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Sinnreich et al.

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(54) **SURGICAL STAPLE REMOVER WITH CHANNEL GUIDED MOVEMENT**

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(63) Continuation-in-part of application No. 13/849,987, filed on Mar. 25, 2013.

(51) **Int. Cl.**
A61B 17/10 (2006.01)

(52) **U.S. Cl.**
USPC **606/138**

(58) **Field of Classification Search**
USPC 227/19, 63, 156; 606/1, 131, 138, 174, 606/205, 206, 207, 208; 81/342, 355, 362; 254/21, 28; 269/3, 6; 29/243.5, 270, 29/278
See application file for complete search history.

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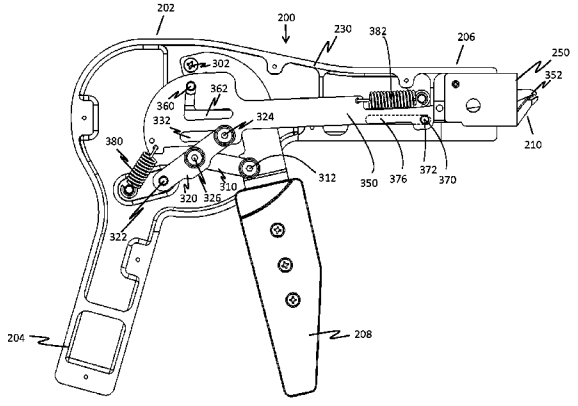
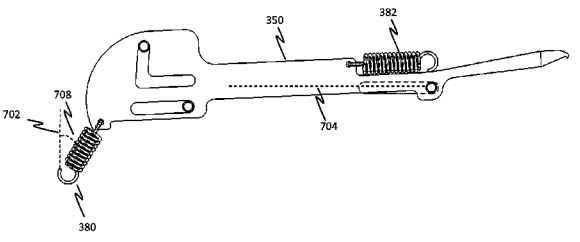
(57) **ABSTRACT**

A surgical staple remover apparatus includes a handle, an upward sloped jaw element, an arm having a hook element on a distal end, and a channel cut out of a surface of the arm. The apparatus further includes a rigid element having a first portion movably coupled to the channel such that the first portion moves within the channel, and a lever mechanically coupled to the rigid element, wherein moving the lever closer to the handle results in the rigid element moving upwards and proximally within the channel, thereby resulting in the hook element pressing against a crown of a surgical staple, deforming the surgical staple for removal and moving the surgical staple proximally. The apparatus further includes a strip element located, such that when the hook element moves the surgical staple proximally, the surgical staple is moved under the strip element.

19 Claims, 15 Drawing Sheets





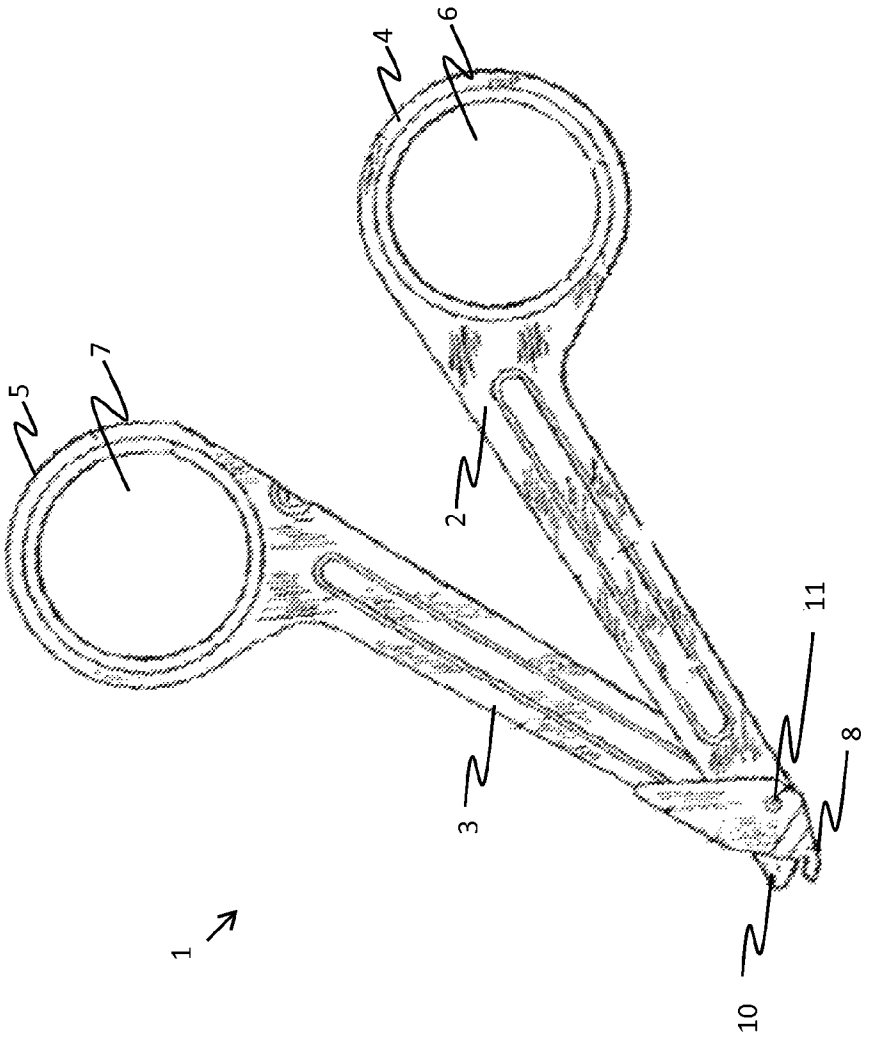


FIG. 1

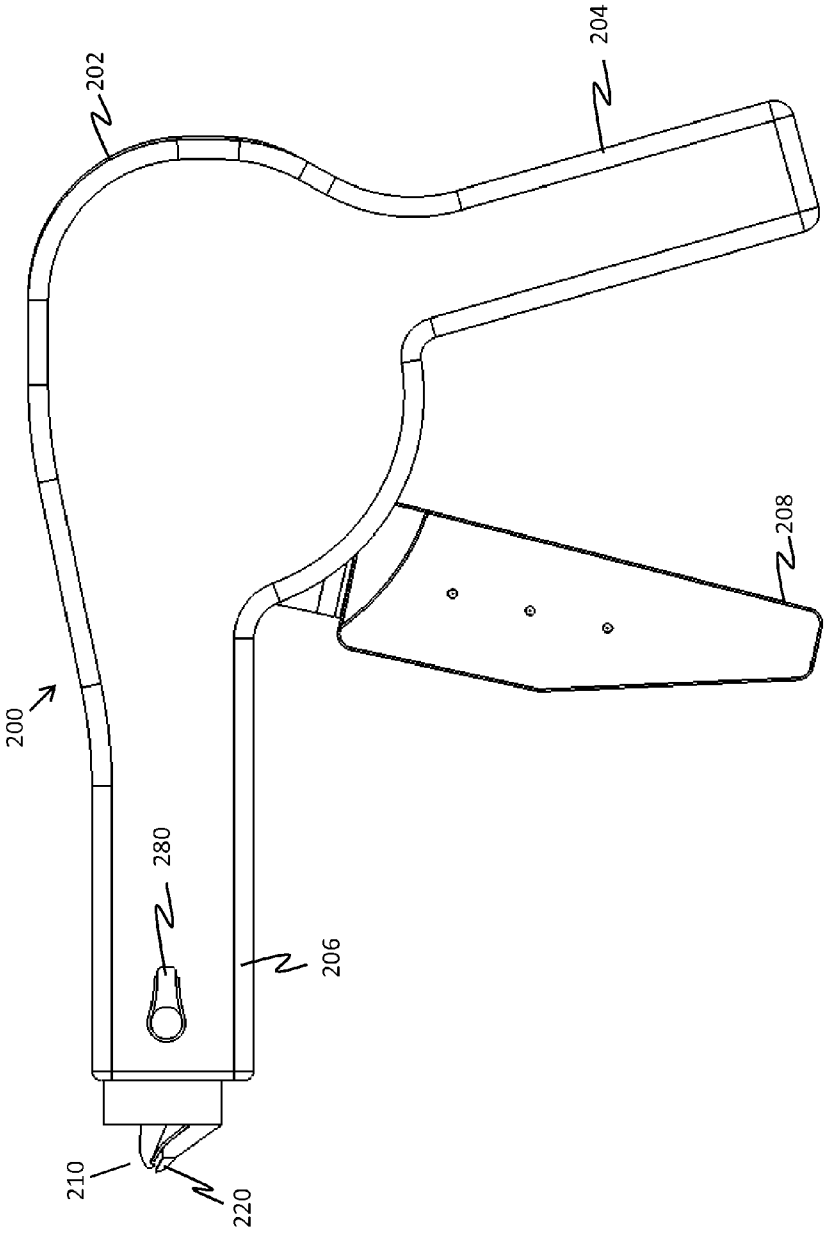


FIG. 2A

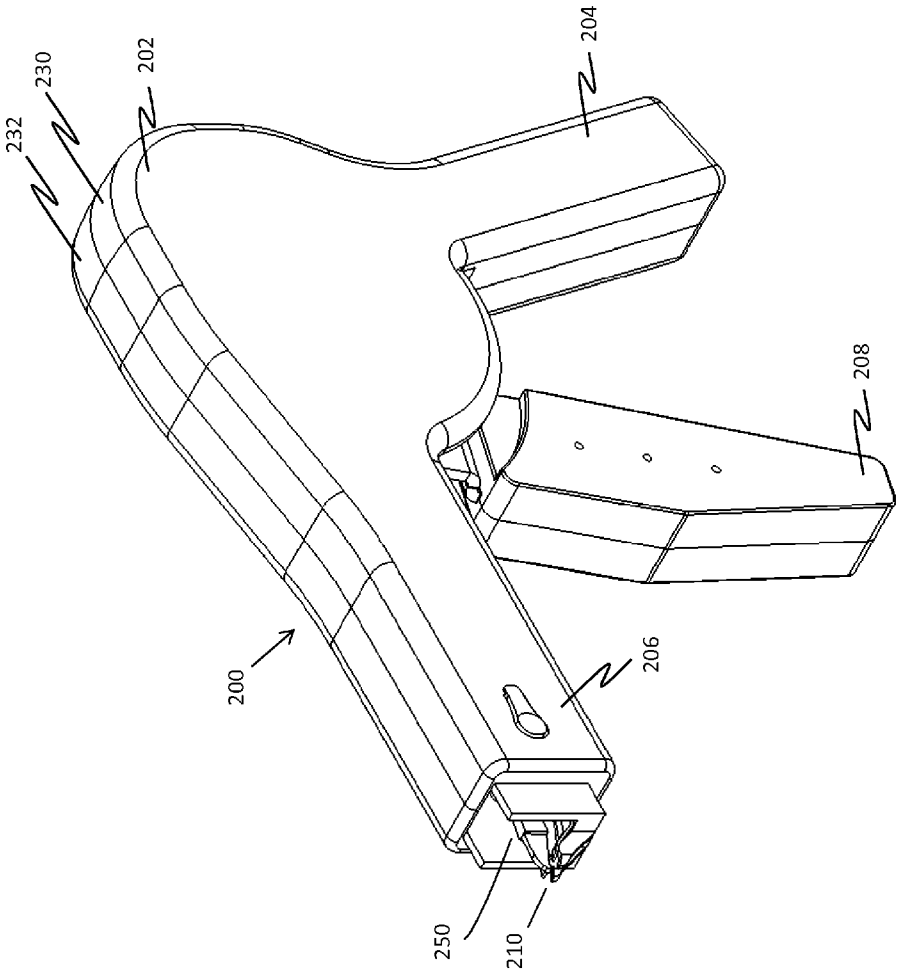


FIG. 2B

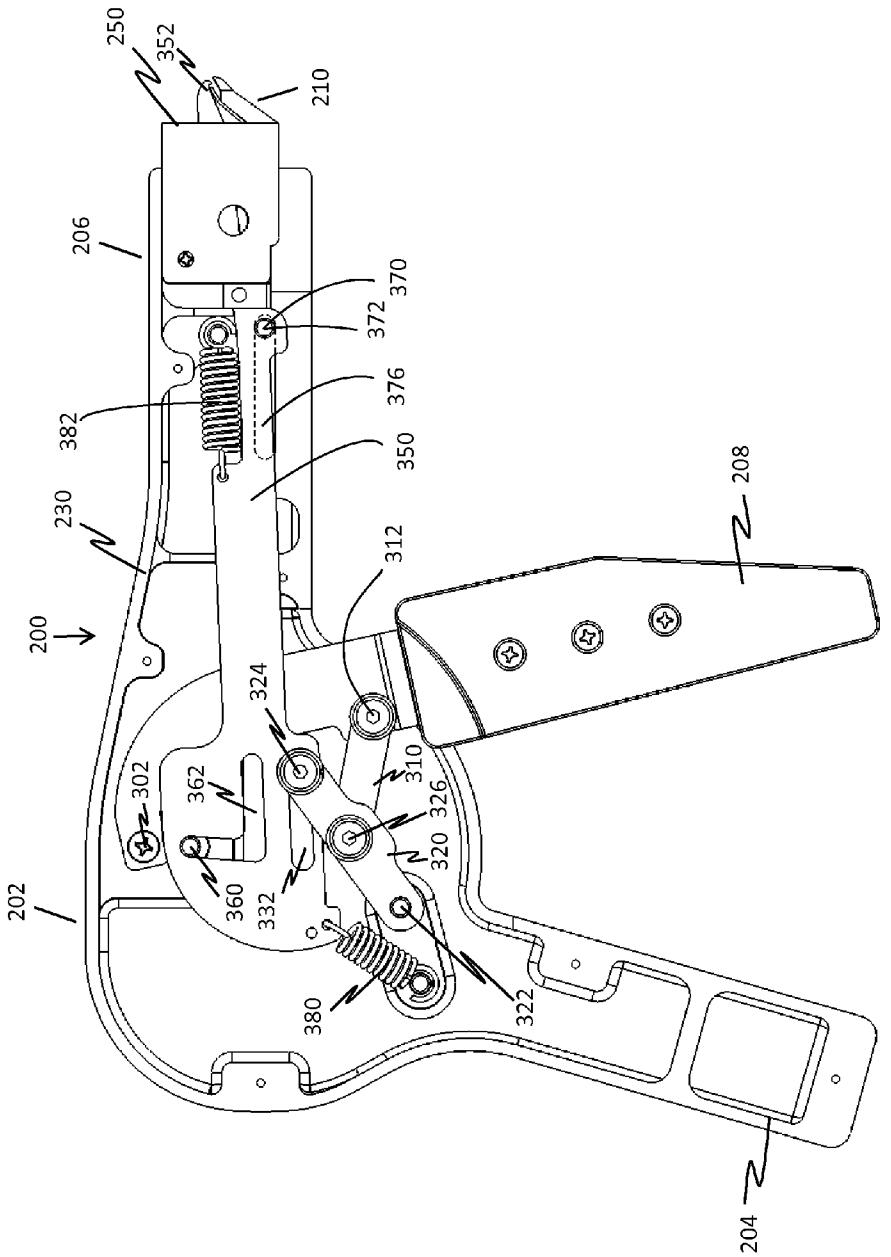

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FIG. 3

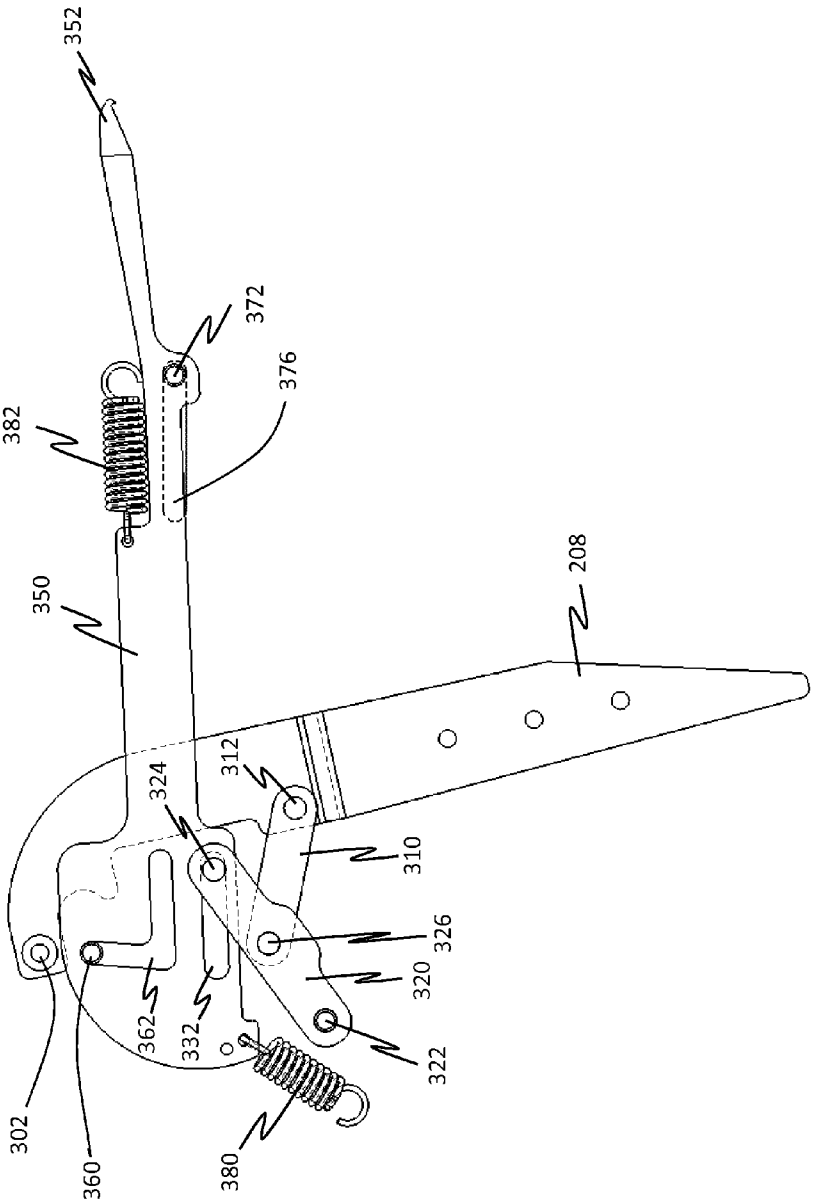
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FIG. 4A

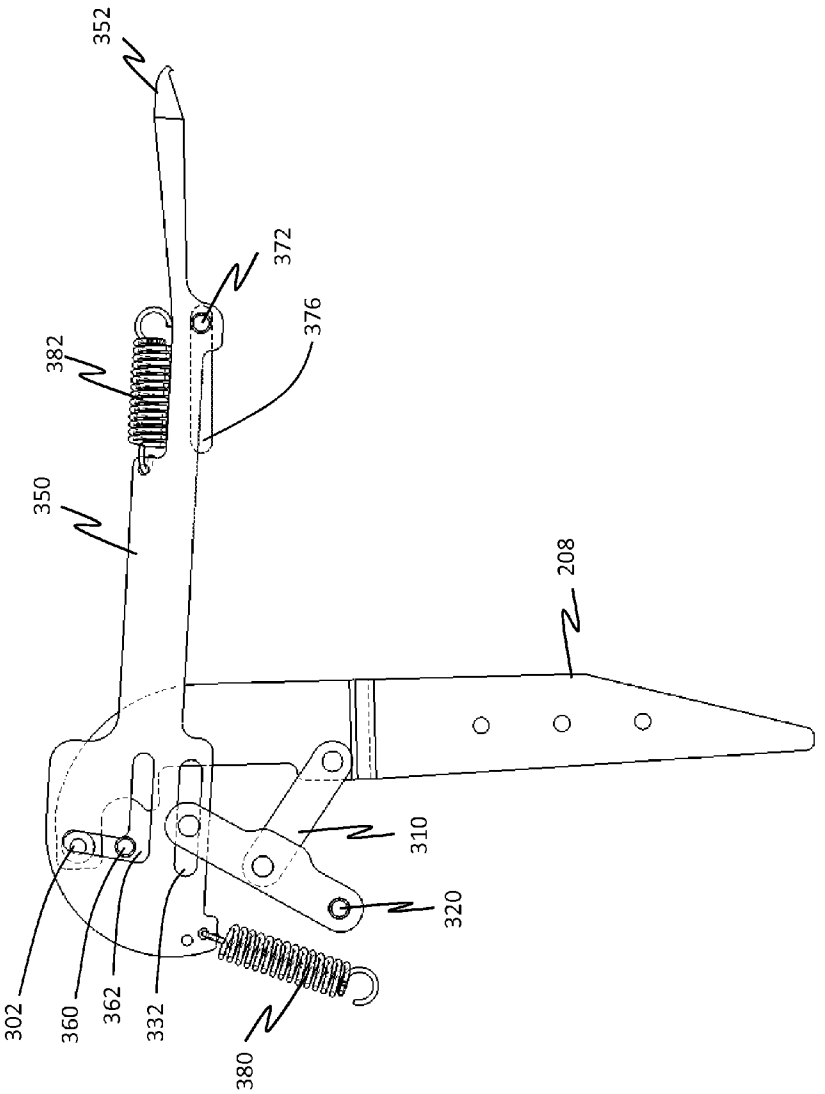


FIG. 4B

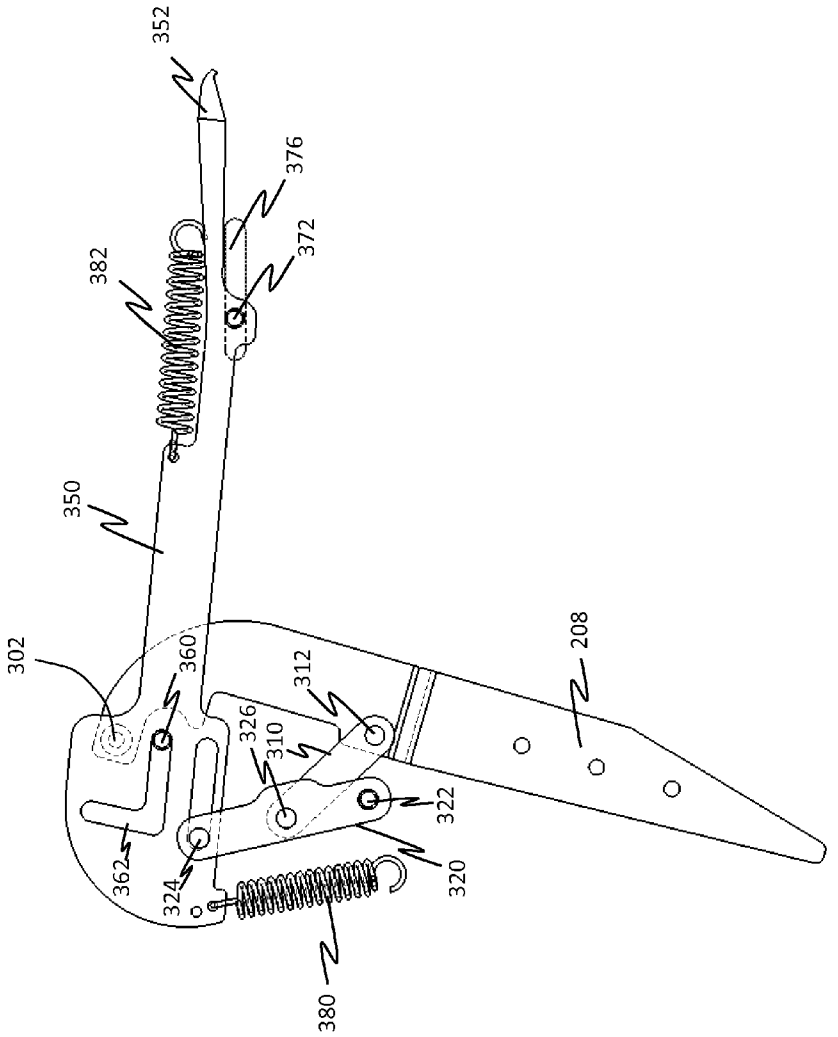


FIG. 4C

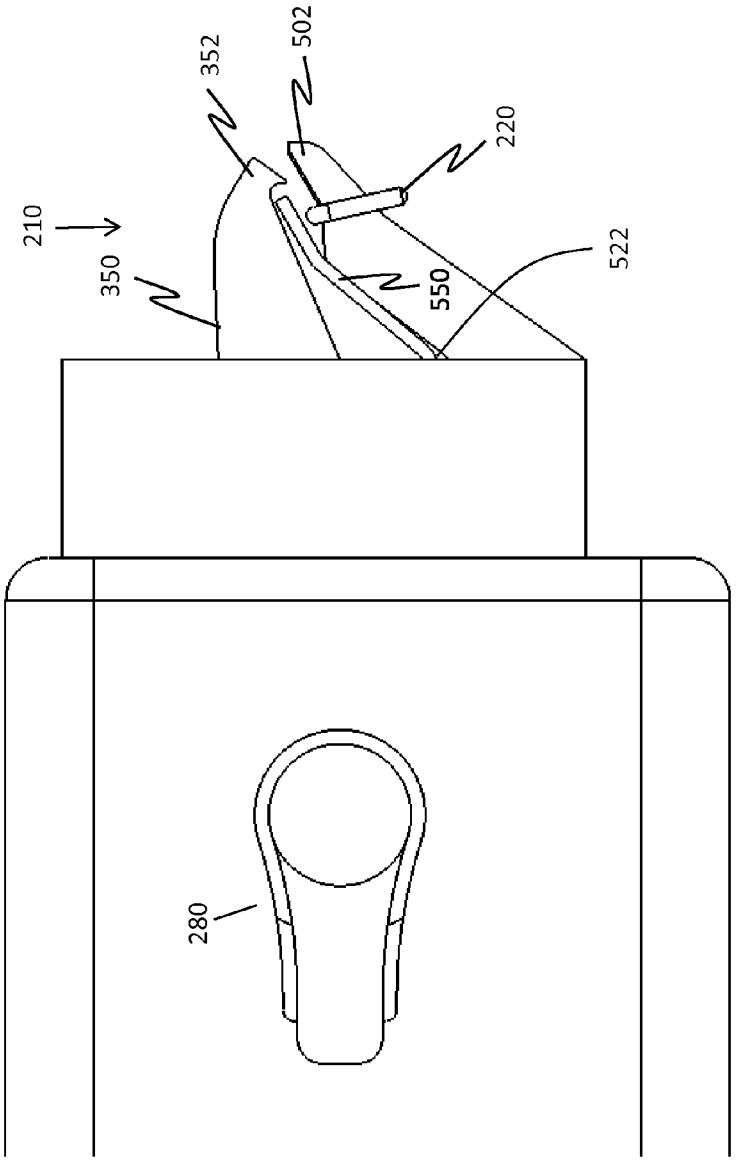


FIG. 5A

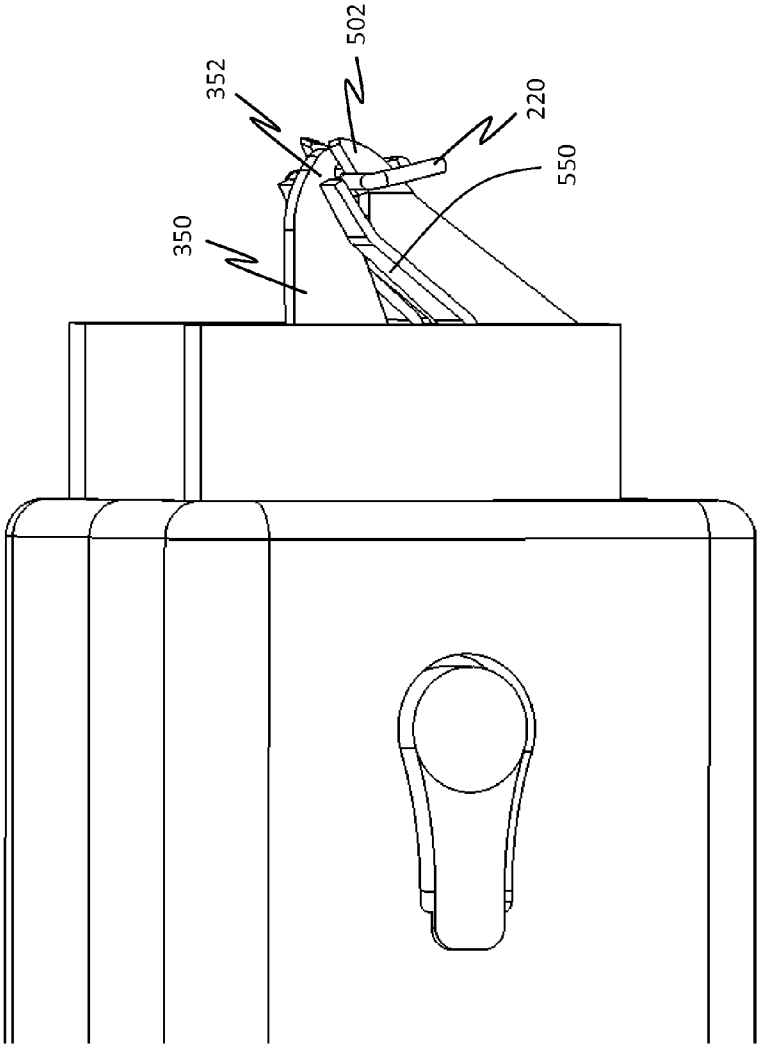


FIG. 5B

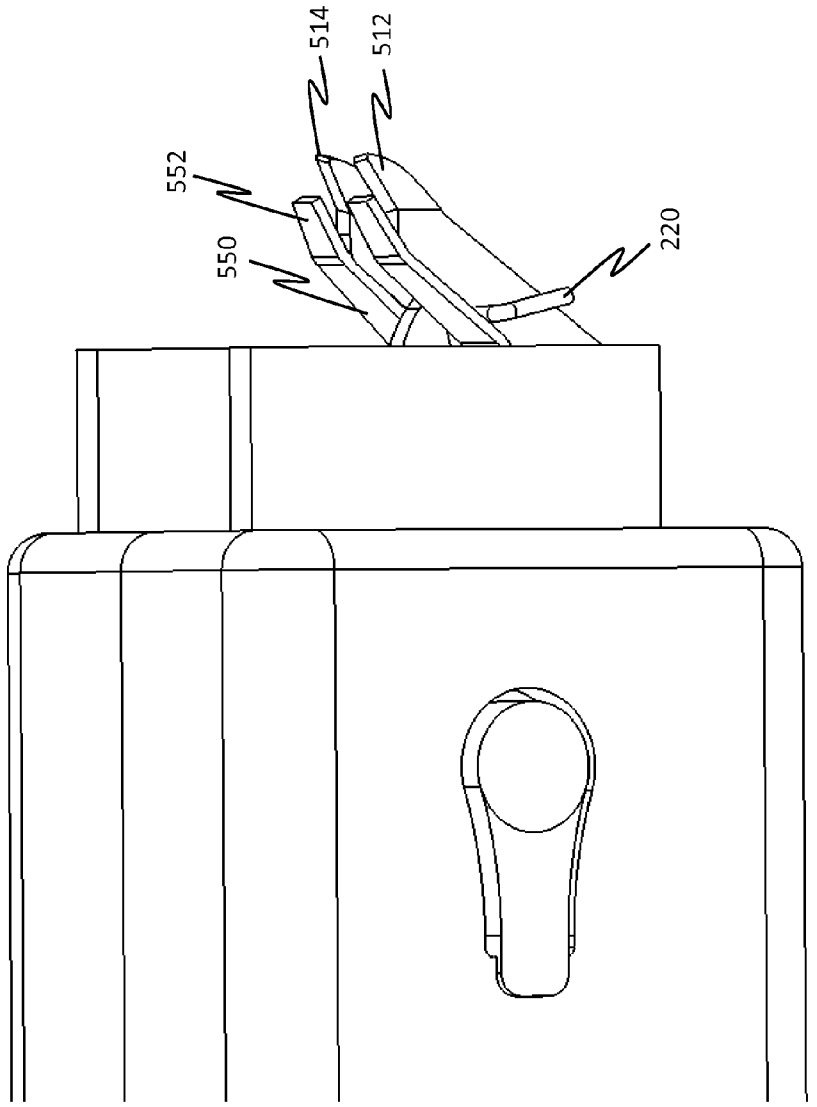
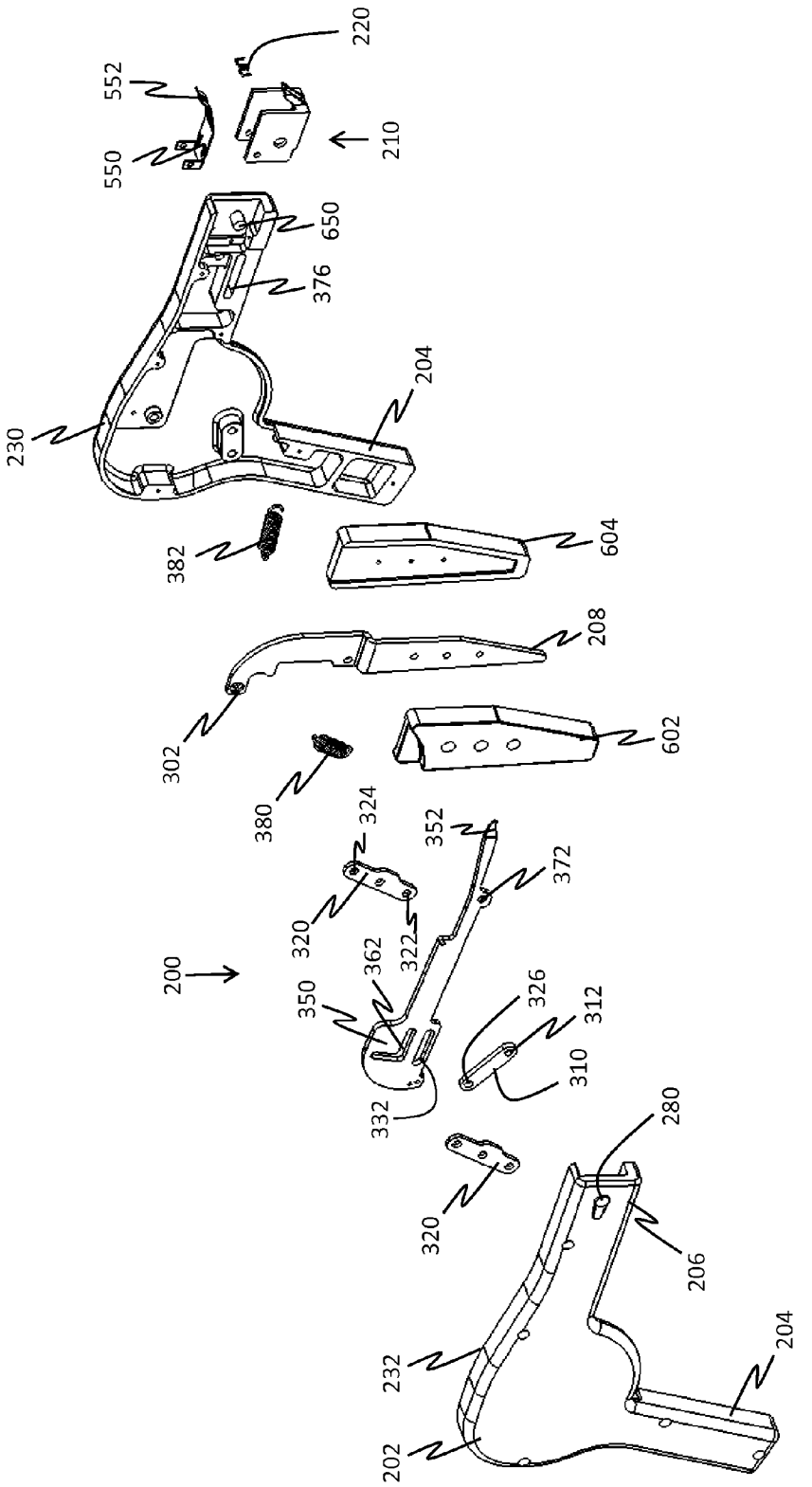


FIG. 5C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202

FIG. 6

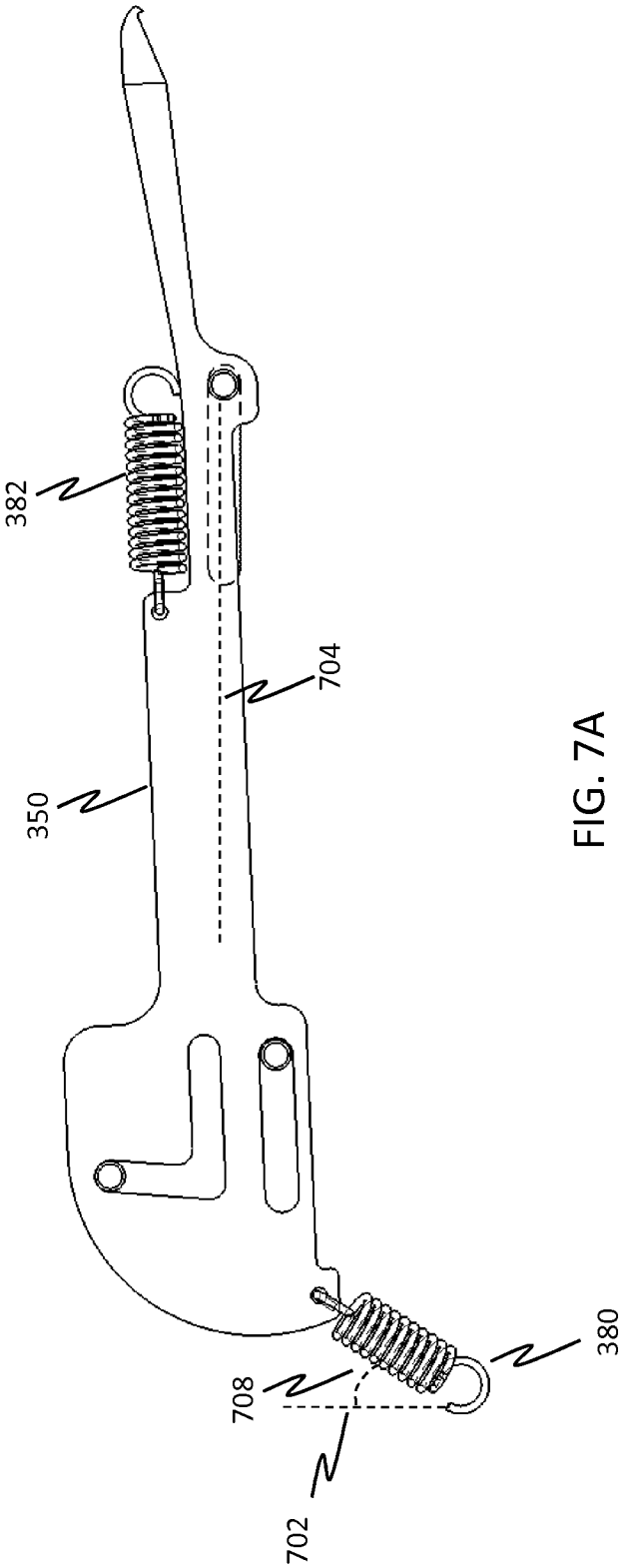

FIG. 7A

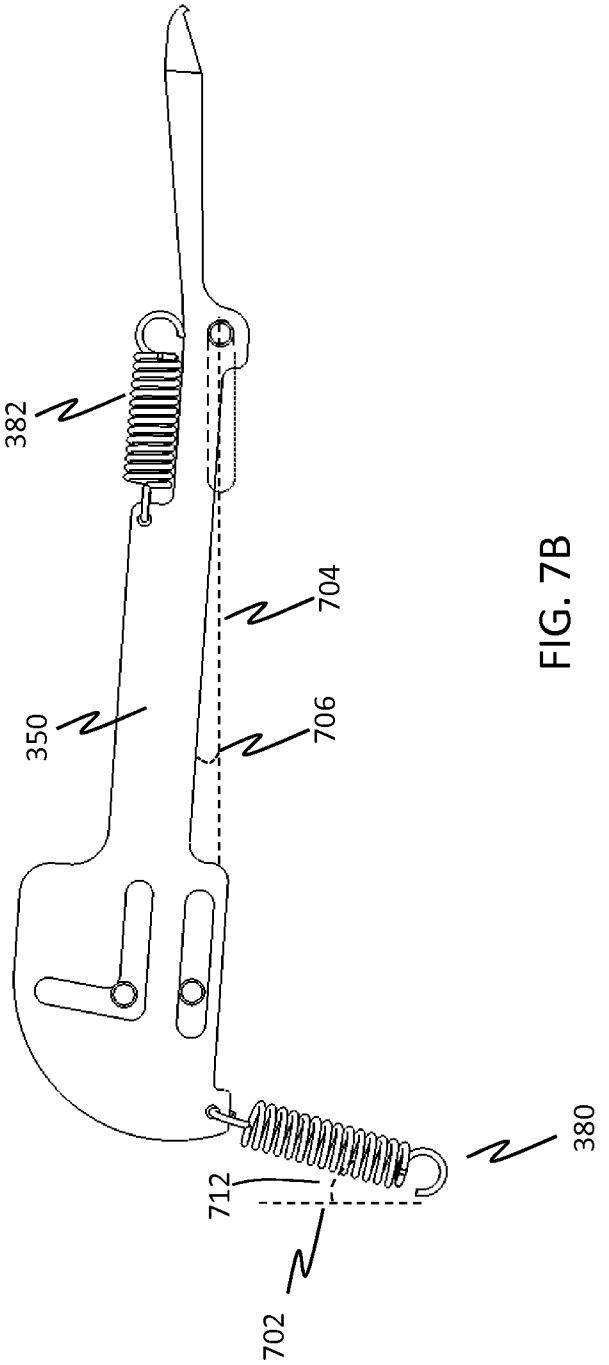

FIG. 7B

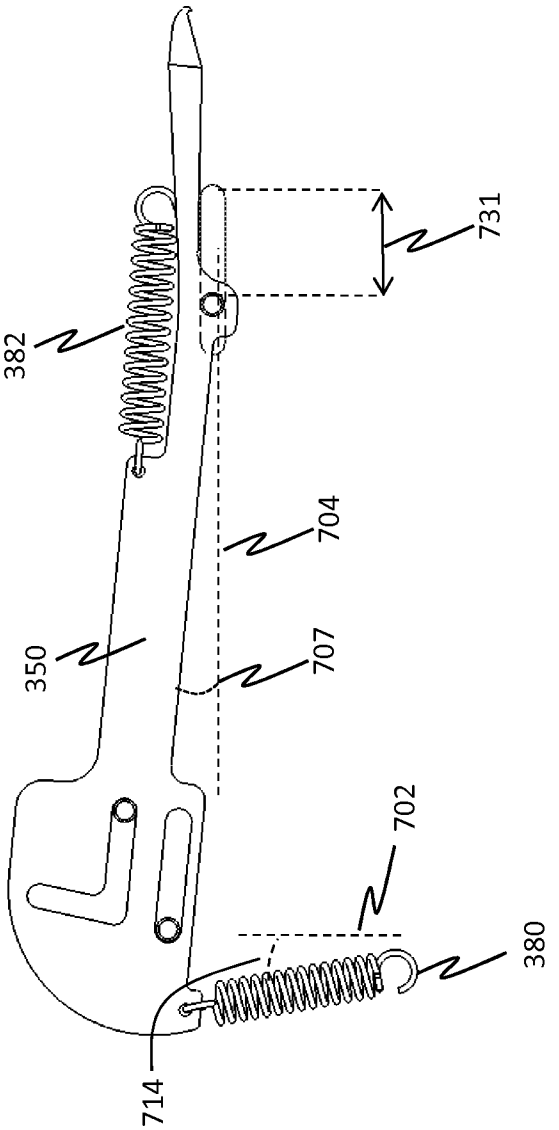

FIG. 7C

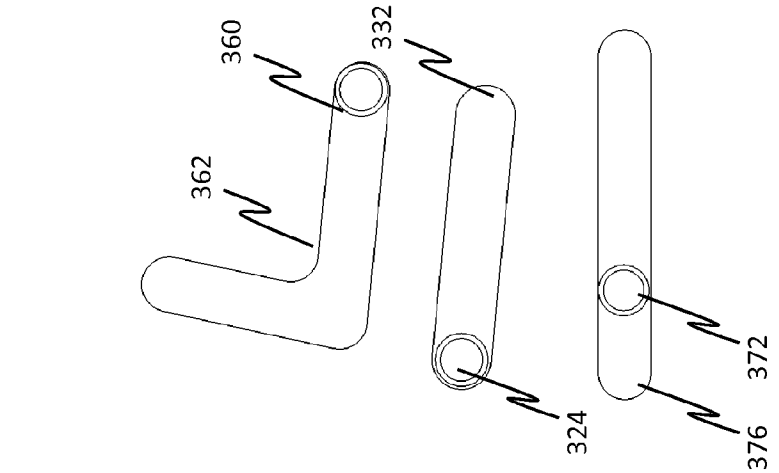

FIG. 8C

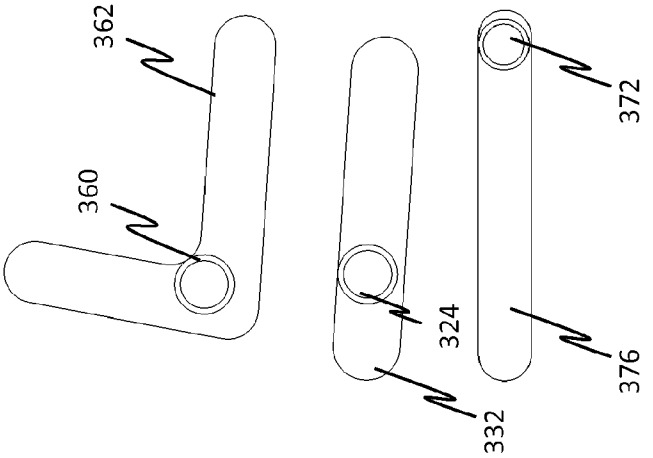

FIG. 8B

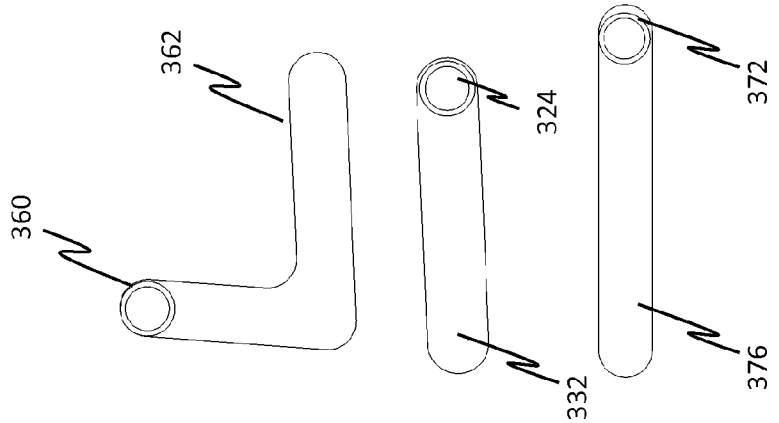

FIG. 8A

SURGICAL STAPLE REMOVER WITH CHANNEL GUIDED MOVEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application is a continuation-in-part of utility patent application Ser. No. 13/849,987, filed on Mar. 25, 2013 and entitled "Surgical Staple Remover with Removable Front End," which is a continuation-in-part of utility patent application Ser. No. 13/769,633, filed on Feb. 18, 2013 and entitled "Surgical Staple Remover." The subject matter of patent application Ser. No. 13/769,633 and patent application Ser. No. 13/849,987 are hereby incorporated by reference in their entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable.

INCORPORATION BY REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC

Not Applicable.

FIELD OF THE INVENTION

The invention disclosed broadly relates to the field of medical devices, and more particularly relates to the field of devices for automating the process of removing surgical staples.

BACKGROUND OF THE INVENTION

The use of surgical staples in the medical industry for closing wounds or incisions in the skin of a patient has grown over the last decade due to its advantages over thread sutures. One of the main advantages of surgical staples over thread sutures is the reduced amount of time required for surgical staples to be implanted. In cases where large incisions are made, the use of surgical staples can, for example, reduce the length of time required for the suturing process and thus the length of time the patient must be maintained under anesthesia.

Conventional surgical staples comprise an elongated crown and an L-shaped portion on each end of the crown, wherein when implanted in a patient, the crown is located on the exterior of the skin of the patient and the L-shaped portions are bent in a downward direction so that the ends of the L-shaped portions are opposed, thereby incising and gripping the skin. The aforementioned conventional surgical staple may be removed from the skin of a patient by deforming the staple crown into a U-shaped configuration. This causes the L-shaped legs of the staple to shift upwardly and outwardly so that they may be lifted away from the patient's skin.

A conventional surgical staple remover **1**, shown in FIG. **1**, typically comprises a first handle **2** and a second handle **3** pivoted together at pivot point **11**. Each handle includes circular finger inserts (**4** and **5**), each of which includes an orifice (**6** and **7**) for inserting a pair of fingers, such as a thumb and forefinger. The second handle **3** terminates in element **8** comprising two parallel, dual-pronged J-shaped units that are inserted under a surgical staple to be removed. The first handle **2** terminates in an anvil **10** that includes a downward facing footprint that is situated between the two units of the dual-pronged J-shaped element **8** and wherein the anvil **10** is placed on top of the crown of the surgical staple to be removed. When the conventional surgical staple remover **1** is gripped and contracted by a user, the downward facing footprint of anvil **10** applies force to the top of the crown of the surgical staple, thereby deforming the staple crown into a U-shaped configuration. Consequently, the L-shaped legs of the staple are moved upwardly and outwardly, thereby lifting away from the patient's skin.

One of the disadvantages of a conventional surgical staple remover is that it does not adequately deal with the final disposition of the surgical staple being removed. It is common to have surgical staples jump into the air or fall away during removal. Personnel must then go about finding and disposing of the removed surgical staple and sterilizing anything the staple came into contact with. It is unsanitary to allow removed surgical staples to come into contact with individuals or things since implanted surgical staples have resided within a human's body and may contain biologically hazardous residue that could contaminate individuals and locations. Further, the process of cleaning up after the conventional removal of surgical staples is time consuming and expensive since proper decontamination and sterilization procedures, employing the use of costly protective equipment and cleaning materials, must be undertaken. Further, during an operation on a patient, it is imperative that all removed staples are accounted for, lest the removed staple falls into an open incision unnoticed.

Another disadvantage of a conventional surgical staple remover is that it requires that each removed surgical staple is immediately disposed of. That is, the doctor or technician must remove a surgical staple, place it in a receptacle, and then return to the wound to remove the next surgical staple. This is problematic as it requires that the doctor or technician temporarily lose sight of the wound while he disposes of the removed surgical staple.

Therefore, a need exists to overcome the problems with the prior art as discussed above, and particularly for a more effective and efficient surgical staple remover, as well as a more sanitary and easy-to-operate surgical staple remover.

SUMMARY OF THE INVENTION

Briefly, according to an embodiment, a surgical staple remover apparatus is disclosed. The surgical staple remover apparatus comprises a handle located at a rear of the apparatus, an upward sloped jaw element comprising a pair of jaws, an arm having a hook element on a distal end, wherein the arm is positioned such that the hook element is disposed over the jaw element, and a channel cut out of a surface of the arm. The surgical staple remover apparatus further comprises a rigid element having a first portion movably coupled to the channel such that the first portion moves within the channel, and a lever mechanically coupled to the rigid element, wherein moving the lever closer to the handle results in the first portion of the rigid element moving upwards and proximally within the channel of the arm, a proximal end of the arm moving upwards, the hook element moving downwards towards the jaw element, and the arm retracting proximally, thereby resulting in the hook element pressing against a crown of a surgical staple, deforming the surgical staple for removal and moving the surgical staple proximally. The surgical staple remover apparatus further includes a strip element located on top of the jaw element, such that when the hook element deforms and moves the surgical staple proximally, the surgical staple is moved under the strip element and held in place by same.

The foregoing and other features and advantages of the embodiments will be apparent from the following more particular description of the preferred embodiments of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter, which is regarded as the invention, is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features and also the advantages of the invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings.

FIG. **1** is an illustration of a side view of a prior art surgical staple remover.

FIG. **2**A is a left side view of the surgical staple remover in an open position, in accordance with one embodiment.

FIG. **2**B is a perspective view of the surgical staple remover in a closed position, in accordance with one embodiment.

FIG. **3** is a right side view of the surgical staple remover in an open position, in accordance with one embodiment.

FIG. **4**A is a right side view of the moving interior components of the surgical staple remover in an open position, in accordance with one embodiment.

FIG. **4**B is a right side view of the moving interior components of the surgical staple remover in an interim position, in accordance with one embodiment.

FIG. **4**C is a right side view of the moving interior components of the surgical staple remover in a closed position, in accordance with one embodiment.

FIG. **5**A is a right side view of the components of the working end of the surgical staple remover in an open position, in accordance with one embodiment.

FIG. **5**B is a right perspective side view of the components of the working end of the surgical staple remover in an interim position, in accordance with one embodiment.

FIG. **5**C is a right side perspective view of the components of the working end of the surgical staple remover in a closed position, in accordance with one embodiment.

FIG. **6** is an exploded view of the surgical staple remover showing the main interior and exterior components, in accordance with one embodiment.

FIG. **7**A is a right side view of interior components of the surgical staple remover in an open position, in accordance with one embodiment.

FIG. **7**B is a right side view of interior components of the surgical staple remover in an interim position, in accordance with one embodiment.

FIG. **7**C is a right side view of interior components of the surgical staple remover in a closed position, in accordance with one embodiment.

FIG. **8**A is an illustration of various channels or cutouts of the surgical staple remover in the open position, in accordance with one embodiment.

FIG. **8**B is an illustration of various channels or cutouts of the surgical staple remover in the interim position, in accordance with one embodiment.

FIG. **8**C is an illustration of various channels or cutouts of the surgical staple remover in the closed position, in accordance with one embodiment.

DETAILED DESCRIPTION

Applicant's surgical staple remover solves problems with the prior art by providing a simple and easy-to-use surgical staple remover that automatically captures deformed and removed surgical staples. The surgical staple remover apparatus improves upon the prior art by definitively dealing with the final disposition of each surgical staple being removed from a patient. The surgical staple remover apparatus eliminates the possibility of having surgical staples jump into the air or fall away during removal. The surgical staple remover apparatus further eliminates the necessity for personnel to find and dispose of the removed surgical staple and sterilize anything the staple came into contact with. The surgical staple remover apparatus eradicates the potential for removed surgical staples to come into contact with, and contaminating, individuals or things. Further, the surgical staple remover apparatus eliminates the need to clean up after the conventional removal of surgical staples, thereby saving time and expense. Also, the surgical staple remover apparatus allows a doctor or technician to undergo the process of removing multiple surgical staples without losing sight of the wound during the process.

Finally, the surgical staple remover apparatus provides a surgical staple remover with a minimal number of component parts, thereby reducing the potential for failure or malfunction of the device. Also, the minimal number of component parts allows for quick and inexpensive fabrication of the surgical staple remover, thereby meeting the economic requirements for a disposable surgical staple remover. The surgical staple remover apparatus can be constructed of various metals, as well as plastic. Lastly, the surgical staple remover apparatus provides channel guided movement wherein various channels, located in the interior of the apparatus, facilitate and/or guide the movement of the apparatus during use.

The embodiments of the surgical staple remover apparatus will be described heretofore with reference to FIGS. **2** through **8**C below. FIG. **2**A is a left side view of the surgical staple remover **200** in an open position, in accordance with one embodiment. The apparatus **200** may be composed of a conventional medical device material such as stainless steel and other metal alloys, or a disposable material, such as plastic or a plastic derivative, so that the apparatus (or a portion thereof, such as the removable and replaceable front end) may be disposed after a single use, thereby eliminating the necessity for cleaning or sterilizing the apparatus (or a portion thereof) between uses. One or more of the components that comprise the apparatus **200** may be stamp manufactured from a planar metallic sheet or molded from plastic using conventional plastic molding processes. See FIG. **6** which shows an exploded view of the components of the surgical staple remover **200**. The low number of parts, especially moving parts, and the simplicity of the design results in a surgical staple remover **200** that is straightforward and inexpensive to fabricate, thereby meeting the requirements for a disposable medical device.

The apparatus **200** may include a body or housing **202** that comprises a handle **204** (for accommodating the palm of a user's hand) and a protruding element **206** that includes the working end **210** (i.e., a front end) of the surgical staple remover, for removing and capturing staples, such as staple **220**. The apparatus **200** may also include a lever **208** (for accommodating one or more of the user's fingers) that rotates about a pivot point when pressed such that the lever **208** moves closer to the handle **204**, i.e., towards the rear of the apparatus **200** or proximally. (The lever **208** may have two covers **602**, **604** shown in the exploded view of FIG. **6**.) Note that the angle between the handle **204** and the lever **208** may be substantially in the range of thirty degrees and ninety degrees. Thus, operation of the apparatus **200** occurs as follows: the user holds the apparatus **200** via the handle **204**, the jaw element of the working end **210** is placed under the staple

200, the lever 208 is pressed by the user's fingers so as to move the lever 208 closer to the handle 204, i.e., proximally, and the working end 210 of the apparatus 200 deforms the staple 220, removes it, and retracts the staple 220 towards the rear of the apparatus 200, or proximally. In one embodiment, a lever 280 (described in greater detail below) is used to remove and replace front end 210.

FIG. 2B is a perspective view of the surgical staple remover 200 in an open position. FIG. 2B further shows that the body or housing 202 of the surgical staple remover 200 may comprise two parts 230, 232, wherein each part comprises one half of the entire housing 202, having an interior volume that encompasses various interior working components of the apparatus 200. The two parts 230, 232 of the housing 202 may be coupled via one or more screws, tabs, or other fasteners. FIG. 2B shows that the protruding element 206 of housing 202 includes an opening 250 that provides access to the interior volume of the housing 202 and from which portions or components of the working end 210 of apparatus 200 project.

FIG. 3 is a right side view of the surgical staple remover 200 in an open position, in accordance with one embodiment. FIG. 3 shows one view of the apparatus 200 wherein the part 232 of the housing 202 has been removed such that the interior components of the apparatus 200 may be viewed. FIG. 3 shows that the lever 208 is pivotally or rotatably connected to the part 230 of housing 202 at pivot point 302 such that the lever 208 rotates or pivots about the pivot point 302. A pivot point is point wherein a first element is attached to a second element and wherein the first element may pivot or rotate about the pivot point. A pivot point may, for example, include a screw, shaft, hinge or other attachment mechanism that both attaches the first element to the second element but that still allows the first element to pivot or rotate. FIG. 3 also shows that a rigid first beam 310 is rotatably connected to lever 208 at pivot point 312 such that first beam 310 rotates with respect to the lever 208 about the pivot point 312. The pivot point 312 is located at a first end of first beam 310. Another pivot point 326 is located at the second end of first beam 310.

In this document, the terms pivotally or rotatably connected or coupled refers to a first element being attached to a second element in such a way that the first element and/or the second element may rotate or pivot in relation to the other element. The attachment mechanism between the first and second elements may be a hinge, socket, joint, gate or the like. Also, the term mechanically connected or coupled refers to a first element being either directly to indirectly attached to a second element using mechanical means. For example, lever 208 is mechanically coupled to arm 350, since beams 310 and 320 provide the connection between lever 208 and arm 350.

FIG. 3 also shows a rigid second beam 320 having a first end, a second end and a midpoint. The first end of second beam 320 is rotatably connected to part 230 at pivot point 322 such that the second beam 320 rotates about the pivot point 322. The midpoint of second beam 320 is rotatably connected to first beam 310 at pivot point 326 such that the first beam 310 and second beam 320 rotate with respect to each other about the pivot point 326. Note that pivot point 326 may be located in any location on second beam 320 between the first and second ends of the second beam 320. Note that the pivot points 302, 312, 326 and 322 may comprise pin and bore embodiments, wherein an orifice or bore is located in one or both elements of the pivot point, and a pin or shaft extends through the bore. In one embodiment, the aforementioned pivot points include a bore, a pin comprising a screw and one or more washers to facilitate the rotation of one or both elements about the screw.

The apparatus 200 also includes an arm 350, which comprises a planar element that extends from the interior of the housing 202, through the protruding element 206 and extending out of the opening 250. The arm 350 includes a hook element 352 at a distal end, wherein the hook element 352 comprises a hook shaped element that protrudes downwards from the arm 350. The downward facing hook element 350 includes a footprint for placement on top of a crown of a surgical staple. The hook element 350 serves to hook or grab the removed surgical staple as it is retracted towards the rear of the apparatus 200, or proximally.

FIG. 3 shows the second end of second beam 320 is rotatably connected to arm 350 at pivot point 324 such that the second beam 320 and arm 350 rotate with respect to each other about the pivot point 324. In one embodiment, the pivot point 324 may comprise a sliding or dynamic pivot point wherein the location of the pivot point in arm 350 is not fixed. In this embodiment, the pivot point 324 may comprise a channel or cutout 332 in the arm 350. A channel or cutout is a portion of a planar element that has been removed so as to present a gutter or conduit carved out of a surface of the arm 350 or, alternatively, an aperture or orifice of various sizes in the surface of the arm 350. In this embodiment, the pivot point 324 may comprise a pin, rod or shaft that is fixed or secured to the second beam 320 and that extends into or through the channel or cutout 332. As the second beam 320 moves in relation to the arm 350, the second end of second beam 320 (i.e., pivot point 324) moves in the path defined by the channel or cutout 332. The purpose of channel or cutout 332 is to define the movement of the arm 350 in response to the movement of the pivot point 324 due to the rotation of the second beam 320.

In one embodiment, the channel or cutout 332 may extend substantially horizontally in a substantially straight line along the main longitudinal axis of the arm 350, allowing for insertion of the pin, rod or shaft of the second beam 320. In this embodiment, the channel or cutout 332 may have an elongated form with rounded edges. In another embodiment, the channel or cutout 332 may comprise a gutter or conduit or, alternatively, an aperture or orifice, that extends substantially horizontally in a substantially straight line along the main longitudinal axis of the arm 350, wherein the channel allows for insertion of the pin, rod or shaft of the second beam 320.

FIG. 3 also shows that arm 350 includes a channel or cutout 362, which may comprise a first gutter or conduit or, alternatively, an aperture or orifice, that extends substantially horizontally in a substantially straight line along the main longitudinal axis of the arm 350, wherein the first gutter or aperture allows for insertion of a pin, rod or shaft 360, which is affixed or secured to housing 202 and/or parts 230, 232. In another embodiment, the channel or cutout 362 also includes a second gutter or conduit or, alternatively, an aperture or orifice, located at a proximal end of the first gutter or aperture, wherein the second gutter or aperture extends substantially vertically in a substantially straight line, and wherein the second gutter or aperture allows for insertion of the pin, rod or shaft 360. In this embodiment, the channel or cutout 362 comprises substantially an L-shape. The pin, rod or shaft 360 is inserted into the cutout 362 and thus the arm 350 follows the path of the cutout 362 when the arm 350 moves in relation to the housing 202. The purpose of cutout 362 is to define the movement of the arm 350 in relation to the housing 202.

FIG. 3 further shows that arm 350 includes a shaft or protuberance 370 located between the working end 210 and the rear of the arm 350 containing the cutouts 362, 332. The shaft or protuberance 370 comprises a pivot point 372 about which the arm 350 rotates. Further, the housing 202 includes

a channel or cutout **376** (shown in doted lines in FIG. **3** due to the absence of housing **202**), which may comprise a first gutter or aperture that extends substantially horizontally in a substantially straight line along the main longitudinal axis of the protruding element **206** of housing **202**, wherein the first gutter or aperture allows for insertion of the shaft or protuberance **370** of the arm **350**. The shaft or protuberance **370** of arm **350** is inserted into the cutout **376** and thus the arm **350** follows the path of the cutout **376** when the arm **350** moves in relation to the housing **202**. The purpose of cutout **376** is to define the movement of the arm **350** in relation to the housing **202**. Furthermore, the pivot point **372** acts as a pivot about which arm **350** rotates when the arm **350** moves in relation to the housing **202**. The pivot point **372** acts like a fulcrum wherein when the left side of the arm **350** move upwards, the right side of the arm **350** moves downwards, and vice versa.

Lastly, FIG. **3** shows a first spring **380** that is attached to the arm **350** at a top end and attached to the housing **202** at a bottom end. Thus, the bottom end of the spring **380** is stationary with respect to the housing **202**. The spring **380** provides a downward force upon arm **350** as the arm **350** moves upwards and away from the spring **380**. FIG. **3** also shows a second spring **382** that is attached to the arm **350** at a proximal end and attached to the housing **202** at a distal end. Thus, the distal end of the spring **382** is stationary with respect to the housing **202**. The spring **382** provides a distal or outward force upon arm **350** as the arm **350** moves inwards or proximally into the apparatus **200**.

FIG. **4**A is a right side view of the moving interior components of the surgical staple remover **200** in an open position, in accordance with one embodiment. The open position corresponds to a position wherein the apparatus **200** is not in use or has not been activated by a user. In the open position, the lever **208** and the arm **350** are positioned as far forward as the apparatus **200** allows. Further, springs **380** and **382** have not been extended, or fully extended, and therefore the forces provided by the springs **380** and **382** upon the arm **350** are minimal or nonexistent. Note that in the open position, the shaft **360** is located at the top of cutout **362**, the pivot point **324** is located to the right-most location within cutout **332** and the shaft **372** is located in the right-most location within cutout **376**.

FIG. **4**B is a right side view of the moving interior components of the surgical staple remover **200** in an interim position, in accordance with one embodiment. The interim position corresponds to a position wherein the apparatus **200** is in use and has been partially activated by a user while removing a surgical staple. Specifically, the interim position corresponds to a state of use wherein the lever **208** has been pulled back by a user to approximately half or 50 percent of its range of motion. In the interim position, the lever **208** and the arm **350** have been moved towards the rear of the apparatus **200**, or proximally, approximately half or 50 percent of the distance allowed by the apparatus **200**. Further, springs **380** and **382** have been partially extended, and therefore the spring **380** provides a stronger downward force upon arm **350** and spring **382** provides a stronger distal or outward force upon arm **350**.

FIG. **4**B shows that as lever **208** has been pulled back towards the rear or apparatus **200**, the lever **208** has rotated about pivot point **302** such that lever **208** is closer to the absolute vertical of FIG. **4**B. Further, lever **208** has pushed first beam **310** such that the first beam **310** is at substantially a forty-five degree angle with the absolute horizontal of FIG. **4**B. Also, first beam **310** has pushed second beam **320** such that second beam **320** is closer to the absolute vertical of FIG. **4**B. Note also that the angle between the first beam **310** and the second beam **320** has changed. Whereas in FIG. **4**A, an acute angle is made between the vertices **312**, **326** and **324**, in FIG. **4**B, the relationship between the first beam **310** and the second beam **320** has changed such that an obtuse angle is made between the vertices **312**, **326** and **324**.

FIG. **4**B also shows that as second beam **320** has rotated, the pivot point **324** has travelled substantially to the rear-most/left-most portion of the cutout **332**. Further, as the second beam **320** has rotated such that the pivot point **324** has travelled upwards, due to the interaction of the pivot point **324** with the cutout **332**, the rear portion of the arm **350** has moved upwards. Consequently, due to the role played by the pivot point **372** as a fulcrum, as the rear portion of the arm **350** has moved upwards, the front or distal portion of the arm **350** (i.e., the hook element **352**) has moved downwards.

FIG. **4**B further shows that as the rear portion of the arm **350** has moved upwards, the pivot point **360** has travelled downwards towards the vertex of the L-shaped cutout **362**, or the rear-most/left-most portion of the cutout **362**. Lastly, FIG. **4**B shows that as the arm **350** has moved towards the rear of the apparatus **200**, i.e., proximally, the pivot point **372** has travelled proximally towards the rear of the cutout **376**.

FIG. **4**C is a right side view of the moving interior components of the surgical staple remover **200** in a closed position, in accordance with one embodiment. Specifically, the closed position corresponds to a state of use wherein the lever **208** has been pulled back by a user to the fullest or 100 percent of its range of motion. In the closed position, the lever **208** and the arm **350** have been moved to the rear of the apparatus **200** as far back as allowed by the apparatus **200**. Further, springs **380** and **382** have been fully extended, and therefore the spring **380** provides the fullest extent of its downward force upon arm **350** and spring **382** provides the fullest extent distal or outward force upon arm **350**.

FIG. **4**C shows that as lever **208** has been pulled back towards the rear or apparatus **200**, the lever **208** has rotated about pivot point **302** such that lever **208** is substantially parallel to the handle **204**. Further, first beam **310** has pushed second beam **320** such that the angle between the first beam **310** and the second beam **320** (i.e., the angle made between the vertices **312**, **326** and **322**) is smaller or more acute than the same angle in FIG. **4**B. Further, the angle made between the vertices **312**, **326** and **324** in FIG. **4**C is closer to 180 degrees than the same angle made in FIG. **4**B.

FIG. **4**C also shows that as second beam **320** has rotated, the pivot point **324** remains substantially at the rear-most or left-most portion of the cutout **332**. Further, as the arm **350** has moved towards the rear of apparatus **200**, the pivot point **360** has travelled forwards towards the forward-most or right-most portion of the cutout **362**. Lastly, FIG. **4**C show that as the arm **350** has moved towards the rear of the apparatus **200**, the pivot point **372** has travelled towards the rear-most or left-most portion of the cutout **376**.

FIG. **5**A is a right side view of the components of the working end **210** of the surgical staple remover **200** in the open position, while FIG. **5**B is a right side view (with a slightly angled perspective) of the components of the working end **210** in the interim position, and FIG. **5**C is a right side view (with a slightly more angled perspective) of the components in the closed position.

The working end **210** of the surgical staple remover **200** includes a dual-toothed jaw element **502** protruding from the bottom portion of the working end **210** of the surgical staple remover **200** (see FIGS. **5**A through **5**C). The dual-toothed jaw element **502** may be integrally formed (such as via a stamping process) from one continuous piece of plastic, metal or alloy (or the like). The dual-toothed jaw element **502** includes two parallel jaws **512** and **514** that point in an upward

direction. The top surface of the jaws **512** and **514** includes a dip or indentation **522**, **524** in which a surgical staple **220** is secured while it is deformed during removal. The dual-toothed jaw element **502** may have a size and shape that allows its insertion underneath a crown of a conventional surgical staple **220**. The dual-toothed jaw element **502** may further be engineered to allow for slight lateral expansion to ease the deforming of the surgical staple.

Recall the arm **350** includes a downward facing hook element **352**, which may comprise a curved element that protrudes downward from one end of the arm **350**, the tip of which includes a footprint for placement on top of a crown of a surgical staple. The hook element **352** serves to hook or grab the removed staple as it is retracted towards or into the opening **250** of the apparatus **200**. The gap between the two parallel jaws **512** and **514** of jaw element **502** corresponds to, or accommodates, a profile of the hook element **352** (see FIG. **5**B and FIG. **5**C).

The hook element **352** and jaw element **502** work in concert to remove surgical staples. At rest, the hook element **352** is separated from the jaw element **502** so as to produce a space between the two items (see the open position of FIG. **5**A). The apparatus **200** is maneuvered such that the jaw element **502** is placed underneath the crown of the surgical staple to be removed. The crown of the surgical staple to be removed rests on top of the jaws **512** and **514**. Upon retraction the arm **350**, the hook element **352** is moved downward towards the jaw element **502** and is eventually moved in between the jaws **512** and **514** of the jaw element **502** (see the interim position of FIG. **5**B). In so doing, the hook element **352** deforms the crown of the surgical staple such that the staple crown is bent into a U-shaped configuration, causing the L-shaped legs of the staple to shift upwardly and outwardly so that they may be lifted away from the patient's skin. Subsequently, upon full retraction of the arm **350**, the hook element **352** grabs the deformed and removed surgical staple and moves it underneath strip element **550** and in the direction of the rear of apparatus **200**, i.e., proximally (see the closed position of FIG. **5**C).

FIG. **5**C shows that strip element **550** includes dual pronged jaw element **552**, which mirrors the jaw element **502**, such that jaw element **552** is curved upwards. FIG. **5**C shows that the strip element **550** is located on top of jaw element **502** such that there is a narrow space between jaw element **502** and strip element **550** to allow the removed and deformed staple to be held securely in the removal and storage process. When the hook element **352** moves a removed surgical staple towards the opening **250**, the removed surgical staple is moved under the strip element **550** and held in place between the jaw element **502** and strip element **550**. The strip element **550** may comprise a strip of plastic or a shape memory alloy that includes one or more bends. The strip element **550** may hold a plurality of removed surgical staples in between the narrow gap between the element **550** and jaw element **502**. In this manner, multiple surgical staples can be quickly and easily removed, and securely captured by, the apparatus **200**.

FIG. **7**A is a right side view of interior components of the surgical staple remover **200** in the open position, in accordance with one embodiment. Recall the open position corresponds to a position wherein the apparatus **200** is not in use or has not been activated by a user. In the open position, the arm **350** is positioned as far forward as the apparatus **200** allows and the arm **350** is situated substantially horizontally such that arm **350** is parallel or near parallel to the horizontal **704**. Also recall that the spring **380** is disposed substantially vertically or substantially at a forty-degree angle **708** from the vertical **702**. The lower end of the spring **380** is attached in a stationary fashion to a point on housing **202** lower than the arm **350** and that the upper end of the spring **380** is attached to a point on a proximal end and a lower end of the arm **350**. Thus, spring **380** provides a downwards force on the proximal end and a lower end of the arm **350**. Further recall that the spring **382** is disposed substantially horizontally such that the distal end of the spring **382** is attached in a stationary fashion to a point on housing **202** and that the proximal end of the spring **382** is attached to a point on the arm **350**. Thus, spring **382** provides forward force (i.e., a force in the forward or distal direction) on the arm **350**. In the open position, springs **380** and **382** have not been extended, or fully extended, and therefore the forces provided by the springs **380** and **382** upon the arm **350** are minimal or nonexistent.

The attachment of a spring to the arm **350** (or other interior component of **200**) or to the housing **200** may be effectuated in a variety of ways. In one embodiment, springs **380** and **382** may be tension, extension or compression springs and each end of the springs comprise a hook shaped element wherein the hook shaped element is inserted into an orifice in either the arm **350** (or other interior component of **200**) or to the housing **200**. The springs **380** and **382** have any of a variety of shapes and pitches including barrel, conical, hourglass, constant pitch or variable pitch.

FIG. **7**B is a right side view of interior components of the surgical staple remover **200** in the interim position, in accordance with one embodiment. Recall the interim position corresponds to a position wherein the apparatus **200** is in use and has been partially activated by a user while removing a surgical staple. Specifically, the interim position corresponds to a state of use wherein the lever **208** has been pulled back by a user to approximately half or 50 percent of its range of motion. In the interim position, the rear of the arm **350** has been moved upwards within the housing of the apparatus **200**. Note also that the proximal or rear end of arm **350** has moved upwards, causing the arm **350** to move from its horizontal or near horizontal position, thereby causing the arm **350** to exhibit an acute angle **706** from the horizontal **704**.

Note that while in FIG. **7**A the spring **380** is disposed substantially at a forty-degree angle **708** from the vertical **702**, in FIG. **7**B, due to the movement of the arm **350** (in the proximal and upwards directions), the spring **380** is disposed substantially at a smaller or more acute angle **712** from the vertical **702**. Further note that due to the movement of the arm **350** in the upwards direction, the spring **380** has been elongated. Thus, due to the load placed on spring **380** and the resulting elongation of the spring **380**, the spring **380** provides a greater downwards force on the proximal end and a lower end of the arm **350**, as compared to the force exhibited by spring **380** in FIG. **7**A.

Also note that due to the movement of the arm **350** in the proximal or rear direction, the spring **382** has been elongated. Thus, due to the load placed on spring **382** and the resulting elongation of the spring **382**, the spring **382** provides a greater forwards or distal force on the arm **350**, as compared to the force exhibited by spring **382** in FIG. **7**A. In summary, FIG. **7**B shows that springs **380** and **382** have been partially extended, and therefore the spring **380** provides a greater downward force upon arm **350** and spring **382** provides a greater distal or outward force upon arm **350**.

FIG. **7**C is a right side view of interior components of the surgical staple remover **200** in the closed position, in accordance with one embodiment. Specifically, the closed position corresponds to a state of use wherein the lever **208** has been pulled back by a user to the fullest or 100 percent of its range of motion. Recall that in the closed position, the lever **208** and the arm **350** have been moved to the rear of the apparatus **200**

as far back as allowed by the apparatus **200**, namely, by distance **731**. Note also that the arm **350** continues to exhibit an acute angle **707** from the horizontal **704**.

Note that while in FIG. **7**B the spring **380** is disposed substantially at an acute angle **712** from the vertical **702**, in FIG. **7**C, due to the movement of the arm **350** (in the proximal or rear direction), the spring **380** is disposed substantially at an acute angle **714** on the other side of the vertical **702**, i.e., the angle of spring **380** may have changed up to forty five degrees in the proximal or rear direction. Further note that due to the movement of the arm **350** in the proximal or rear direction, the spring **380** has been further elongated. Thus, due to the increased load placed on spring **380** in FIG. **7**C and the resulting further elongation of the spring **380**, the spring **380** provides an even greater downwards force on the proximal end and a lower end of the arm **350**, as compared to the force exhibited by spring **380** in FIG. **7**B.

Also note that due to the movement of the arm **350** in the proximal or rear direction, the spring **382** has been further elongated. Thus, due to the increased load placed on spring **382** in FIG. **7**C and the resulting further elongation of the spring **382**, the spring **382** provides an even greater forwards or distal force on the arm **350**, as compared to the force exhibited by spring **382** in FIG. **7**B. In summary, in FIG. **7**C springs **380** and **382** have been fully extended, and therefore the spring **380** provides the fullest extent of its downward force upon arm **350** and spring **382** provides the fullest extent of its distal or outward force upon arm **350**.

The purpose of the forces exhibited by the springs **380** and **382** is to facilitate or guide the movement of the components of the apparatus, such as arm **350**, so as to aid in the removal of surgical staples. Further, the forces exhibited by the springs **380** and **382** is to facilitate or guide the movement of the components of the apparatus back to the open position, such that the user need only apply pressure to the lever **208** of the apparatus **200** to remove a surgical staple, and the spring loaded movement of the apparatus automatically returns the apparatus back to the open position. This is an improvement over the prior art, such as surgical staple remover **1**, shown in FIG. **1**, wherein—like a conventional scissor—the user must place pressure on the handles to remove the surgical staple and must also apply reverse pressure to place the staple remover back in the open position.

FIG. **8**A is an illustration of various channels or cutouts of the surgical staple remover in the open position, in accordance with one embodiment. In the open position, the shaft **360** is located at the top of cutout **362**, the pivot point **324** is located to the right-most location within cutout **332** and the shaft **372** is located in the right-most location within cutout **376**.

FIG. **8**B is an illustration of various channels or cutouts of the surgical staple remover in the interim position, in accordance with one embodiment. In the interim position, the pivot point **324** has travelled proximally or towards the left of cutout **332**. Also, the shaft **360** has travelled downwards towards the vertex of the L-shaped cutout **362**, or the rear-most or left-most portion of the cutout **362**. Lastly, the shaft **372** has travelled slightly towards the left or the rear of the cutout **376**.

FIG. **8**C is an illustration of various channels or cutouts of the surgical staple remover in the closed position, in accordance with one embodiment. In the closed position, the pivot point **324** has moved to the rear-most or left-most portion of the cutout **332**. Further, the shaft **360** has travelled distally or forwards towards the forward-most or right-most portion of the cutout **362**. Lastly, the shaft **372** has travelled towards the rear-most or left-most portion of the cutout **376**.

The purpose of the cutouts **362**, **332** and **376** is to facilitate or guide the movement of the components of the apparatus, such as arm **350** and beam **320**, so as to aid in the removal of surgical staples. Further, the cutouts facilitate or guide the movement of the arm **350** of the apparatus **200** such that the arm first moves downwards towards the surgical staple to be removed, so as to deform the staple, and then, as the lever **208** continues to be pressed, the arm **350** moves back or retracts, so as to retract the staple that has been removed. This is an improvement over the prior art, such as surgical staple remover **1**, shown in FIG. **1**, wherein the user removes the surgical staple and must make additional arrangements to retract and catch the removed surgical staple for proper disposal (which may entail additional movements or actions on the user's part). The apparatus **200**, on the other hand, allows the apparatus **200** to remain stationary, while the user simply retracts the lever **208** with a single movement in one direction, while the arm **350** moves in different directions to deforms the staple and retract it, in order to capture the staple.

Although not shown in the figures, in one embodiment the surgical staple remover **200** may include a miniature battery-powered LED on top of the opening **250** of housing **202**, or on top of the working end **210**, wherein the LED points at the service end of the apparatus **200** so as to illuminate the area surrounding the staple being removed. Alternatively, the LED may be placed on top of the arm **350**, on top of the tip **352** of the arm **350**, on top of the working end **210**, under the working end **210** or under the opening **250** of housing **202**.

Although specific embodiments of the invention have been disclosed, those having ordinary skill in the art will understand that changes can be made to the specific embodiments without departing from the spirit and scope of the invention. The scope of the invention is not to be restricted, therefore, to the specific embodiments. Furthermore, it is intended that the appended claims cover any and all such applications, modifications, and embodiments within the scope of Applicant's surgical staple remover apparatus.

What is claimed is:

1. A surgical staple remover apparatus, comprising:

a handle located at a rear of the apparatus;

an upward sloped jaw element comprising a pair of jaws;

an arm having a hook element on a distal end, wherein the arm is positioned such that the hook element is disposed over the jaw element;

a channel cut out of a surface of the arm;

a rigid element having a first portion movably coupled to the channel such that the first portion moves within the channel;

a lever mechanically coupled to the rigid element, wherein moving the lever closer to the handle results in the first portion of the rigid element moving upwards and proximally within the channel of the arm, a proximal end of the arm moving upwards, the hook element moving downwards towards the jaw element, and the arm retracting proximally, thereby resulting in the hook element pressing against a crown of a surgical staple, deforming the surgical staple for removal and moving the surgical staple proximally; and

a strip element located on top of the jaw element, such that when the hook element deforms and moves the surgical staple proximally, the surgical staple is moved under the strip element and held in place by same.

2. The surgical staple remover apparatus of claim **1**, wherein the jaw element comprises a size and shape that allows insertion of the jaw element underneath a crown of a surgical staple.

3. The surgical staple remover apparatus of claim 2, wherein a gap between the parallel jaws of the jaw element corresponds to a profile of the hook element.

4. The surgical staple remover apparatus of claim 3, wherein the hook element comprises a hook shaped element that protrudes downward from a tip of the arm.

5. The surgical staple remover apparatus of claim 4, wherein the strip element includes a gap that corresponds to a profile of the hook element.

6. The surgical staple remover apparatus of claim 5, further comprising a pivot point located between the proximal end and the distal end of the arm, such that the arm pivots about the pivot point.

7. The surgical staple remover apparatus of claim 6, wherein the pivot point comprises a pin coupled to the arm and an orifice comprising an elongated form with circular edges located in the housing.

8. The surgical staple remover apparatus of claim 1, wherein the channel comprises an orifice having an elongated shaped that travels along a main longitudinal axis of the arm.

9. The surgical staple remover apparatus of claim 8, wherein the first portion of the rigid element comprises a pin that is inserted into the channel.

10. The surgical staple remover apparatus of claim 9, wherein the rigid element comprises a rigid bar comprising a pin on a first end of the rigid bar and a hinge at a second end of the rigid bar.

11. A surgical staple remover apparatus, comprising:

a handle located at a rear of the apparatus;

an upward sloped jaw element comprising a pair of jaws;

an arm having a hook element on a distal end, wherein the arm is positioned such that the hook element is disposed over the jaw element;

a first channel cut out of a surface of the arm;

a rigid element having a first portion movably coupled to the first channel such that the first portion moves within the first channel;

a housing having an interior volume that encompasses at least a portion of the arm;

a second channel cut out of the surface of the arm;

a stationary pin coupled to the housing and extending into the second channel such that the second channel moves about the pin;

a lever mechanically coupled to the rigid element, wherein moving the lever closer to the handle results in the first portion of the rigid element moving upwards and proximally within the first channel of the arm, a proximal end of the arm moving upwards, the second channel moving about the stationary pin, the hook element moving downwards towards the jaw element, and the arm retracting proximally, thereby resulting in the hook element pressing against a crown of a surgical staple, deforming the surgical staple for removal and moving the surgical staple proximally; and

a strip element located on top of the jaw element, such that when the hook element deforms and moves the surgical staple proximally, the surgical staple is moved under the strip element and held in place by same.

12. The surgical staple remover apparatus of claim 11, wherein the jaw element comprises a size and shape that allows insertion of the jaw element underneath a crown of a surgical staple.

13. The surgical staple remover apparatus of claim 12, wherein a gap between the parallel jaws of the jaw element corresponds to a profile of the hook element.

14. The surgical staple remover apparatus of claim 13, wherein the hook element comprises a hook shaped element that protrudes downward from a tip of the arm.

15. The surgical staple remover apparatus of claim 14, wherein the strip element includes a gap that corresponds to a profile of the hook element.

16. The surgical staple remover apparatus of claim 15, wherein the first channel comprises an orifice having an elongated shaped that travels along a main longitudinal axis of the arm.

17. The surgical staple remover apparatus of claim 16, wherein the second channel comprises an orifice having an L-shape that travels downwards and along the main longitudinal axis of the arm.

18. A surgical staple remover apparatus, comprising:

a handle located at a rear of the apparatus;

an upward sloped jaw element comprising a pair of jaws;

an arm having a hook element on a distal end, wherein the arm is positioned such that the hook element is disposed over the jaw element;

a first channel cut out of a surface of the arm, wherein the first channel comprises an orifice having an elongated shaped that travels along a main longitudinal axis of the arm;

a rigid element having a first portion movably coupled to the first channel such that the first portion moves within the first channel;

a housing having an interior volume that encompasses at least a portion of the arm;

a second channel cut out of the surface of the arm, wherein the second channel comprises an orifice having an L-shape that travels downwards and along the main longitudinal axis of the arm;

a stationary pin coupled to the housing and extending into the second channel such that the second channel moves about the pin;

a third channel cut out of a surface of the housing, wherein the arm comprises a pin movably coupled to the third channel such that the pin moves within the third channel;

a lever mechanically coupled to the rigid element, wherein moving the lever closer to the handle results in the first portion of the rigid element moving upwards and proximally within the first channel of the arm, a proximal end of the arm moving upwards, the second channel moving about the stationary pin, the hook element moving downwards towards the jaw element, the arm retracting proximally, and the pin moving proximally within the third channel of the arm, thereby resulting in the hook element pressing against a crown of a surgical staple, deforming the surgical staple for removal and moving the surgical staple proximally; and

a strip element located on top of the jaw element, such that when the hook element deforms and moves the surgical staple proximally, the surgical staple is moved under the strip element and held in place by same.

19. The surgical staple remover apparatus of claim 18, further comprising an LED positioned under the housing and arranged so as to illuminate an area distal to the jaw element.

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