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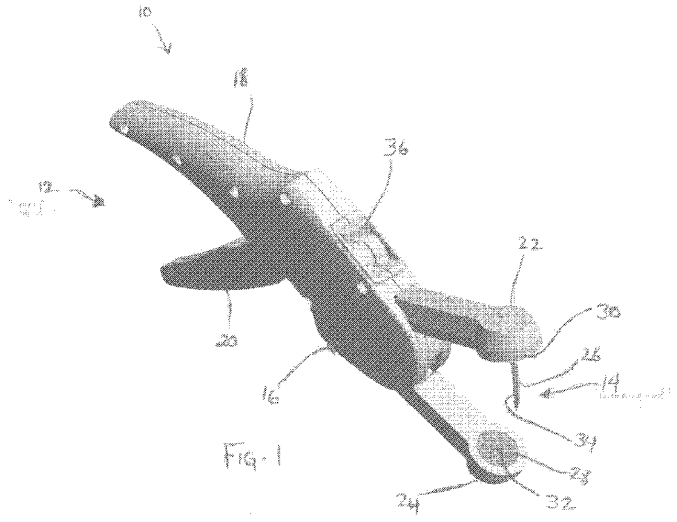



FIG. 1

(57) Abstract: The present invention is directed to a device for suturing having a grip end and a working end. The grip end includes a stationary handle and a pivoting handle. The working end includes an upper jaw and a lower jaw that are squeezed together, when the pivoting handle is squeezed to the stationary handle. The jaws are configured to accommodate a needle. Each of the upper jaw and the lower jaw include mechanics for retaining and releasing the needle and the needle can have corresponding geometry, in order to ensure that the needle is held securely. A toggle lever actuates the mechanics to switch the needle from the upper jaw to the lower jaw, or vice versa, when the jaws are in the closed position. The device can be used to suture tissue, such as fascia, during surgery to close an incision, or in the field to close a wound.

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# SUTURE NEEDLE TRANSFER DEVICE FOR CLOSURE OF SURGICAL INCISIONS

## CROSS REFERENCE TO RELATED APPLICATION

**[0001]** This application claims the benefit of U.S. Provisional Patent Application No. 61/928,580 filed on January 17, 2014, which is incorporated by reference, herein, in its entirety.

## FIELD OF THE INVENTION

**[0002]** The present invention relates generally to surgery. More particularly, the present invention relates to a device for the closure of wounds and surgical incisions, and reapproximation of tissue.

## BACKGROUND OF THE INVENTION

**[0003]** Many surgical procedures and wound closures require sutures to be placed by a physician. In general, physicians manually stitch the incision or wound together. Best practice procedures often call for sutures to be placed evenly from one another, in order to prevent complications. This can often be difficult and time consuming to do by hand, leading to inconsistencies in suture placement. One exemplary type of surgery or wound closure, requiring complicated suturing, is for abdominal suturing or wound closure. For abdominal suturing, surgeons manually stitch the incised fascia together with a large, semi-circular needle attached to a suture, and often need additional devices such as a malleable, a metal plate placed between the internal organs and the fascia, used to prevent bowel puncture. Best practices call for abdominal sutures to close fascia to be placed evenly, 1 cm apart, in order to prevent complications.

**[0004]** In the event of war, natural disaster, or other instances where a person may experience trauma or injury, any affected tissue may need to be reapproximated to provide hemostasis, to

prevent further injury, or to allow return of function. In these situations, it may be necessary to reapproximate tissue in an efficient and expeditious manner to minimize further risk of harm to the affected individual. In these circumstances, an ideal instrument to reapproximate separated tissue allows quick deployment, ease of use, and can be operated with one hand to allow the most opportunity for the injured individual to use the device to control his or her own injury. However, no such instrument is currently available.

**[0005]** It would therefore be advantageous to provide a device for suturing surgical incisions or separated tissue that allows for precision sutures having the appropriate spacing and tension in a shorter amount of time.

## SUMMARY OF THE INVENTION

**[0006]** The foregoing needs are met by the present invention which provides a device for facilitating suturing of an incision or wound including a working end disposed at a distal end of the device for suturing. The working end includes a lower jaw and an upper jaw both configured for retaining a needle. The needle is configured for being coupled to a suture. The device also includes a grip end disposed at a proximal end of the device for suturing. The grip end includes a stationary handle and a pivoting handle, wherein the pivoting handle is configured to pivot with respect to the stationary handle. Additionally, the device includes a hub disposed between the working end and the grip end and containing a first set of mechanics for converting the movement of the pivoting handle with respect to the stationary handle into opening and closing movements for the upper and lower jaws. The hub also includes a second set of mechanics for actuating the passing of the needle from the upper jaw to the lower jaw and vice versa. The second set of mechanics includes first and second locking tabs configured to lock the needle in

place in either the upper or the lower jaws. A toggle lever is included for engaging the second set of mechanics for passing the needle from the upper jaw to the lower jaw.

**[0007]** According to an embodiment of the present invention, the device is designed to allow accommodation of different types of needles in various size and shapes. Depending on the proposed utilization, the device can also include a segment which allows separate modules to be attached. These modules add to the function of the device by providing further capabilities, such as deployment of saline cleaning solution, antibiotics, analgesics, or lighting source. The modules are designed to functionally attach to parts of the device, either through mechanical attachments, magnetic attachments, or by other means of direct attachment.

**[0008]** According to another embodiment of the present invention, a suturing device for facilitating reapproximation of tissue includes a working end formed by a lower jaw and an upper jaw both configured for alternatively retaining a surgical needle. The device includes a grip end formed by a stationary handle and a pivotable handle. The pivotable handle is configured to pivot with respect to the stationary handle. The device includes a hub defining a pivotable joint coupled to both the working end and the grip end. The pivotable joint converts compressing and releasing movements of the grip end into opening and closing movements of the working end. The device also includes a toggle lever coupled with a linkage system for locking and unlocking the surgical needle from the lower jaw or the upper jaw. Additionally, the device includes a means for holding the needle within the upper and the lower jaw and for switching the surgical needle between the lower and the upper jaw of the working end.

**[0009]** According to yet another aspect of the present invention, the device includes a surgical needle with two sharp ends can be retained in either the lower jaw or the upper jaw of the

working end. The surgical needle includes a hole between its two sharp tips for carrying sutures. The device can include one or more add-on modules for additional functions based on different purposes, including but not being limited to lighting, retraction, and liquids. The add-on modules are connected to the body of the device using one of a tracked groove and magnets. The linkage system, includes mechanics to convert the movement of the grip end into the movement of the working end. The mechanics can includes a configuration that a drive tab in contact with a spring and the spring is coupled to a locking tab which locks and releases the needle. Coupling methods between the locking tab and the needle can be but are not limited to the keyhole coupling with notches on the needle. The stationary handle of the grip end can be integrated into and extends from the hub or can also be a separate component. The working end can be straightly or angularly coupled with the hub. The toggle lever can be located on top, side, or beneath the body of the hub in shapes of trigger or switch.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0010]** The accompanying drawings provide visual representations, which will be used to more fully describe the representative embodiments disclosed herein and can be used by those skilled in the art to better understand them and their inherent advantages. In these drawings, like reference numerals identify corresponding elements and:

**[0011]** FIG. 1 illustrates a device for suturing a surgical incision or wound, according to an embodiment of the present invention.

**[0012]** FIGS. 2A-2D illustrate a needle transfer cycle for a device for suturing according to an embodiment of the present invention.

**[0013]** FIGS. 3A-3G illustrate side views of upper and lower jaws and a needle for the suture device according to an embodiment of the invention, wherein the side views of the upper and lower jaws illustrate the jaws and the needle in different positions.

**[0014]** FIGS. 4A and 4B illustrate sectional views of a working end of the device for suturing according to an embodiment of the present invention.

**[0015]** FIGS. 5A and 5B illustrate perspective and underside views, respectively, of an upper or a lower jaw, according to an embodiment of the present invention.

**[0016]** FIGS. 6A and 6B illustrate a working end of the device according to an embodiment of the present invention.

**[0017]** FIG. 7 illustrates a side view of a device for suturing according to an embodiment of the present invention.

**[0018]** FIGS. 8 and 9 illustrate side views of devices for suturing according to embodiments of the present invention.

**[0019]** FIGS. 10A-10D illustrate a needle transfer cycle for a device for suturing according to an embodiment of the present invention.

**[0020]** FIGS. 11A-11D illustrate sectional views of a working end of a device for suturing according to an embodiment of the present invention, during a needle transfer cycle.

**[0021]** FIGS. 12A-12D illustrates a working end of a device for suturing according to an embodiment of the present invention.

**[0022]** FIGS. 13A-13D illustrates a working end of a device for suturing according to an embodiment of the present invention.

**[0023]** FIGS. 14A-14D illustrates a working end of a device for suturing according to an embodiment of the present invention.

**[0024]** FIGS. 15A-15D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention.

**[0025]** FIGS. 16A-16D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention.

**[0026]** FIGS. 17A-17D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention.

**[0027]** FIGS. 18A-18D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention.

**[0028]** FIGS. 19A-19D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention.

**[0029]** FIGS. 20A-20D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention.

**[0030]** FIGS. 21A-21C illustrate a module and attachment of the module to a device for suturing according to an embodiment of the present invention.

## DETAILED DESCRIPTION

**[0031]** The presently disclosed subject matter now will be described more fully hereinafter with reference to the accompanying Drawings, in which some, but not all embodiments of the

inventions are shown. Like numbers refer to like elements throughout. The presently disclosed subject matter may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Indeed, many modifications and other embodiments of the presently disclosed subject matter set forth herein will come to mind to one skilled in the art to which the presently disclosed subject matter pertains, having the benefit of the teachings presented in the foregoing descriptions and the associated Drawings. Therefore, it is to be understood that the presently disclosed subject matter is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims.

**[0032]** The present invention is directed to a device for suturing having a grip end for the physician to hold and a working end for executing the sutures. The grip end includes a stationary handle and a pivoting handle, such that the pivoting handle can be squeezed to the stationary handle. The working end includes an upper jaw and a lower jaw that are squeezed together, when the pivoting handle is squeezed to the stationary handle. The upper and lower jaws are configured to accommodate a suturing needle. Each of the upper jaw and the lower jaw include mechanics for retaining and releasing the needle, and the needle can have corresponding geometry, in order to ensure that the needle is held securely. A toggle lever actuates the mechanics to switch the needle from the upper jaw to the lower jaw, or vice versa, when the jaws are in the closed position. The device can be used to suture tissue, such as fascia, during surgery to close an incision, or in the field to close a wound.

**[0033]** FIG. 1 illustrates a device for suturing a surgical incision or wound, according to an embodiment of the present invention. As illustrated in FIG. 1, a device for suturing 10 includes a

grip end 12 disposed at a proximal end of the device for suturing 10 and a working end 14 disposed at a proximal end of the device for suturing. The device for suturing 10 also includes a hub 16 disposed between the grip end 12 and the working end 14. The hub 16 includes internal components (not shown) that assist in the function of the device for suturing 10 and will be described herein. Further, the grip end 12 includes a first grip member 18. As illustrated in FIG. 1, the first grip member 18 is integrated into and extends from the hub 16. However, the first grip member 18 may also be a separate component, simply coupled to the hub with a fastener, fitting, or other means of connection. The grip end 12 also includes a second grip member 20 disposed below the first grip member 18. The second grip member 20 is coupled to the device 10 approximately where the hub 16 meets the first grip member 18. The second grip member 20 is coupled and positioned such that it is pivotable with respect to the hub 16 and is brought into closer proximity to the first grip member18.

**[0034]** As illustrated in FIG. 1, the working end 14 includes an upper jaw 22, a lower jaw 24, and a needle 26. The upper jaw 22 and the lower jaw 24 are coupled to the hub 16 in such a way that they are pivotable with respect to the hub 16 and also open and close together. The lower jaw includes a lower cup 28 for receiving the needle 26 and the upper jaw includes an upper cup 30 for receiving the needle 26. Both the lower cup 28 and the upper cup 30 define an opening 32 for receiving the needle 26. Additionally, the needle 26 includes a notch 34 configured to allow a gripper bar (not pictured) within the device, to hold the needle in either the lower cup 28 or as illustrated in FIG. 1, the upper cup 30. In function, when the second grip member 20 is squeezed, the upper and lower jaws 22, 24 are squeezed together and the needle 26 enters the opening in the cup it is not secured in. In order to switch the cup in which the needle is secured, toggle lever 36 is displaced to a forward position.

**[0035]** The needle 26 includes a distal sharpened end and a proximal sharpened end. The needle 26 also includes a hole transversely therethrough, defined by the body of the needle 26 and configured to allow for the connection of suturing materials. The hole is disposed between the distal sharpened end and the proximal sharpened end. As will be described further herein, the needle can include a feature or features 34 that correspond to geometry of the mechanics and gripper bar within the upper and lower cups of the working end of the device. It should be noted that the needle can be included integrally with the device or can be a separate component, or any other suitable suturing needle known to or conceivable by one of skill in the art.

**[0036]** FIGS. 2A-2D illustrate a needle transfer cycle for a device for suturing according to an embodiment of the present invention. More particularly, FIG. 2A illustrates the device for suturing in an open position with the needle retained in the cup of the upper jaw. Both the grip members and the upper and lower jaws are fully separated in the open position. In the open position illustrated in FIG. 2A, the toggle lever is not accessible. FIG. 2B illustrates the device for suturing in a closed position. Both the grip members and the upper and lower laws are fully compressed together in the closed position. The compression of the grip members is converted at the hub to bring the upper and lower jaws together. The needle is disposed within the opening in the top cup and the opening in the lower cup. It should be noted that the top cup and the lower cup are preferably configured such that the needle sits within but also such that the needle does not penetrate through the upper or the lower cup. Any other suitable configuration that allows the needle to be held within the upper and the lower cup can also be used.

**[0037]** In the closed position, illustrated in FIG. 2B, the toggle lever is accessible for changing whether the needle is retained in the cup of the upper jaw or in the cup of the lower jaw. FIG. 2C

illustrates the device for suturing in the closed position illustrated in FIG. 2B. However, in FIG. 2C the toggle lever is pushed forward in order to transfer the needle from one cup to the other. FIG. 2D illustrates the device for suturing in the open position with the needle retained in the cup of the lower jaw. Both the grip members and the upper and lower jaws are fully separated in the open position. In the open position illustrated in FIG. 2D, the toggle lever is pushed forward and is not accessible.

**[0038]** FIGS. 3A-3G illustrate side views of upper and lower jaws and a needle for the suture device according to an embodiment of the invention, wherein the side views of the upper and lower jaws illustrate the jaws and the needle in different positions. FIG. 3A illustrates the upper and lower jaws in an open position. In FIG. 3A the jaws are ready to receive the needle and needle locking tabs within the jaws and described further herein are retracted using a manual override, such that the needle can be loaded into the device. FIG. 3B illustrates the needle loaded in the jaws and both the upper and the lower jaw closed on the needle. In the position illustrated in FIG. 3B, the locking tabs are engaged. FIG. 3C illustrates the jaws in an open position and the needle retained in the lower jaw using the lower jaw locking tab. In the position illustrated in FIG. 3C, the lower jaw can be positioned on the tissue to be punctured. FIG. 3D illustrates the jaws in a closed position, such as the jaws would be for puncturing tissue. At this time the locking tabs can be switched such that the upper jaw will retain the needle, when the jaws are reopened. FIG. 3E illustrates the jaws in an open position with the needle retained in the upper jaw using the upper jaw locking tab. The jaws can be pulled away from the tissue to be sutured, repositioned on the fascia and the steps can be repeated. FIG. 3F illustrates the jaws in a closed position with the locking tabs retracted. FIG. 3G illustrates the jaws in an open position and the needle removed.

**[0039]** FIGS. 4A and 4B illustrate sectional views of a working end of the device for suturing according to an embodiment of the present invention. As illustrated in FIG. 4A, the upper jaw and the lower jaw are closed together and have a housing that defines a hollow interior space for accommodating mechanics for actuating the needle locking tabs. FIG. 4B illustrates the upper and lower jaws in an open position and also ghosted behind in a closed position. FIGS. 4A and 4B illustrate linkage drive tabs 36 and 38 that are actuated in order to lock or unlock the needle from the upper jaw or the lower jaw. The linkage drive tabs 36 and 38 are in contact with springs 40 and 42 and the springs are coupled to the locking tabs 44 and 46. The locking tabs 44 and 46, as illustrated in FIGS. 4A and 4B include keyhole and slot grooves 48, 50 for coupling with notches 52 and 54 on the needle in order to lock and release the needle. When the slot of the keyhole and slot groove is engaged with the notch on the needle, the needle is locked in place. FIG. 4B also illustrates the opening 32 in the upper cup 30 for receiving an end of the needle. The opening 32 accommodates the insertion of the end of the needle, such that it can be engaged by the locking tab.

**[0040]** FIGS. 5A and 5B illustrate perspective and underside views, respectively, of an upper or a lower jaw, according to an embodiment of the present invention. More particularly, FIG. 5A illustrates a side view of the upper or the lower jaw. As illustrated in FIG. 5A, the jaw includes a tapered edge. FIG. 5B illustrates an underside view of the jaw. As illustrated in FIG. 5B, the opening includes a chamfered edge to help align the needle with the opening. The jaw can also include visual indicators to show suture depth from the edge of the tissue to the sutured.

**[0041]** FIGS. 6A and 6B illustrate a working end of the device according to an embodiment of the present invention. FIG. 6A illustrates the upper and lower jaws of the working end in an open

position and FIG. 6B illustrates the upper and lower jaws of the working end in a closed position. The bite depth of the jaws is minimized in order to reduce the force required to puncture tissue such as the fascia.

**[0042]** FIG. 7 illustrates a side view of a device for suturing according to an embodiment of the present invention. The device includes a grip end, a working end, and a hub, similarly to the embodiment illustrated in FIG. 1. However, in FIG. 7 the position of the trigger switch is underneath the hub, whereas, with respect to FIG. 1 the trigger switch is positioned on top of the hub.

**[0043]** FIGS. 8 and 9 illustrate side views of devices for suturing according to embodiments of the present invention. FIG. 8 illustrates an embodiment having a trigger underneath the device, wherein the trigger changes the jaw in which the needle is being retained. The device illustrated in FIG. 8 also includes a manual override switch positioned at the top of the device. FIG. 9 illustrates an embodiment having a trigger underneath the device, wherein the trigger changes the jaw in which the needle is being retained. The device illustrated in FIG. 9 also includes a manual override switch positioned on each side of the device.

**[0044]** FIGS. 10A-10D illustrate a needle transfer cycle for a device for suturing according to an embodiment of the present invention. More particularly, FIG. 10A illustrates the device for suturing in an open position with the needle retained in the cup of the upper jaw. Both the grip members and the upper and lower jaws are fully separated in the open position. In the open position illustrated in FIG. 10A, the trigger lever cannot be pulled back to exchange the needle. FIG. 10B illustrates the device for suturing in a closed position. Both the grip members and the upper and lower laws are fully compressed together in the closed position. The needle is

disposed within the opening in the top cup and the opening in the lower cup. In the closed position, illustrated in FIG. 10B, the trigger lever is accessible for changing whether the needle is retained in the cup of the upper jaw or in the cup of the lower jaw. FIG. 10C illustrates the device for suturing in the closed position illustrated in FIG. 2B. However, in FIG. 10C the trigger lever is pulled back in order to transfer the needle from one cup to the other. FIG. 10D illustrates the device for suturing in the open position with the needle retained in the cup of the lower jaw. Both the grip members and the upper and lower jaws are fully separated in the open position. In the open position illustrated in FIG. 2D, the toggle lever is pushed forward and is not accessible.

**[0045]** FIGS. 11A-11D illustrate sectional side views of a working end of a device for suturing according to an embodiment of the present invention, during a needle transfer cycle. As illustrated in FIG. 11A, the trigger lever is pulled back, engaging the linkage drive tab to push forward the locking tab in the lower jaw, by overcoming the resistance of the spring member. Pushing forward the locking tab brings the needle into the keyhole of the locking tab to release it from the lower jaw. Meanwhile, there is no pressure on the spring in the upper jaw and therefore the locking tab is retracted back, such that the needle is being held tightly in the slot of the locking tab. The needle is then retained in the upper jaw. FIG. 11B illustrates the linkage drive tab transitioning from the lower jaw to the upper jaw, in order to change the engagement of the needle. The trigger is actuated in order to cause this movement. FIG. 11C illustrates the linkage drive tab moved to the upper jaw, such that the needle is released from the upper jaw. FIG. 11D illustrates the needle retained in the lower jaw, with the linkage drive tab disposed in the upper jaw.

**[0046]** FIGS. 12A-12D illustrates a working end of a device for suturing according to an embodiment of the present invention. FIGS. 12A-12D illustrate a straight approach for the working end of the device. Therefore, the working end would extend straight with respect to the hub. FIG. 12A illustrates a side view of the jaws in a closed position. FIG. 12B illustrates a perspective view of the jaws in a closed position. FIG. 12C illustrates a side view of the jaws in an open position and FIG. 12D illustrates a perspective view of the jaws in an open position.

**[0047]** FIGS. 13A-13D illustrates a working end of a device for suturing according to an embodiment of the present invention. FIGS. 14A-14D illustrate an angled approach for the working end of the device. Therefore, the working end would extend at an angle with respect to the hub. FIG. 13A illustrates a side view of the jaws in a closed position. FIG. 13B illustrates a perspective view of the jaws in a closed position. FIG. 13C illustrates a side view of the jaws in an open position and FIG. 13D illustrates a perspective view of the jaws in an open position.

**[0048]** FIGS. 14A-14D illustrates a working end of a device for suturing according to an embodiment of the present invention. FIGS. 14A-14D illustrate a tapered/angled approach for the working end of the device. Therefore, the working end would extend at a slight angle with respect to the hub. FIG. 14A illustrates a side view of the jaws in a closed position. FIG. 14B illustrates a perspective view of the jaws in a closed position. FIG. 14C illustrates a side view of the jaws in an open position and FIG. 14D illustrates a perspective view of the jaws in an open position.

**[0049]** FIGS. 15A-15D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention. FIG. 15A illustrates a locking tab having a notch and post geometry for coupling to the needle. FIG. 15B illustrates the needle having a slot

geometry corresponding to the notch and post on the locking tab. The post on the locking tab engages the slot on the needle, locking the needle into position and eliminating twist. FIG. 15C illustrates the locking tab and the needle being engaged together, and FIG. 15D illustrates the locking tab engaged with the needle.

**[0050]** FIGS. 16A-16D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention. FIG. 16A illustrates a locking tab having a notch with a knife edge, and FIG. 16B illustrates the needle, needing no special geometry to engage with the knife-edge locking tab. FIG. 16C illustrates the locking tab and the needle being engaged together, and FIG. 16D illustrates the locking tab engaged with the needle.

**[0051]** FIGS. 17A-17D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention. FIG. 17A illustrates a keyhole and slot locking tab, and FIG. 17B illustrates a needle having corresponding dual slot geometry for engaging with the keyhole slot locking tab. The keyhole and slot locking tab engages dual slots on the needle, locking its position and eliminating twisting. FIG. 17C illustrates the locking tab and the needle being engaged together, and FIG. 17D illustrates the locking tab engaged with the needle.

**[0052]** FIGS. 18A-18D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention. FIG. 18A illustrates a notch locking tab, and FIG. 18B illustrates a needle having corresponding notch geometry for engaging with the notch locking tab. The notch locking tab engages the notch on the needle, locking its position and eliminating twisting. FIG. 18C illustrates the locking tab and the needle being engaged together, and FIG. 18D illustrates the locking tab engaged with the needle.

**[0053]** FIGS. 19A-19D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention. FIG. 19A illustrates a tapered notch locking tab, and FIG. 19B illustrates a needle having corresponding angled notch geometry for engaging with the tapered notch locking tab. The tapered notch locking tab engages the angled notch geometry on the needle, locking its position and eliminating twisting. The tapered notch also has an angled face to undercut the needle and secure the position of the locking tab. FIG. 19C illustrates the locking tab and the needle being engaged together, and FIG. 19D illustrates the locking tab engaged with the needle.

**[0054]** FIGS. 20A-20D illustrate a needle capturing locking tab for a device for suturing, according to an embodiment of the present invention. FIG. 20A illustrates a curved notch locking tab, and FIG. 20B illustrates a needle having corresponding angled notch geometry for engaging with the curved notch locking tab. The curved notch locking tab engages the angled notch geometry on the needle, locking its position and eliminating twisting. The back face of the curved notch matches the curve of the needle to utilize direct pressure to secure the needle. FIG. 20C illustrates the locking tab and the needle being engaged together, and FIG. 20D illustrates the locking tab engaged with the needle.

**[0055]** FIGS. 21A-21C illustrate a module and attachment of the module to a device for suturing according to an embodiment of the present invention. More particularly, FIGS. 21A-21C illustrate the attachment of the module to the device, using a sliding track system. In the embodiment illustrated in FIGS. 21A-21C the device for suturing includes a trigger switch disposed on an underside of the device. The trigger switch can be configured to actuate only the module and therefore used in conjunction with another trigger switch or toggle switch positioned

on the underside, side or top side of the device. Alternately, in some embodiments the present invention can include an automatic needle transfer, and therefore a second trigger or toggle switch would not be needled. Further the trigger mechanism could also be configured to actuate both the module and the needle transfer. The trigger mechanism allows the user to activate or deactivate the attachment module. The modules can take many forms and include varied contents, each with different functions such as dispensing of solid or semi-solid solutions, providing light, or other abilities. The device could also include several modules in a pack with or attached to the device. For instance, a light module and a module for dispensing anesthetic could be included for use depending on the circumstances. The modules can also be exchanged during a procedure, such that, for example after the anesthetic is dispensed the light module can be attached in order to provide visibility for suturing. The modules can be attached to the device using a track and groove arrangement, magnets, frictional attachment, a threaded coupling, quick connect fittings, or any other suitable means of attaching the module to the device known to or conceivable by one of skill in the art.

**[0056]** The many features and advantages of the invention are apparent from the detailed specification, and thus, it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true spirit and scope of the invention. Further, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed is:

1. A device for facilitating suturing of an incision or wound comprising:

a working end disposed at a distal end of the device for suturing comprising a lower jaw and an upper jaw both configured for retaining a needle, wherein the needle is configured for being coupled to a suture;

a grip end disposed at a proximal end of the device for suturing comprising a stationary handle and a pivoting handle, wherein the pivoting handle is configured to pivot with respect to the stationary handle;

a hub disposed between the working end and the grip end and containing a first set of mechanics for converting the movement of the pivoting handle with respect to the stationary handle into opening and closing movements for the upper and lower jaws and containing a second set of mechanics for actuating the passing of the needle from the upper jaw to the lower jaw and vice versa, wherein the second set of mechanics includes first and second locking tabs configured to lock the needle in place in either the upper or the lower jaw; and

a toggle lever for engaging the second set of mechanics for passing the needle from the upper jaw to the lower jaw.

2. The device for suturing of an incision or wound of claim 1 wherein the working end is positioned at an angle to the hub.

3. The device for suturing of an incision or wound of claim 1 further comprising the toggle lever being positioned on a top surface of the device.

4. The device for suturing of an incision or wound of claim 1 wherein the locking tab comprises a specific geometry for securing the needle.

5. The device for suturing of an incision or wound of claim 4 wherein the needle comprises geometry complementary to that of the locking tab in order to secure the needle.

6. The device for suturing of claim 1 further comprising an add-on module configured to be removably attached to the device.

7. The device for suturing of claim 6 further comprising a trigger mechanism configured to control function of the add-on module.

8. The device for suturing of claim 6 wherein the add-on module is connected to the device for suturing using a tracked groove or magnets.

9. The device for suturing of claim 6 wherein the module is used to provide additional abilities to the device, such as dispensing of solids, semisolids, and liquids.

10. The device for suturing of claim 6 wherein the module is used to provide additional abilities to the device, such as providing lighting, retraction, and mechanical advantages.

What is claimed is:

11. A suturing device for facilitating reapproximation of tissue comprising:

a working end formed by a lower jaw and an upper jaw both configured for alternatively retaining a surgical needle;

a grip end formed by a stationary handle and a pivotable handle, wherein the pivotable handle is configured to pivot with respect to the stationary handle;

a hub defining a pivotable joint coupled to both the working end and the grip end, converting compressing and releasing movements of the grip end into opening and closing movements of the working end;

a toggle lever coupled with a linkage system for locking and unlocking the surgical needle from the lower jaw or the upper jaw; and

a means for holding the surgical needle within the upper and the lower jaw of the working end and for switching the surgical needle between the lower and the upper jaw of the working end.

12. The suturing device of claim 11 comprising a surgical needle having a proximal sharp end and a distal sharp end.

13. The suturing device of claim 12, wherein the surgical needle comprises a hole between its two sharp ends configured for carrying sutures.

14. The suturing device of claim 11 comprising an add-on module for additional functionality selected from a group consisting of lighting, retraction, and liquids.

15. The suturing device of claim 14, wherein the add-on modules are coupled to the body of the device using one selected from a group consisting of tracked groove and magnets.

16. The suturing device of claim 11, wherein the linkage system comprises mechanic to convert the movement of the grip end into the movement of the working end and the mechanics further comprise a drive tab in contact with a spring that is coupled to a locking tab which locks and releases the needle.

17. The suturing device of claim 16, wherein the locking tab and the needle can include a keyhole coupling on the locking tab and corresponding notches on the needle.

18. The suturing device of claim 11, wherein the stationary handle of the grip end can be integrated into and extends from the hub.

19. The suturing device of claim 11, wherein the working end can be configured as one selected from a group consisting of straight or angular coupling with the hub.

20. The suturing device of claim 1, wherein the toggle lever can be located on one selected from a group consisting of on top, side, or beneath the body of the hub in shapes of trigger or

switch.

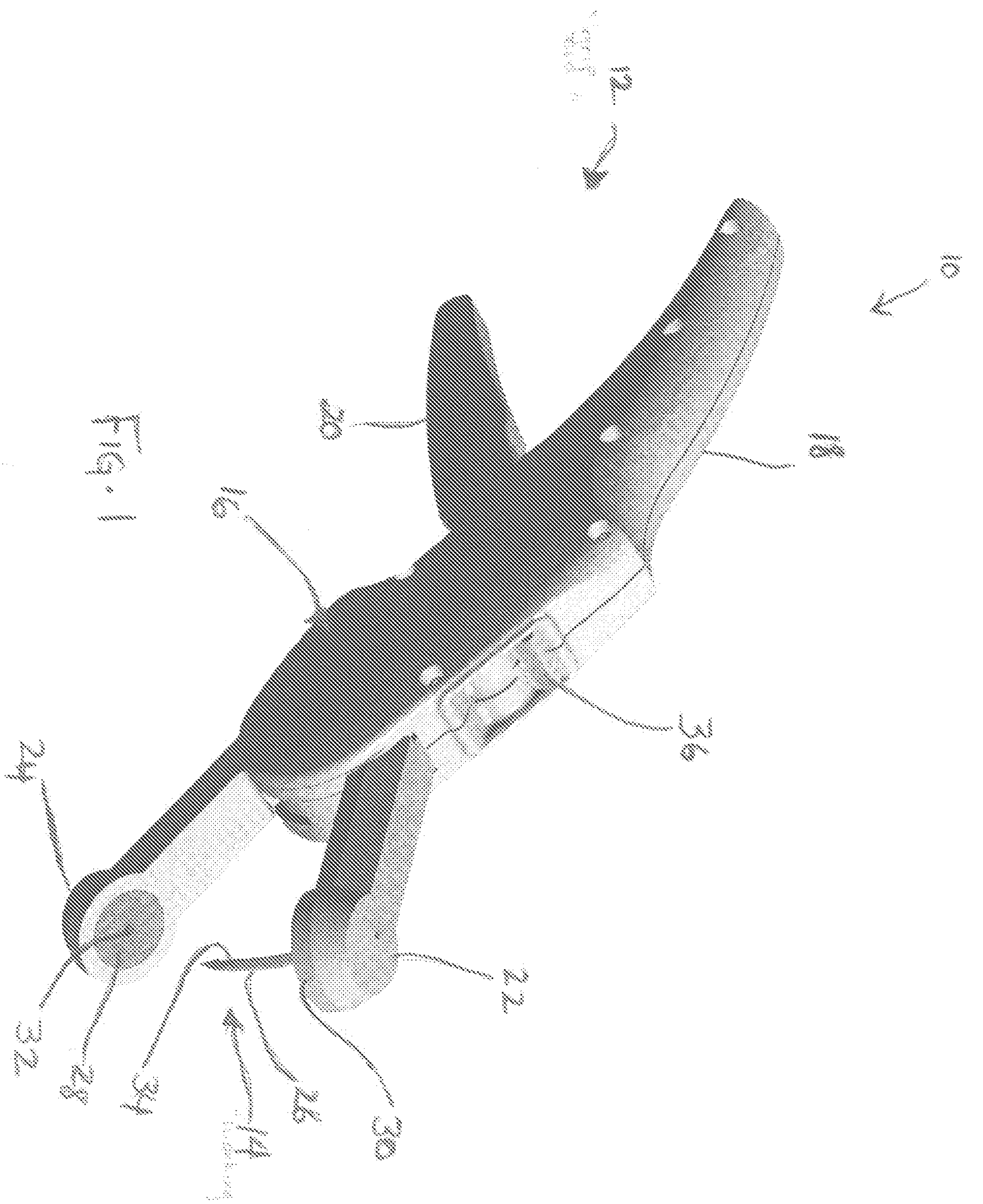



Fig. 1

Fig. 2A

Fig. 2B

Transfer Toggle Lever Forward
Toggle Lever Pushed Forward

Fig. 2C

FIG. 2D

# DEVICE USE SCENARIO

Figs. 3A – 3G



① Fig. 3A
-Jaws Open
-Locking tabs retracted (manual override)
-Ready to load needle



② Fig. 3B
-Jaws Closed on needle
-Locking tabs engaged (manual override)
-Upper/Lower tab engaged



③ Fig. 3C
-Jaws Opened
-Positioned on fascia



④ Fig. 3D
-Jaws Closed
-Puncturing fascia
-Locking tabs activated (manual or mechanical)



⑤ Fig. 3E
-Jaws Opened
-Pulled away from fascia
-Repositioned on fascia
-Repeat Steps 3-5



⑥ Fig. 3F
-Jaws Closed
-Locking tab retracted (manual override)



⑦ Fig. 3G
-Jaws Opened
-Needle removed



USD

DEVICE MECHANICAL DEVELOPMENT

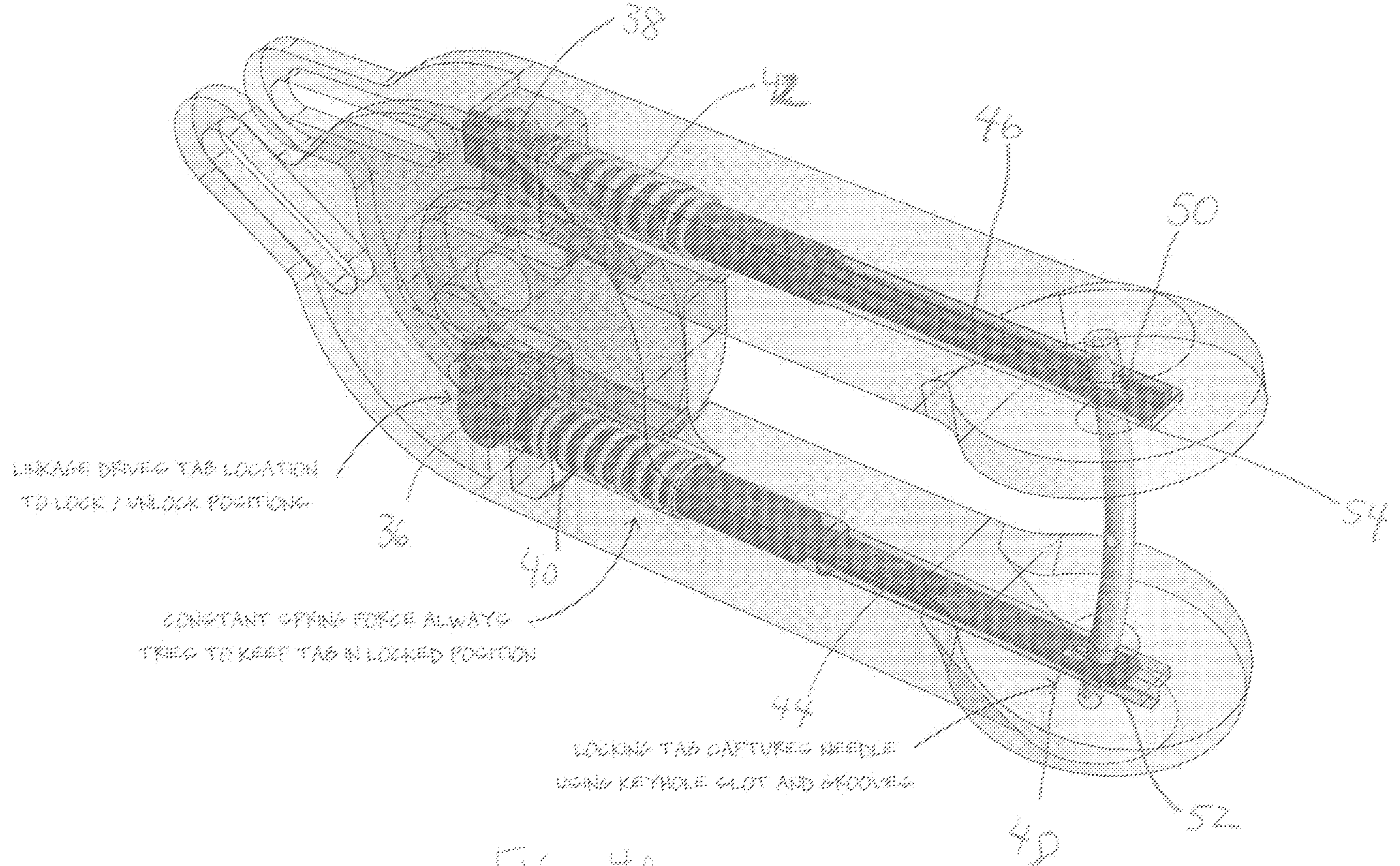



FIG. 4A

DEVICE MECHANICAL DEVELOPMENT




FIG. 4B

FIG. 4A

DEVICE WORKING END




FIG. 5A




FIG. 5B

DEVICE WORKING END




Fig. 7A



Fig. 7B

DRAWINGS ARE FOR CONCEPT DEVELOPMENT ONLY

FIG. 4

3D CUTTER WITH CONCEPT REFINEMENT 13

## DEVICE MANUAL OVERRIDE / NEEDLE LOADING

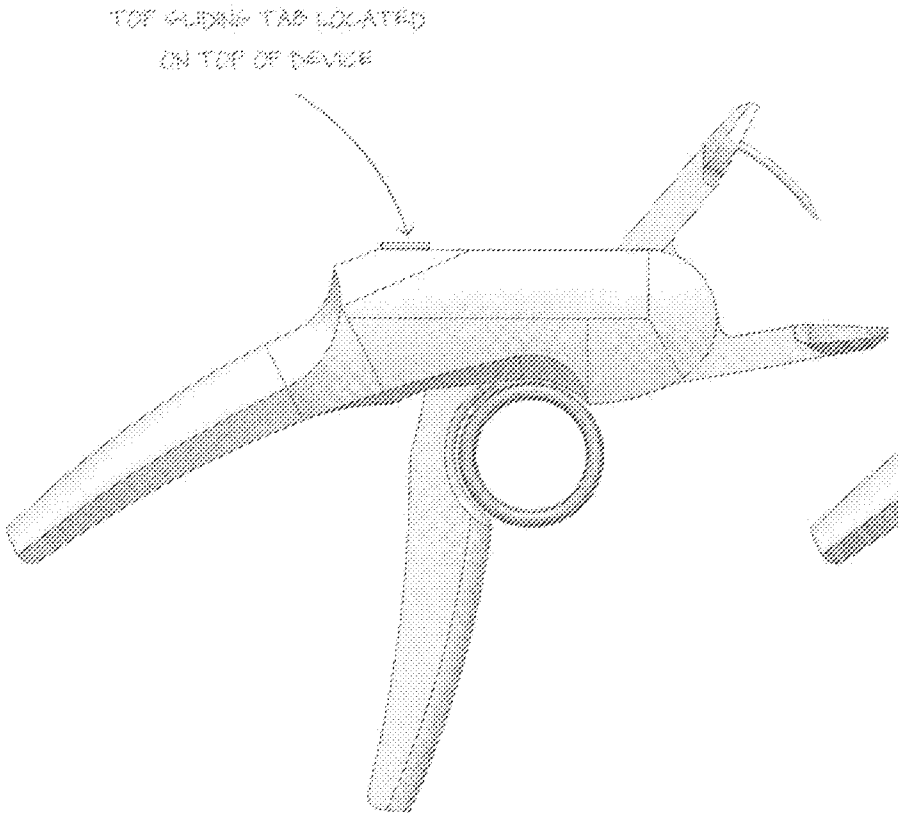



Fig. 8

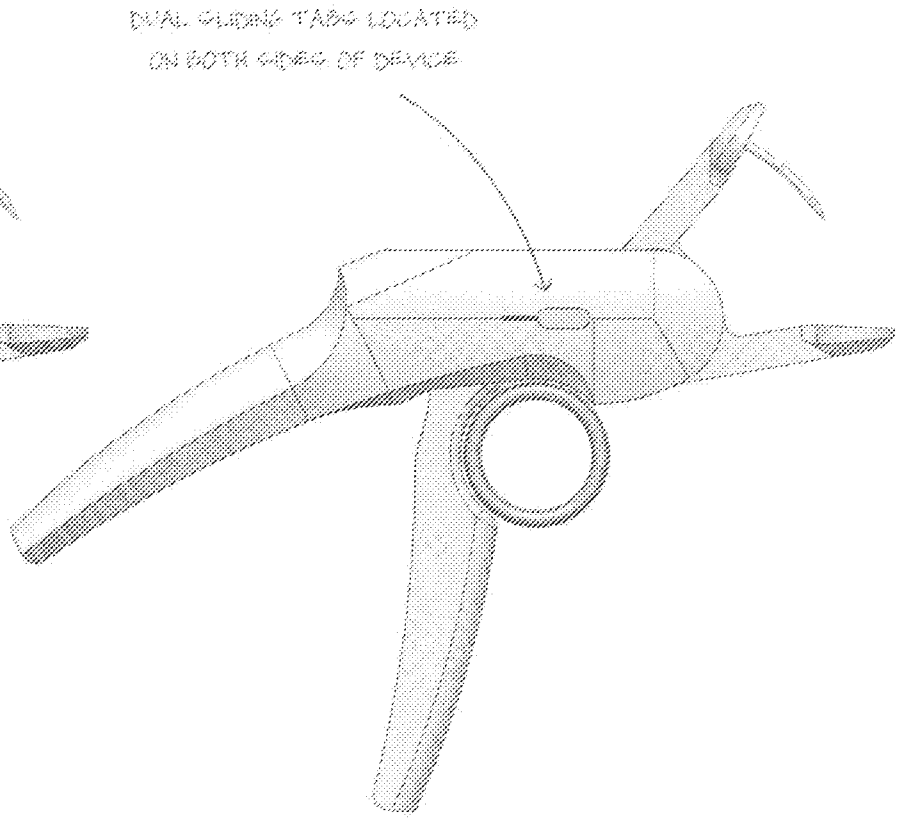



Fig. 9

DEVICE NEEDLE TRANSFER




Fig. 10A




Fig. 10B




Fig. 10C




Fig. 10D

SUTURE TRANSFER CONCEPT REINFORCEMENT 18

FIG. 10

DEVICE MECHANICAL REFINEMENT






Fig. 11A



Fig. 11C



Fig. 11B



Fig. 11D

CONCEPT MECHANICAL REFINEMENT 11

DEVICE END STRAIGHT APPROACH



Fig. 12A



Fig. 12B



Fig. 12C



Fig. 12D

DEVICE END ANGLED APPROACH



Fig. 13C



Fig. 13A



Fig. 13D



Fig. 13B

SUBSTITUTE SHEET (RULE 26)

DISTAL

DEVICE END TAPERED / ANGLED APPROACH



Fig 14A



Fig 14B



Fig 14C



Fig 14D



Fig 14E

NEEDLE CAPTURING CONCEPT 1a




Fig. 15A

Fig. 15B

Fig. 15C

Fig. 15D

NEEDLE CAPTURING CONCEPT 1b




Fig. 16A



Fig. 16B



Fig. 16C



Fig. 16D

NEEDLE CAPTURING CONCEPT 1C




Fig. 17A




Fig. 17B



Fig. 17C



Fig. 17D

NEEDLE CAPTURING CONCEPT_1d




Fig. 18G



Fig. 18A



Fig. 18C



Fig. 18D

NEEDLE CAPTURING CONCEPT 1c




Fig. 19A

Fig. 19B

Fig. 19C

Fig. 19D

SUBSTITUTE SHEET (RULE 26)

NEEDLE CAPTURING CONCEPT 11




Fig. 20A

Fig. 20B

Fig. 20C

Fig. 20D

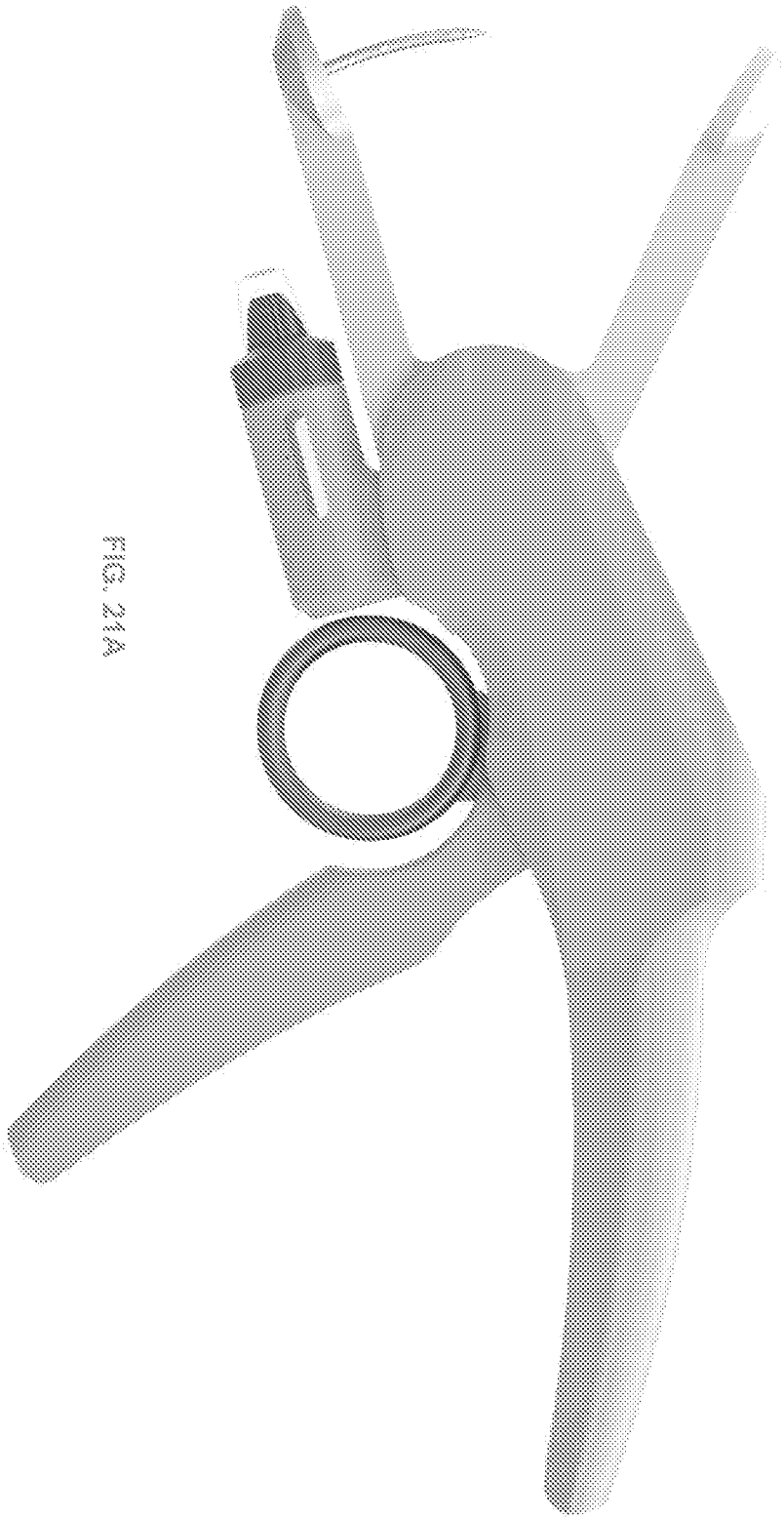


FIG. 21A

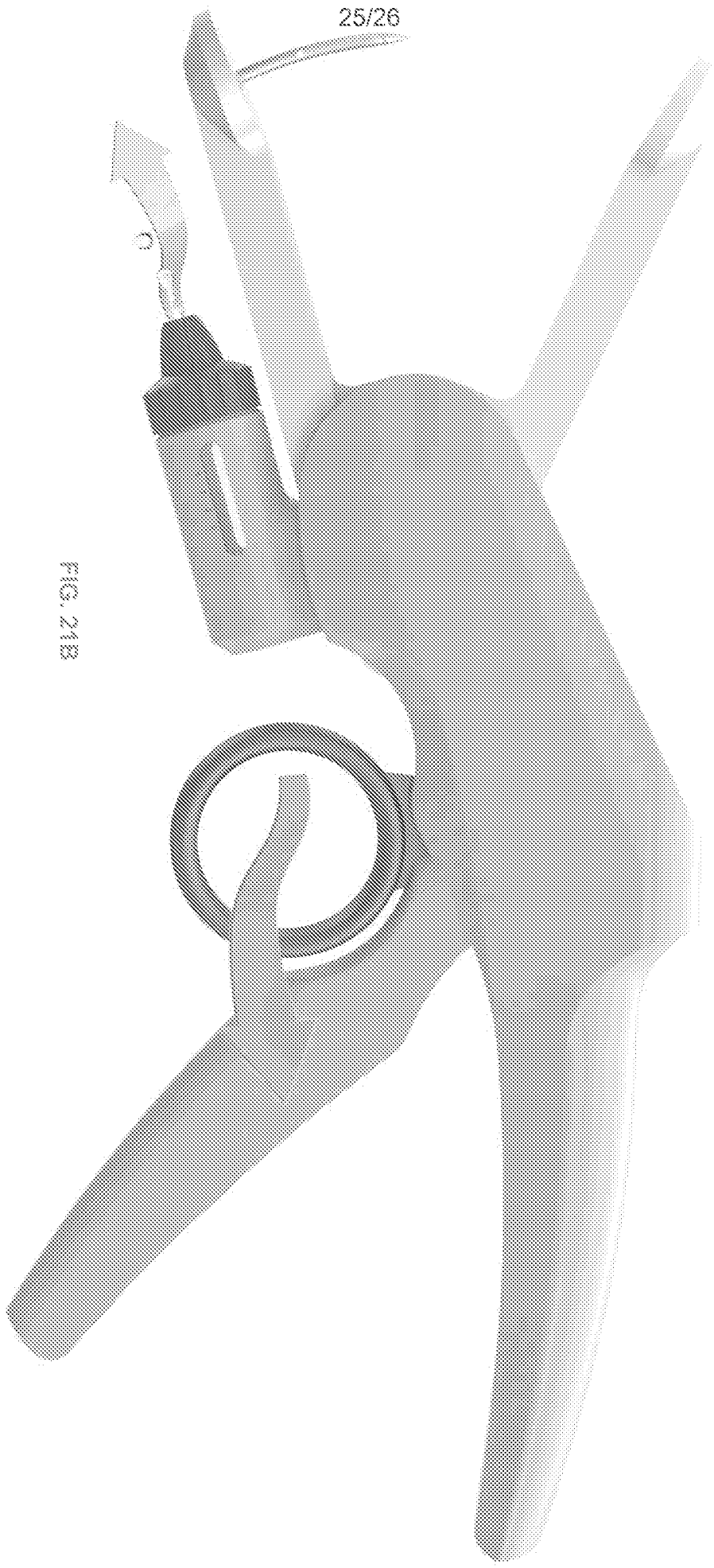



FIG. 21B



FIG. 21C

**INTERNATIONAL SEARCH REPORT**

International application No.
**PCT/US2015/011718**

**A. CLASSIFICATION OF SUBJECT MATTER**

**A61B 17/04(2006.01)i, A61B 17/062(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
A61B 17/04; A61B 17/10; A61B 17/062

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: surturing, working end, lower jaw, upper jaw, needle, grip end, stationary handle, pivoting handle, hub, locking tabs, toggle lever

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| Y | US 2009-0012538 A1 (SALIMAN et al.) 8 January 2009<br>See abstract; paragraphs [0093]-[0095], [0153], [0165]-[0175]; and figures 1, 28A-33. | 6-10,14,15 |
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 22 April 2015 (22.04.2015) | **23 April 2015 (23.04.2015)** |


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Information on patent family members

International application No.

**PCT/US2015/011718**

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