pawl by annular flanges 75 and 76. The flanges 75 and 76 together with extensions 72 and 73 will preclude lateral play of the feeder pawl within the nose portion 3 of the surgical stapling instrument. As is evident from Figure 16, the feeder pawl is pivotally mounted within the nose portion 3, a pivot pin 77 extending through the perforation 74 in the upper end of the feeder pawl. The ends of pivot pin 77 are supported by the walls 28 and 29 of the nose body element 25. The foot portion 71 of the feeder pawl is located behind the upstanding lug 69 of feeder shoe 8. A spring 78 is mounted on pivot pin 77. One end 78a of spring 78 abuts the inside upper surface of the nose body element 25 between the walls 28 and 29 thereof. The other end 78b of spring 78 abuts the rear edge of the feeder pawl 9, so that the feeder pawl is constantly urged to pivot forwardly or clockwise, as viewed in Figures 2 and 16, to advance the feeder shoe 8 and hence the row of staples 65. The fully advanced positions of the feeder shoe 8 and feeder pawl 9 are shown in broken lines at 8a and 9a, respectively, in Figure 16.

The structure thus far described is completed by the plunger and former assembly. Reference is now made to Figure 16. It will be noted that the upper cylindrical portion 26

of the nose body element 25 is provided with a cylindrical bore 79. A hollow cylindrical plunger 80 is slidably mounted within the bore 79. The plunger 80 is open at its lower end and closed at its upper end. The upper end is contacted by the arcuate nose 22 of actuator 4.

A compression spring 81 is located within the bore 79 of the nose portion body element 25 and within the hollow plunger 80. The upper end of spring 81 abuts the upper closed end of plunger 80 while the lower end of spring 81 abuts the bottom of bore 79 in body element 25. The spring 82 constantly urges plunger 80 upwardly and maintains contact between it and the foot 22 of actuator 4. The plunger 80 may be moulded of the same plastics material as the nose portion body element 25.

The staple former 6 is illustrated in Figures 12 and 13. The former comprises an elongated member, preferably made of metal such as stainless steel or the like. At its upper end 6a and its lower end 6b the former is of a width to be just nicely received within former track 40a and slidable therein. At its lower end 6b, the former is provided with a rectangular notch 82 providing bifurcations 83 and 84 which perform the actual staple forming. The bifurcations 83 and 84 may be slightly relieved as at 85 and 86 to more readily initiate the forming action and to prevent damage to the staples.

The upper end 6a of former 6 has a pair of perforations 87 and 88. The web 89 therebetween is deformed so as to provide a rearwardly extending dimple or lug. As is most clearly shown in Figure 16, the lug 89 is intended to be received with a notch or depression 90 in plunger 80. The engagement of former lug 89 in plunger notch 90 is made possible by virtue of the fact that the cylindrical portion 26 of the nose body element 25 is provided with a window or opening 91 in the forward portion of its peripheral surface. The window 91 is most clearly seen in Figure 3.

The basic parts of the surgical stapling instrument of the present invention having been set forth, its operation may be described as follows. It will be understood that during assembly of the surgical stapling instrument, the instrument will be provided with the row 65 of staples and the entire assembly will be subjected to appropriate sterilization procedures. These procedures are well known in the art and do not constitute a part of the present invention.

The operator may adjust nose portion 3 with respect to handle portion 2 to achieve the desired rotational relationship between these elements. For example, the surgical stapling instrument may be set up as illustrated in Figure 1 so that the handle portion 2 and the hand of the operator will be essentially

parallel to the wound or incision being closed and will be drawn therealong. Alternatively, the operator may prefer to orient the handle and his hand at an angle to the length of the wound or incision. This will, of course, depend upon the nature of the wound or incision, its location on the body of the patient and the personal preference of the operator.

Figures 1, 2 and 16 illustrate the surgical stapling instrument in its normal, unactuated condition. The compression spring 81 within plunger 80 will urge plunger 80 upwardly. This, in turn, will urge actuator 4 in a counter-clockwise direction (as viewed in those Figures) about pivot pin 18. The uppermost position of plunger 80 and the normal position of actuator 4 are determined by the abutment of actuator foot 16 against the inside surface of handle portion 2, at the upper end of opening 10 in the handle portion. With plunger 80 in its uppermost position, the former 6 will also be in its uppermost position. It will be noted from both Figures 14 and 16 that, when the plunger is in its uppermost position it is still spaced slightly from the uppermost end of former track 40a.

The row of staples 65 will be constantly urged toward the anvil forming surface 59 by feeder shoe 8 and feeder pawl 9 under the influence of spring 78. It will be evident that when the surgical stapling instrument of the present invention is in its normal position, there will always be a staple (until row 65 is depleted) located upon the anvil forming surface 59 and beneath the staple retainer 47a on the front closure 47 of the nose portion 3. The forwardmost staple 65a is illustrated in this position in Figure 14. The forwardmost staple 65a will maintain this position by virtue of the fact that, in its unformed condition, it is too wide to pass through the rectangular notch 48 in front cover 47 (as shown in Figure 19). Of particular importance is the fact that the staples in the row 65 thereof are always supported on the anvil plate and no transfer of the staples from a cartridge or the like is required. The advancement of the row 65 of staples is wholly independent from the staple former 6 and the mechanism which actuates it. As a consequence of this, less force is required to actuate the surgical stapling instrument of the present invention and all of the force applied to the actuator is utilized to form and implant the forwardmost staple 65a. This further reduces the length of the stroke required of actuator 4.

Once the sides of the wound or incision have been properly gathered at the position where a staple is to be implanted, the lower front portion of the nose 3 of the instrument is located on that position and the actuator 4 is shifted in the direction of arrow A in Figure 1. This clockwise pivoting of the actuator (as viewed in Figures 1, 2 and 16) about pivot pin 18 will cause the arcuate foot 22 of the

actuator to depress plunger 80 against the action of compression spring 81. This downward movement of plunger 80 will simultaneously cause a downward movement of former 6 (see Figure 17). As will be evident from a comparison of Figures 14 and 16 and Figures 17 and 18, the downward movement of former 6 will cause its bifurcations 83 and 84 to engage the outermost portions of the crown of staple 65a and will bend these portions about the staple forming surface 59 of anvil plate 7. As a result, the original downwardly depending portions of forwardmost staple 65a will enter the skin or fascia of the patient and at the same time approach each other, gathering the skin or fascia together. The final shape of the staple at the end of the stroke of the former 6 is illustrated in Figures 17 and 18. The central crown portion of the formed staple will bow slightly, but the amount of this bow is controlled and minimized by the staple retainer lug 47a. A comparison of Figures 18 and 19 will reveal that the formed staple is now of a size and configuration such that it may pass through the rectangular notch 48 in the front closure 47 of the nose portion 3. Upon retraction of former 6 to its upper position shown in Figures 14 and 16, the tendency of the staple legs to spread slightly until the staple crown is relieved of its bow and the action of feeder shoe 8 and feeder pawl 9 will cause the formed staple 65a to be released from between the anvil forming surface 59 and staple retainer lug 47a. The released staple passes readily through the rectangular notch 48 in the front cover 47 or nose portion 3.

Upon release of manual pressure urging the actuator in the direction of arrow A in Figure 1, the compression spring 81 will be free to shift the plunger 80 upwardly. This, in turn, will pivot the actuator in a direction opposite that indicated by arrow A of Figure 1 to its normal, unactuated position as determined by actuator foot 16. The upward movement of the plunger will also shift the staple former upwardly. Upon release of the formed staple from between the staple retainer lug 47a and the anvil forming surface 59 of anvil plate 7, the next staple in the row 65 thereof will shift to its ready position between anvil surface 59 and the staple retainer lug 47a so that the stapling operation can be repeated at the will of the operator.

It is within the scope of the present invention to provide a safety latch means for the actuator, to prevent inadvertent operation of the surgical stapling instrument. Reference is now made to Figures 1, 20 through 24, wherein an exemplary safety latch means is illustrated. As is most clearly shown in Figures 21 and 23, the handle half 2b may be provided on its interior surface with an enlarged boss 91 located at the forward end of the internal reinforcing rib 21 and near the opening 10 in

70

75

80

85

90

95

100

105

110

115

120

125

130

the forward edge of the handle half. The enlarged boss has a perforation 92 extending therethrough. The perforation 92 has a portion 93 of enlarged diameter. A push button 94 is located in the perforation 92. The push button has an annular flange 95 at its rearward end which is accommodated in the enlarged diameter portion 93 of perforation 92 (see Figure 21). The boss 91 also has a notch 96 formed therein. The notch 96 intersects the large diameter portion 93 of the perforation 92.

Turning now to Figure 24, the side of the actuator 4 which lies adjacent handle half 2b is provided with a pair of spaced notches 97 and 98. Between notches 97 and 98 there is a web 99 of lesser thickness than the normal wall thickness of the wall actuator, the web 99 terminates in a hook-like element 100.

Figure 21 illustrates the handle portion 22 with the actuator 4 in its normal position. It will be immediately evident that the button 94 is captive in perforation 92 since the flange portion 95 of the button is of greater diameter than the perforation 92 and since the button will be retained within perforation 92 by actuator 4. With the actuator 4 in its normal position as illustrated in Figure 21, the hook-like element 100 is engaged in the notch 96 of boss 91. This engagement will maintain the actuator in its normal position.

When the surgical stapling instrument is to be actuated, the operator will grasp the handle portion 2 in such a way as to depress button 94. This, in turn, will lift the hook-like element 100 out of notch 96 through a bending action of the web 99. Once this is done, the actuator 94 is free to be shifted to its working position resulting in the implanting and forming of a staple. During this movement of the actuator, the hook-like element 100 will simply ride along the edge of the rib 21 of handle half 2b. When the actuator returns to its normal position it will not be locked so long as the button 94 is maintained in its depressed position as illustrated in Figure 22. Should the button 94 be released by the operator, however, the actuator will be latched as shown in Figure 21.

The surgical stapling instrument of the present invention has been described in its form as a single-use, disposable instrument. Under these circumstances, only springs 78 and 81, anvil plate 7, feeder shoe 8 and former 6 are made of metal. The former 6, anvil plate 7, and feeder shoe 8 are preferably made of stainless steel. The remainder of the structure may be made, as indicated above, of any appropriate plastics material having sufficient strength characteristics and capable of withstanding appropriate sterilization procedures. Excellent results have been achieved, for example, when these remaining parts of the surgical stapling instrument have been moulded of nylon, polysulfone, or the like.

The surgical stapling instrument may, of course, be manufactured as a non-disposable instrument, the parts being made of appropriately selected materials. In such an instance, the rear cover 63 of nose portion 3 should be made removable and preferably the front cover 47 will also be removable. The covers 63 and 47 may be affixed to the nose body element 25 under these circumstances by screws or the like. This would enable the various parts to be replaced and repaired and an additional supply of staples to be located on anvil plate 7.

While the surgical stapling instrument of the present invention has been described and illustrated as utilizing conventional surgical staples, the device may readily be modified to utilize surgical staples of the type taught in U.S. Patent No. 4,014,492. Under these circumstances, it would only be necessary to modify the configuration of the inside surfaces of the portions 34 and 37 of the walls 29 and 18 of nose body element 25 and the underside of the nose body element flanges 31 and 32 to accommodate staples of that configuration. In all other respects, the surgical stapling instrument of the present invention would be, and would operate, as described above.

WHAT WE CLAIM IS:-

1. A surgical stapling instrument for forming and implanting a staple in the skin or fascia of a patient, said instrument comprising a handle portion and a nose portion, said nose portion having an anvil plate at the bottom end thereof, said anvil plate terminating at its forward end in an anvil surface, said anvil plate being adapted slidably to mount a row of staples, means constantly to urge and advance said row of staples along said anvil plate to place a forwardmost staple of said row on said anvil surface, a staple former mounted in said nose portion and shiftable vertically between a normal upper position closely adjacent said forwardmost staple of said row and a lower position wherein it forms and implants the forwardmost staple about said anvil surface, and means to shift said staple former between said upper and lower positions thereof.

2. A surgical stapling instrument as claimed in claim 1, wherein said means to constantly urge and advance said row of staples along said anvil plate toward said anvil surface is independent of said means to shift said staple former.

3. A surgical stapling instrument as claimed in claim 1, including staple retaining means overlying said anvil surface to control the amount of bending of the crown portion of the staple being formed by said staple former.

4. A surgical stapling instrument as claimed in claim 1 wherein said nose portion is rotatable through 360° with respect to said handle portion whereby said surgical stapling instrument may be used in various



159

he forward edge of the handle half. The enlarged boss has a perforation 92 extending therethrough. The perforation 92 has a portion 93 of enlarged diameter. A push button 94 is located in the perforation 92. The push button has an annular flange 95 at its rearward end which is accommodated in the enlarged diameter portion 93 of perforation 92 (see Figure 21). The boss 91 also has a notch 96 formed therein. The notch 96 intersects the large diameter portion 93 of the perforation 92.

Turning now to Figure 24, the side of the actuator 4 which lies adjacent handle half 2b is provided with a pair of spaced notches 97 and 98. Between notches 97 and 98 there is a web 99 of lesser thickness than the normal wall thickness of the wall actuator, the web 99 terminates in a hook-like element 100. Figure 21 illustrates the handle portion 22 with the actuator 4 in its normal position. It will be immediately evident that the button 94 is captive in perforation 92 since the flange portion 95 of the button is of greater diameter than the perforation 92 and since the button will be retained within perforation 92 by actuator 4. With the actuator 4 in its normal position as illustrated in Figure 21, the hook-like element 100 is engaged in the notch 96 of boss 91. This engagement will maintain the actuator in its normal position.

When the surgical stapling instrument is to be actuated, the operator will grasp the handle portion 2 in such a way as to depress button 94. This, in turn, will lift the hook-like element 100 out of notch 96 through a bending action of the web 99. Once this is done, the actuator 94 is free to be shifted to its working position resulting in the implanting and forming of a staple. During this movement of the actuator, the hook-like element 100 will simply ride along the edge of the rib 21 of handle half 2b. When the actuator returns to its normal position it will not be locked so long as the button 94 is maintained in its depressed position as illustrated in Figure 22. Should the button 94 be released by the operator, however, the actuator will be latched as shown in Figure 21.

The surgical stapling instrument of the present invention has been described in its form as a single-use, disposable instrument. Under these circumstances, only springs 78 and 81, anvil plate 7, feeder shoe 8 and former 6 are made of metal. The former 6, anvil plate 7, and feeder shoe 8 are preferably made of stainless steel. The remainder of the structure may be made, as indicated above, of any appropriate plastics material having sufficient strength characteristics and capable of withstanding appropriate sterilization procedures. Excellent results have been achieved, for example, when these remaining parts of the surgical stapling instrument have been moulded of nylon, polysulfone, or the like.

The surgical stapling instrument may, of course, be manufactured as a non-disposable instrument, the parts being made of appropriately selected materials. In such an instance, the rear cover 63 of nose portion 3 should be made removable and preferably the front cover 47 will also be removable. The covers 63 and 47 may be affixed to the nose body element 25 under these circumstances by screws or the like. This would enable the various parts to be replaced and repaired and an additional supply of staples to be located on anvil plate 7.

While the surgical stapling instrument of the present invention has been described and illustrated as utilizing conventional surgical staples, the device may readily be modified to utilize surgical staples of the type taught in U.S. Patent No. 4,014,492. Under these circumstances, it would only be necessary to modify the configuration of the inside surfaces of the portions 34 and 37 of the walls 29 and 18 of nose body element 25 and the underside of the nose body element flanges 31 and 32 to accommodate staples of that configuration. In all other respects, the surgical stapling instrument of the present invention would be, and would operate, as described above.

WHAT WE CLAIM IS:-

1. A surgical stapling instrument for forming and implanting a staple in the skin or fascia of a patient, said instrument comprising a handle portion and a nose portion, said nose portion having an anvil plate at the bottom end thereof, said anvil plate terminating at its forward end in an anvil surface, said anvil plate being adapted slidably to mount a row of staples, means constantly to urge and advance said row of staples along said anvil plate to place a forwardmost staple of said row on said anvil surface, a staple former mounted in said nose portion and shiftable vertically between a normal upper position closely adjacent said forwardmost staple of said row and a lower position wherein it forms and implants the forwardmost staple about said anvil surface, and means to shift said staple former between said upper and lower positions thereof.

2. A surgical stapling instrument as claimed in claim 1, wherein said means to constantly urge and advance said row of staples along said anvil plate toward said anvil surface is independent of said means to shift said staple former.

3. A surgical stapling instrument as claimed in claim 1, including staple retaining means overlying said anvil surface to control the amount of bending of the crown portion of the staple being formed by said staple former.

4. A surgical stapling instrument as claimed in claim 1 wherein said nose portion is rotatable through 360° with respect to said handle portion whereby said surgical stapling instrument may be used in various



* C L M S *

attitudes.

5. A surgical stapling instrument as claimed in claim 1 including releasable latch means to prevent inadvertent actuation of said means to shift said staple former.

6. A surgical stapling instrument as claimed in claim 3 wherein said means to constantly urge and advance said row of staples along said anvil plate towards said anvil surface is independent of said means to shift said staple former.

7. A surgical stapling instrument as claimed in claim 3 including a plunger mounted in said nose portion and shiftable vertically therein between a normal upper position and a lower position, means to urge said plunger to said normal upper position, said staple former being operatively connected to said plunger, said normal upper position of said plunger corresponding to said normal upper position of said former, said lower position of said plunger corresponding to said lower position of said staple former, an actuator pivotally mounted on said handle portion to shift said plunger and hence said staple former between their respective upper and lower positions.

8. A surgical stapling instrument as claimed in claim 3 wherein said staple retaining means is spaced upwardly from said anvil surface by a distance about 25 per cent greater than the wire diameter of said staples.

9. A surgical stapling instrument as claimed in claim 7 wherein said nose portion comprises a body element having a cylindrical portion rotatively mounted in said handle portion and a pair of downwardly depending walls in parallel spaced relationship, forward portions of said walls providing a vertical former track within which said former is slidably mounted, said anvil plate being affixed to the bottom edges of said walls with said anvil surface underlying said former track, said anvil plate having a longitudinally extending raised central portion located between said walls and leading to said anvil surface, said walls each having an internal flange partially overlying said raised central portion of said anvil plate and in parallel spaced relationship thereto, said staples of said row thereof straddling said raised central portion of said anvil plate beneath said wall flanges, said body element having a rear cover extending across the rear edges of said walls and a front cover closing the space between said walls at the front edges thereof, said front cover having a notch at the bottom thereof so dimensioned that the forwardmost staple of said row can pass therethrough only after being formed by said former, said front cover having a lug extending inwardly between said walls for a distance approximating the thickness of said former and constituting said staple retaining means, said cylindrical portion of said body element having an axial bore formed therein, said

plunger comprising a hollow cylindrical element open at its bottom end and closed at its top end and slidably mounted in said bore, a compression spring mounted within said plunger to urge said plunger to said normal upper position, one end of said compression spring abutting the bottom of said bore and the other end of said compression spring abutting the closed top end of said plunger.

10. A surgical stapling instrument as claimed in claim 9 including a feeder shoe straddling said raised central portion of said anvil plate and slidably mounted thereon behind said row of staples, a feeder pawl pivotally mounted between said nose body element walls, spring means urging said feeder pawl against said feeder shoe to urge and advance said row of staples along said anvil plate toward said anvil surface.

11. A surgical stapling instrument as claimed in claim 9 wherein said staple retaining means is spaced upwardly from said anvil surface by a distance about 25 per cent greater than the wire diameter of said staples.

12. A surgical stapling instrument as claimed in claim 10 wherein said handle portion is hollow with an opening in the forward edge thereof, said actuator comprising an elongated member pivoted at its lower end to said handle portion and swingable between a normal position wherein the majority of said actuator is located outside said handle portion and a working position wherein the majority of said actuator lies within said handle portion, the lower end of said actuator having an extension in abutting relationship with said top end of said plunger, said actuator being biased to said normal position by said compression spring and said abutting relationship of said top end of said plunger and actuator extension, said actuator extension being so configured and positioned that when said actuator is shifted to its working position, said extension will shift said plunger to its lower position and hence said former to its staple forming position against the action of said compression spring.

13. A surgical stapling instrument as claimed in claim 12 including a latch means for said actuator to maintain said actuator in its normal position unless released, said latch means comprising a resilient tyne on said actuator, a notch on the inside surface of said handle portion to receive said tyne when said actuator is in said normal position and pushbutton means on said handle portion to remove said tyne from said notch to release said actuator.

14. A surgical stapling instrument as claimed in claim 12 wherein said anvil plate, feeder shoe, former, feeder pawl spring means and compression spring are formed of metal, the remainder of said surgical stapling instrument being moulded of plastics



(17)

material.

15. A surgical stapling instrument as
claimed in claim 1 wherein said former and
said anvil plate are formed of metal, the
remainder of said surgical stapling instrument
being moulded of plastics material.

16. A surgical stapling instrument as
claimed in claim 1 wherein said surgical
stapling instrument is constructed of such
materials that said surgical stapling instru-
ment is a single-use, disposable instrument.

17. A surgical stapling instrument for
forming and implanting a staple in the skin
or fascia of a patient substantially as described
hereinbefore with particular reference to the
accompanying drawings.

15

CARPMAELS & RANSFORD
Chartered Patent Agents,
43 Bloomsbury Square,
London WC1A 2RA
Agents for the Applicants

20