PATENT SPECIFICATION (11) 1 537 089

1 537 089

(21) Application No. 48985/76 (22) Filed 24 Nov. 1976 (19)
(31) Convention Application No. 664 231 (32) Filed 5 March 1976 in
(33) United States of America (US)
(44) Complete Specification published 29 Dec. 1978
(51) INT. CL.² B25C 11/00
(52) Index at acceptance
B4W 1B 5C2 5G 5X1

(54) SURGICAL STAPLE EXTRACTOR

(71) We, SENCO PRODUCTS, INC., a corporation organized under the laws of the State of Ohio, United States of America, of 8485 Broadwell Road, Cincinnati, Ohio 45244, 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:—

The invention relates to a staple extractor, and more particularly to a manually operated extractor for surgical staples.

In recent years surgeons have turned more and more to the use of surgical staples, rather than conventional thread sutures, for closing wounds or incisions in the skin of a patient, because the stapling operation is often simpler. More importantly, however, is the fact that the stapling operation is very much faster than conventional thread suturing. Thus, particularly in those instances where a considerable amount of suturing is required, the length of time for the suturing operation and the length of time the patient must be maintained under anesthesia are greatly reduced when surgical staples are used.

A typical type of surgical staple is illustrated in United States Letters Patent 3,643,851; 3,717,294 and 3,837,555. A staple of the type shown in these patents initially has an elongated crown terminating in downwardly depending portions. The free ends of the downwardly depending portions are provided with downwardly and outwardly sloping cuts, forming points. During the forming and implanting of such a staple in the skin of a patient, end portions of the elongated crown are bent downwardly. This forms a staple with a narrower crown and L-shaped legs, the pointed ends of which are opposed.

Another type of surgical staple is taught in the co-pending application Ser. No. 585,804, filed June 11, 1975 in the name of Robert G. Rothfuss and entitled SURGICAL STAPLE. This staple initially comprises a central crown portion terminating at either end in portions sloping upwardly and outwardly, these upwardly and outwardly sloping portions, in turn, terminate in downwardly and outwardly sloping portions. The last mentioned portions are provded with cut surfaces forming points. These cut surfaces initially lie in a position substantially perpendicular to the staple crown and the skin of the patient to be joined. During forming and implanting of this type of staple, the upwardly and outwardly sloping portions of the staple, at their juncture with the crown, are bent downwardly to form a staple having a crown and L-shaped legs, the points of which are opposed.

Either type of staple described above may be removed from the skin of a patient by bending the staple crown into a U-shaped configuration. This will cause the L-shaped legs of the staple to shift upwardly and outwardly so that they may be lifted from the patient's skin.

Prior art workers have developed manual extractors for bending the crown of surgical staples and lifting the staple from the patients skin. In its typical form, a prior art extractor comprises first and second handle elements pivoted together and formed of sheet metal. The first handle element terminates in a pair of bending members in parallel spaced relationship. The bending members are provided at their rearward ends with notches so that, when the bending members are slipped under the crown portion of a surgical staple, the crown will be received in the notches.

The second handle of the extractor generally is provided with a thick, two-ply, blade at its forward end substantially as long or longer than the bending members. When the handle elements of the extractor are in their open position, this blade lies above the bending members and the notches therein. As the handle elements are shifted to their closed position, the blade element passes between the bending members and the notches therein making the above described U-shaped bend in the staple crown located in the notches.

It will be understood that when the bending members are slipped beneath the crown of a staple, they will rub against traumatized areas of the skin, causing pain to the patient. Since the blade is as long or longer than the

bending members, it partially obscures the bending members, making their proper insertion under the staple crown and location of the staple crown in the bending member notches more difficult. Furthermore, when the extractor bending members are parallel throughout their length, the operator may inadvertently slip only one bending member under the crown of the staple to be extracted. Under these circumstances the staple will not properly open and if the operator pulls the extractor upwardly the patient will undergo severe pain.

When the typical prior art extractor is actuated to bend the crown, clearance between the blade and the bending members is such that the crown tends to make the bending members spread apart, further irritating the traumatized skin. As a further consequence, the legs of the U-shaped bend in the staple crown are generally non-parallel, with the result that the staple legs themselves are not fully opened. In addition, prior art extractors are generally constructed in such a way that the first handle element can inadvertently become "flipped" (or pivoted through more than 180°) with respect to the second handle element, thus rendering the extractor useless until its handle elements are returned to their proper orientation. Finally, prior art extractors are generally provided with means to bias the handle elements to their open position. This biasing means can become dislocated, tending to jam the extractor.

The extractor of the present invention is intended to overcome these problems encounter with prior art extractors. The extractor of the present invention is simple in construction and inexpensive to manufacture either as a single-use, disposable tool or as a sterilizable and reusable tool. The extractor of the present invention will be described in two-piece and three-piece embodiments.

According to the invention there is provided a manually operated surgical staple extractor comprising first and second handle elements joined together by a pivot, said pivot allowing movement between an open position and a closed position, said first handle element having bifurcated forward end, said bifurcations terminating in a pair of elonagted bending members in parallel spaced relationship and adapted to be slipped beneath a crown portion of a surgical staple in the skin of a patient, said extractor being characterized by said bending members having forward ends angled toward each other with the frontmost tips thereof being substantially contiguous, said bending members having rearward ends provided with aligned notches for receiving said crown of a surgical staple, said bifurcations providing an upwardly and rearwardly sloping surface adjacent each said notches to assist in locating said staple crown in said notches a blade being located between said bifurcations of said first handle element, said second handle element being operatively connected at its forward end to said blade, said blade having a nose portion shorter than said bending members and having a lower edge, and said blade nose portion being shiftable by said second handle element between a first position when said handle elements are in said open position wherein said lower edge of said nose lies above said bending members and said notches therein and a second position when said handle elements are in said closed position wherein said nose lies between said bending members with said lower edge below said bending members, there being clearance between said nose portion and each of said bending members.

The clearance is preferably substantially equal to the diameter of a crown portion of a staple, whereby when said pending members are slipped beneath the crown portion of a staple in the skin of a patient with the crown located in said aligned notches and said blade is shifted to its second position by said second handle element, said crown of said stable will be formed into a U-shape causing said L-shaped staple legs to shift upwardly and outwardly enabling them to be lifted from the skin of a patient.

In one embodiment the extractor of the present invention comprises a two-piece tool held together with an appropriate pivot pin, the blade comprising an integral, one-piece part of the second handle element. In another embodiment, the extractor of the present invention comprises a three-piece tool. In this instance, the blade is a separate element affixed between the bifurcations of the first handle element and operatively connected to the forward end of the second handle element. This allows that part of the extractor in contact with the skin of the patient to remain stationary. This, in turn, minimizes extraneous movement of the bending members during the staple extraction helping to minimize the major cause of pain to the patient.

Both embodiments of the extractor of the present invention lend themselves well to manufacture as a single use, disposable tool or as a re-sterilizable, reusable tool.

The invention will now be described with reference to the preferred embodiments as shown in the accompanying drawings, in which:—

Figure 1 is a top view of the extractor of the present invention;

Figure 2 is a side elevational view of the extractor of Figure 1;

Figure 3 is an enlarged fragmentary elevational view of the extractor of Figure 2 illustrating the relative positions of the bend-

ing members and blade prior to the bending of the staple crown;

Figure 4 is an enlarged fragmentary elevational view similar to Figure 3 illustrating the relative positions of the bending members and blade after the bending of the staple crown;

Figure 5 is a fragmentary elevational view, partly in cross section, showing a staple embedded in the skin of a patient;

Figure 6 is a fragmentary elevational view, partly in cross section, illustrating the configuration of the staple after extraction;

Figure 7 is a side elevational view of another embodiment of the extractor of the present invention;

Figure 8 is a bottom view of the extractor of Figure 7;

Figure 9 is an enlarged fragmentary elevational view illustrating the relative positions of the blade and bending members of the extractor of Figures 7 and 8 prior to the bending of the staple crown, and

Figure 10 is a fragmentary elevational view, similar to Figure 9, and showing the relative positions of the blade and bending members after the bending of the staple crown.

The extractor tool of the present invention is best illustrated in Figures 1 and 2. The extractor comprises a first handle element generally indicated at 1 and a second handle element generally indicated at 2. The first handle element 1 is a unitary, one-piece structure folded so as to have an inverted U-shaped cross section, with downwardly depending legs 3 and 3*a*, except at its rearward end which terminates in a broad portion 4 to be engaged by the operator's thumb.

An elongated U-shaped opening 5 is made in the handle element 1 prior to its forming into the above noted U-shaped cross section, so as to provide a resilient tine 6 the purpose of which will be described hereinafter.

Forwardly of opening 5 a portion of the base of the inverted U-shaped cross section remains forming a bridge 7. The legs 3 and 3*a* continue forwardly to provide bifurcations 8 and 9 terminating in elongated bending members 10 and 11. It will be apparent from Figure 1 that bifurcations 8 and 9 and bending members 10 and 11 are in parallel spaced relationship with the forwardmost ends 10*a* and 11*a* of bending members 10 and 11 being angled toward each other with their forwardmost tips being contiguous. At the juncture of bifurcation 8 and anvil 10, a notch 12 is provided. That portion of bifurcation 8 adjacent notch 12 is configured to present upwardly and rearwardly sloping surface 13. In similar fashion, a notch 14 is located at the juncture of bifurcation 9 and bending member 11, the bifurcation 9 providing an upwardly and rearwardly sloping surface 15 equivalent to surface 13 of bifurcation 8.

The second handle element 2 also comprises an integral, one-piece structure the central portion of which is folded into a U-shaped cross section with upwardly extending legs 16 and 16*a* in parallel abutting relationship (see Figure 1). Near the rearward end of handle element 2 the legs 16*a* and 16 flare outwardly to form the wide, hook-shape portion 17 to be engaged by the middle and fourth fingers of the hand of the operator.

At the forward end of handle element 2, leg 16 terminates as at 18 (see Figures 1, 2 and 3). Leg 16*a*, on the other hand, is extended to form a blade 19 having nose portion 20 and lower bending edge 21. As is evident from Figure 1, the continuation of leg 16*a* is offset as at 22 so that the blade 19 extends centrally of the legs 16 and 16*a* of the handle element 2. In this way, a single thickness blade is provided.

By virtue of the fact that legs 16 and 16*a* of handle element 2 are abutting, while legs 3 and 3*a* of handle element 1 are in parallel spaced relationship, the central portion of handle element 2 can be received between the legs 3 and 3*a* of handle element 1. Handle elements 1 and 2 are pivotally joined together by pivot pin or rivet 23.

As will be evident from Figure 2, the upstanding legs 16 and 16*a* of handle element 2 provide a surface 24 along which the resilient tine 6 of handle element 1 can exert pressure. Resilient tine 6 serves to bias handle elements 1 and 2 to their open position, as illustrated in Figures 1 and 2. The surface 24 of handle element 2 in cooperation with les 3 and 3*a* of handle element 1 form a trough-like structure for the free end of tine 6, assuring that the tine cannot become laterally dislocated to jam handle elements 1 and 2. The legs 3 and 3*a* of handle element 1 may be provided with integral tabs 25 and 25*a*, respectively, which cooperate with surface 24 to determine the relative closed position of handle elements 1 and 2.

To better understand the operation of the extractor of Figures 1 through 4, reference is first made to Figure 5. In Figure 5 surgical staple (generally indicated at 26) is shown in its fully formed and implanted condition joining skin segments 27 and 28. It will be noted that the fully formed staple 26 has a crown portion 29 and a pair of L-shaped legs 30 and 31 in opposed position.

The handle elements 1 and 2 of the extractor of the present invention may be grasped by the operator in any convenient fashion. Normally, the operator's thumb will engage the portion 4 of handle element 1 and the operator's middle finger and forth

finger will hook beneath the portion 17 of handle element 2. The first step in the use of the extractor is to insert bending members 10 and 11 beneath the crown 29 of staple 26 until the crown 29 is located in aligned notches 12 and 14 of bending members 10 and 11. This is shown in Figure 3. As is evident from Figures 1 and 3, bending members 10 and 11 and their forward portions 10*a* and 11*a* are elongated, and are of thin enough gauge (as viewed in plan in Figure 1) and of sufficient narrowness (as viewed in side elevation in Figure 3) so as to allow convenient insertion of the bending members 10 and 11 and their forward portions 10*a* and 11*a* underneath the crown of the surgical staple to be extracted. The nose portion 20 of blade 19, being shorter than the bending members 10 and 11, permits the operator to clearly observe the bending members 10 and 11 and the staple 26 during this step. The fact that the bending member tips 10*a* and 11*a* are contiguous enables them to be more easily inserted beneath staple crown 29, and precludes the possibility of only one bending member being inserted under the staple crown 29. The upwardly and rearwardly sloping bifurcation surfaces 13 and 15 serve as stops, assuring that staple crown 29 is properly located in aligned notches 12 and 14. All of these factors materially reduce the pain experienced by the patient during this initial step.

At this point, handle elements 1 and 2 are shifted to their closed position forcing the blade 19 against staple crown 29 and downwardly between bending members 10 and 11. As is shown in Figure 4, this operation produces a U-shaped bend in the crown 29 of staple 26, most clearly illustrated in Figure 6. As is evident from Figure 6, this bending of crown 29 causes legs 30 and 31 to shift upwardly and outwardly, enabling the staple 26 to be pulled upwardly and away from skin segments 27 and 28.

As will be noted in Figure 1, the single thickness blade 19 is free to pass between bending members 10 and 11 with clearance on both sides of blade 19 at the positions of notches 12 and 14 at least substantially equal to the diameter of crown 29 of staple 26. This clearance provides a number of advantages. First of all, the bend in staple crown 29 can be formed with minimal or no spreading of bending members 10 and 11 and their tips 10*a* and 11*a*. This, of course, eliminates a possible source of pain to the patient. In addition, the U-shaped bend in crown 29 (as illustrated in Figure 6) can be formed with substantially parallel upstanding legs 29*a* and 29*b*, assuring that staple legs 30 and 31 will be fully opened and allowing staple 26 to be lifted from skin segments 27 and 28 with minimal pain. Furthermore, the staple 26 can be readily released from the extractor by simply permitting handle elements 1 and 2 to return to their open position (as shown in Figure 2) under the influence of resilient tine 6.

As indicated above, the inwardly bent bending member tips 10*a* and 11*a* facilitate the lining up of the extractor with staple 26 during insertion of the bending members 10 and 11 beneath the staple crown 29. The fact that the bending members 10 and 11 and their tips 10*a* and 11*a* are narrow, as viewed in Figure 3, minimizes trauma in placing them beneath staple crown 29. Since blade 19 comprises a single thickness of the material from which handle element 2 is made, the above described sharper U-shaped bend in staple crown 29 can be made, even in small staples of minimum crown length.

The bridge 7, most clearly shown in Figures 1 and 2, serves a number of purposes. First of all, it assures the proper spacing between the blade 19 and bending members 10 and 11. Furthermore, the bridge renders the structure stronger. Finally, the bridge cooperates with the blade 19, serving as a stop to determine the maximum amount by which handle element 1 can be rotated about rivet 23 with respect to handle element 2 beyond the normal open position of handle elements 1 and 2 illustrated in Figure 2. This prevents handle element 1 from being inadvertently "flipped" to a position wherein it underlies handle element 2 rendering the extractor useless until the proper orientation of handle elements 1 and 2 is regained.

The extractor of Figures 1 and 2 is of simple two-piece construction, handle elements 1 and 2 being joined together by rivet or pivot pin 23. This structure can be inexpensively manufactured from non-corrosive sheet metal or other material of sufficient strength, compatible with a surgical environment and capable of sterilization. Rivet 23 may also be made of a non-corrosive metal. Thus, the extractor may be readily made as a single-use, disposable tool lending itself to pre-sterile packaging. On the other hand, the extractor may be made of stainless steel, if it is intended to be a reusable tool.

A second embodiment of the extractor of the present invention is illustrated in Figures 7 through 10. In this embodiment, the extractor is again provided with two handle elements generally indicated at 32 and 33. Handle element 32 is formed of non-corrosive sheet metal and length wise is of a gentle S-curve configuration. Handle element 32 is formed into an inverted U-shaped configuration (providing downwardly depending legs 32*a* and 32*b*) except at its rearward end where the handle is provided with a broad, hook-shaped portion 34 adapted to

be engaged by the operator's middle and fourth fingers.

The upper surface of handle element 32 has an elongated U-shaped opening 35 therein, forming an integral, resilient tine 36, the purpose of which will be described hereinafter. The remaining top portion of the handle, ahead of opening 35, forms a bridge 37 joining the downwardly depending legs 32*a* and 32*b*.

At their forwardmost ends, legs 32*a* and 32*b* are extended to form parallel bifurcations 38 and 39. These bifurcations are bent inwardly as at 38*a* and 39*a* and terminate in parallel portions 38*b* and 39*b* which lie closer together. Portions 38*b* and 39*b* terminate in parallel bending members 40 and 41. Bending members 40 and 41, in turn, are provided with tips 40*a* and 41*a* which are bent inwardly so that their forwardmost ends are contiguous or nearly so. Bending members 40 and 41 and their respective tips 40*a* and 41*a* are of a narrowness in height and of a thinness in gauge which allow convenient insertion of the bending members 40 and 41 and their tips 40*a* and 41*a* beneath the crown of the staple prior to extraction of the staple. Bending members 40 and 41 are provided with aligned notches equivalent to the notches 12 and 14 of Figures 1 through 4. One such notch in the bending member 40 is shown at 42 in Figures 7 and 9. The notches in the bending members 40 and 41 serve the same purpose as notches 12 and 14 of the embodiment of Figures 1 through 4. The notches of the bending members 40 and 41 are followed by upwardly and rearwardly sloping surfaces equivalent to the surfaces 13 and 15 of Figures 1 and 2. These surfaces are located on bifurcation portions 38*b* and 39*b*, the surface on bifurcation portion 38*b* being shown at 43 in Figures 7, 9 and 10.

Handle element 33 is also configured longitudinally in a gentle S-shape. Handle element 33 is formed of non-corrosive sheet metal so as to have an inverted U-shaped cross section with downwardly depending legs 33*a* and 33*b* in parallel spaced relationship. At their forward ends, legs 33*a* and 33*b* are extended to form bifurcations 44 and 45 having inwardly bent portions 44*a* and 45*a* terminating in parallel portions 44*b* and 45*b*. The bifurcation portions 44*b* and 45*b* are provided with coaxial perforations adapted to receive a rivet or pivot pin 46 of non-corrosive metal or the like. The purpose of rivet 46 will be described hereinafter. The forward end of handle element 33 extends through opening 35 in the upper portion of handle element 32 and lies between legs 32*a* and 32*b* of handle element 32, being pivotally affixed thereto by a pivot pin or rivet 47 of non-corrosive metal. The rearward end of handle element 33 is flattened as at 33*c*.

The embodiment of Figures 7 through 10 utilizes a third element in the form of a blade 48 made of single thickness, non-corrosive metal. Blade 48 is pivotally mounted between bifurcations 38 and 39 of handle element 32 by pivot pin or rivet 49, made of non-corrosive metal.

Blade 48 has a forward nose portion 50, shorter than bending member tips 40*a* and 41*a* and provided with a lower bending edge 51. The other end of blade 48 has an enlarged or elongated opening 52 therein adapted to receive the previously described rivet or pivot pin 46. In this way, blade 48 is operatively connected to bifurcation portions 44*b* and 45*b* of handle element 33.

Figure 7 illustrates this embodiment of the extractor of the present invention in its normal condition with handle elements 32 and 33 in their open position. The handle elements 32 and 33 are biased to their open position by the arrangement of resilient tine 36 on the underside of handle element 33. It will be evident from Figure 7 that the openmost position of handle elements 32 and 33 is determined by the abutment of shoulder portion 53 of blade 48 against the forward edge of bridge 37 of handle element 32. When handle elements 32 and 33 are shifted to their closed position, against the action of resilient tine 36, the connection of handle element 33 and blade 48 via rivet or pivot pin 46 will cause blade 48 to pivot about rivet or pivot pin 49 in a counter clockwise direction (as viewed in Figure 7) to a position wherein the blade nose 50 passes between the bending members 40 and 41 with the bending edge 51 of the blade 48 extending therebelow (see Figure 10). Upon release of handle elements 32 and 33, the extractor parts will return to their respective normal positions illustrated in Figure 7. It will be appreciated that the interaction of handle element 33 and blade 48 is permitted by virtue of elongated hole 52. While hole 52 in blade 48 is illustrated as being elongated, it will be understood by one skilled in the art that the same purpose could be served if hole 52 were of circular configuration and had a diameter sufficiently greater than the diameter of rivet or pivot pin 46.

In use, the staple extractor embodiment of Figures 7 through 10 is grasped by the operator in any convenient manner. For example, the operator's middle and fourth fingers may engage about the hook-shaped portion 34 of handle element 32 with the operators thumb engaging flat portion 33*c* of handle element 33. The bending members 40 and 41 are first slipped beneath the staple in the same manner described with respect to the embodiment of Figures 1

through 3. Again, the fact that the bending member tips 40*a* and 41*a* are substantially contiguous; the fact that the bending members 40 and 41 and their tips 40*a* and 41*a* are elongated, of a suitable height and gauge as described previously; and the fact that nose 50 of blade 4 is shorter than bending members 40 and 41 and their tips 40*a* and 41*a*, all work together to facilitate the lining up of the extractor with the staple and the placement of both bending mem- 40 and 41 beneath the staple crown with a minimum of pain to the patient. Again, the upwardly and rearwardly angled edges of bifurcation portions 38*b* and 39*b* (one such edge shown at 43 in Figure 9) assures that staple crown 29 will be properly located in the aligned bending member notches (one of which is shown at 42 in Figures 7 and 9).

After this first stage of the extracting process, handle elements 32 and 33 may be shifted to their closed position causing blade 48 to assume the position illustrated in Figure 10. This forms the above described U-shaped bend in staple crown 29, as illustrated in Figure 5. The clearance between blade 48 and the bending members 40 and 41 is again at least substantially equal to the diameter of staple crown 29 (see Figure 8), assuring that the legs 29*a* and 29*b* of the U-shaped bend in staple crown 29 will again be parallel (see Figure 5), with staple legs 30 and 31 in their fully opened position. This is true even when the extractor is used to remove a staple having a minimum size crown.

At this point, the staple may be lifted from the skin of a patient with minimal pain. In the embodiment of Figures 7 through 10, the bridge 37 of handle element 32 will insure the precise spacing between blade 48 and anvils 40 and 41 and will render the extractor assembly stronger.

The clearance provided between blade 48 and bending members 40 and 41 will minimize spreading of bending members 40 and 41 and their tips 40*a* and 41*a* during the extracting process. This, in turn, eliminates a major source of pain to the patient. This same clearance also permits an extracted staple to be readily dropped from the extractor upon release of handle elements 32 and 33 to their normal, open position.

The three-piece design of the embodiment of Figures 7 through 10 allows handle element 32 and its bending members 40 and 41 and their tips 40*a* and 41*a* to remain stationary while in contact with the skin of the patient. Only blade 48 closes down to bend staple crown 29. This feature minimizes extraneous movement of the extractor bending members during the staple extraction, helping to eliminate a major source of pain. The mechanical connection between handle 33 and blade 48 prevents handle 33 from being inadvertently "flipped" with respect to handle 32.

As with the embodiment of Figures 1 through 3, the extractor of Figures 7 through 10 may be made of any suitable material of sufficient strength, capable of sterilization and compatible with a surgical environment. When intended to be a single-use, disposable instrument, the extractor may be made, for example, of a non-corrosive metal, as indicated above. The extractor lends itself well to disposable, pre-sterile packaging. When intended for reuse and resterilization, it may be made of stainless steel.

WHAT WE CLAIM IS:—

1. A manually operated surgical staple extractor comprising first and second handle elements joined together by a pivot, said pivot allowing movement of said handle elements between an open position and a closed position, said first handle element having a bifurcated forward end, said bifurcations terminating in a pair of elongated bending members in parallel spaced relationship and adapted to be slipped beneath a crown portion of a surgical staple in the skin of a patient, the extractor being characterized by said bending members having forward ends angled toward each other with the frontmost tips thereof being substantially contiguous, said bending members having rearward ends provided with aligned notches for receiving said crown of a surgical staple, said bifurcations providing an upwardly and rearwardly sloping surface adjacent each of said notches to assist in locating said staple crown in said notches, a blade being located between said bifurcations of said first handle element, said second handle element being operatively connected at its forward end to said blade, said blade having a nose portion shorter than said bending members and having a lower edge, and said blade nose portion being shiftable by said second handle element between a first position when said handle elements are in said open position wherein said lower edge of said nose lies above said bending members and said notches therein and a second position when said handle elements are in said closed position wherein said nose lies between said bending members with said lower edge below said bending members, there being clearance between said nose portion and each of said bending members.

2. An extractor as claimed in claim 1 including means to bias said handle elements to their open position.

3. An extractor as claimed in claim 1 wherein said blade comprises an integral one-piece part of said second handle element.

4. An extractor as claimed in claim 1

through 3. Again, the fact that the bending member tips 40*a* and 41*a* are substantially contiguous; the fact that the bending members 40 and 41 and their tips 40*a* and 41*a* are elongated, of a suitable height and gauge as described previously; and the fact that nose 50 of blade 4 is shorter than bending members 40 and 41 and their tips 40*a* and 41*a*, all work together to facilitate the lining up of the extractor with the staple and the placement of both bending mem- 40 and 41 beneath the staple crown with a minimum of pain to the patient. Again, the upwardly and rearwardly angled edges of bifurcation portions 38*b* and 39*b* (one such edge shown at 43 in Figure 9) assures that staple crown 29 will be properly located in the aligned bending member notches (one of which is shown at 42 in Figures 7 and 9).

After this first stage of the extracting process, handle elements 32 and 33 may be shifted to their closed position causing blade 48 to assume the position illustrated in Figure 10. This forms the above described U-shaped bend in staple crown 29, as illustrated in Figure 5. The clearance between blade 48 and the bending members 40 and 41 is again at least substantially equal to the diameter of staple crown 29 (see Figure 8), assuring that the legs 29*a* and 29*b* of the U-shaped bend in staple crown 29 will again be parallel (see Figure 5), with staple legs 30 and 31 in their fully opened position. This is true even when the extractor is used to remove a staple having a minimum size crown.

At this point, the staple may be lifted from the skin of a patient with minimal pain. In the embodiment of Figures 7 through 10, the bridge 37 of handle element 32 will insure the precise spacing between blade 48 and anvils 40 and 41 and will render the extractor assembly stronger.

The clearance provided between blade 48 and bending members 40 and 41 will minimize spreading of bending members 40 and 41 and their tips 40*a* and 41*a* during the extracting process. This, in turn, eliminates a major source of pain to the patient. This same clearance also permits an extracted staple to be readily dropped from the extractor upon release of handle elements 32 and 33 to their normal, open position.

The three-piece design of the embodiment of Figures 7 through 10 allows handle element 32 and its bending members 40 and 41 and their tips 40*a* and 41*a* to remain stationary while in contact with the skin of the patient. Only blade 48 closes down to bend staple crown 29. This feature minimizes extraneous movement of the extractor bending members during the staple extraction, helping to eliminate a major source of pain. The mechanical connection between handle 33 and blade 48 prevents handle 33 from being inadvertently "flipped" with respect to handle 32.

As with the embodiment of Figures 1 through 3, the extractor of Figures 7 through 10 may be made of any suitable material of sufficient strength, capable of sterilization and compatible with a surgical environment. When intended to be a single-use, disposable instrument, the extractor may be made, for example, of a non-corrosive metal, as indicated above. The extractor lends itself well to disposable, pre-sterile packaging. When intended for reuse and resterilization, it may be made of stainless steel.

WHAT WE CLAIM IS:—

1. A manually operated surgical staple extractor comprising first and second handle elements joined together by a pivot, said pivot allowing movement of said handle elements between an open position and a closed position, said first handle element having a bifurcated forward end, said bifurcations terminating in a pair of elongated bending members in parallel spaced relationship and adapted to be slipped beneath a crown portion of a surgical staple in the skin of a patient, the extractor being characterized by said bending members having forward ends angled toward each other with the frontmost tips thereof being substantially contiguous, said bending members having rearward ends provided with aligned notches for receiving said crown of a surgical staple, said bifurcations providing an upwardly and rearwardly sloping surface adjacent each of said notches to assist in locating said staple crown in said notches, a blade being located between said bifurcations of said first handle element, said second handle element being operatively connected at its forward end to said blade, said blade having a nose portion shorter than said bending members and having a lower edge, and said blade nose portion being shiftable by said second handle element between a first position when said handle elements are in said open position wherein said lower edge of said nose lies above said bending members and said notches therein and a second position when said handle elements are in said closed position wherein said nose lies between said bending members with said lower edge below said bending members, there being clearance between said nose portion and each of said bending members.

2. An extractor as claimed in claim 1 including means to bias said handle elements to their open position.

3. An extractor as claimed in claim 1 wherein said blade comprises an integral one-piece part of said second handle element.

4. An extractor as claimed in claim 1

* C L M S *

wherein said blade comprises a separate element pivotally attached to said first handle element between said bifurcations thereof, said blade element having a forward end comprising said nose and a rearward end operatively connected to said forward end of said second handle element.

5. An extractor as claimed in claim 3 including means to bias said handle elements to their open position.

6. An retractor as claimed in claim 3 wherein said first handle element comprises an elongated one-piece member folded transversely so as to have an inverted U-shaped cross-section having downwardly depending legs in parallel spaced relationship, said legs of said first handle element being extended at said forward end of said first handle element to form said bifurcations, said legs flaring outwardly at the other end of said first handle element to form a portion for engagement by the hand of the operator, said second handle element comprising an elongated one-piece member folded transversely so as to have a U-shaped cross-section, with upwardly extending legs in parallel abutting relationship, one of said legs being extended at said forward end of said second handle element flaring outwardly at the other end of said second handle element to form a portion to be engaged by the hand of the operator, said second handle element lying below said first handle element with said upstanding legs of said second handle element being receivable between said downwardly depending legs of said first handle element and said legs of second handle element adjacent said blade being pivotally affixed to and between said legs of said first handle element adjacent said bifurcations by a pivot pin.

7. An extractor as claimed in claim 4 wherein said first handle element comprises an elongated one-piece member folded transversely so as to have an inverted U-shaped cross-section with downwardly depending legs in parallel spaced relationshisp, said legs of said first handle element being extended at said forward end of said first handle element to form said bifurcations, said legs flaring outwardly at the other end of said first handle element to form a portion for engagement by the hand of the operator, said second handle element comprising an elongated one-piece member folded trarsversely so as to have an inverted U-shaped cross section with downwardly depending legs in parallel spaced relationship said legs at said forward end of said second handle element being extended to form a second pair of bifurcations, said legs flaring outwardly at the other end of said second handle element to form a portion for engagement by the hand of the operator, said first handle element having an elongated opening formed therein between the legs thereof, said second handle element lying above said first handle element with said forward end of said second handle element extending through said opening in said first handle element and being pivotally attached to and between said legs of said first handle element, said blade being pivotally attached to and between said bifurcations of said first handle element by a pivot pin, said rearward end of said blade having an elongated slot therein, said rearward end of said blade lying between and being operatively connected to said bifurcations of said second handle element by a pivot passing through coaxial holes in said last mentioned bifurcations and said slot in said rearward end of said blade.

8. An extractor as claimed in claim 6 wherein said first and second handle elements are formed from non-corrosive sheet metal.

9. An extractor as claimed in claim 6 including an integral resilient tine on said first handle element extending downwardly and forwardly between said legs thereof, said upstanding legs of said second handle element providing an upper surface to be engaged by said tine whereby said tine urges said first and second handle elements to their open position.

10. An extractor as claimed in claim 6 wherein that portion of said inverted U-shaped cross-section of said first handle element at said forward end thereof and joining said downwardly depending legs thereof comprises a bridge maintaining said bifurcations of said first handle element and said blade in proper alignment and cooperating with said blade to determine the open-most position of said first and second handle elements.

11. An extractor as claimed in claim 7 wherein said first and second handle elements and said blade are formed from non-corrosive sheet metal, said blade being a single thickness of said sheet metal.

12. An extractor as claimed in claim 7 including an integral resilient tine extending forwardly above and away from said first handle element, said tine engaging said second handle element between said legs thereof whereby said tine urges said first and second handle elements to their open position.

13. An extractor as claimed in claim 7 wherein that portion of said inverted U-shaped cross-section of said first handle element at said forward end thereof and joining said downwardly depending legs thereof comprises a bridge maintaining said bifurcations of said first handle element and said blade in proper alignment and cooperating with said blade to determine the open-most position of said first and second handle elements.

* C L M S *

14. An extractor claimed in claim 8 wherein said extractor is a disposable, single-use tool.

15. An extractor as claimed in claim 8 wherein said sheet metal is stainless steel, said extractor comprising a reusable and resterilizable tool.

16. An extractor as claimed in claim 9 including integral, interned, opposed tabs on said downward depending legs of said first handle element adapted to contact said surface to be engaged by said tine to determine said closed position of said first and second handle elements.

17. An extractor as claimed in claim 11 wherein said extractor is a disposable single-use tool.

18. An extractor as claimed in claim 11 wherein said sheet metal is stainless steel, said extractor comprising a reusable and resterilizable tool.

19. A manually operable extractor substantially as described herein with reference to the accompanying drawings.

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

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1978.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY
from which copies may be obtained.

* C L M S *