US 20120245567A1

(19) **United States**

(12) **Patent Application Publication**

Lee et al.

(10) **Pub. No.: US 2012/0245567 A1**

(43) **Pub. Date: Sep. 27, 2012**

(54) **SURGICAL INSTRUMENT**

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(21) Appl. No.: **13/307,321**

(22) Filed: **Nov. 30, 2011**

Related U.S. Application Data

(63) Continuation of application No. 12/592,767, filed on Dec. 2, 2009, now Pat. No. 8,083,765, Continuation of application No. 11/649,352, filed on Jan. 2, 2007, now Pat. No. 7,648,519.

(60) Provisional application No. 60/844,130, filed on Sep. 13, 2006.

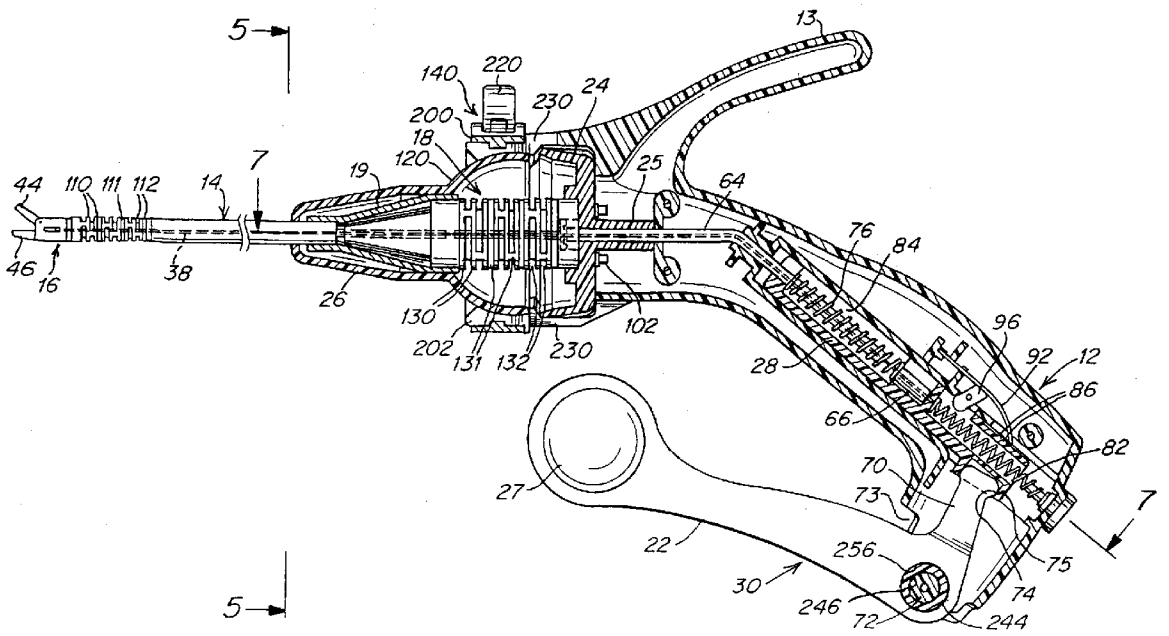
Publication Classification

(51) **Int. Cl.**
A61B 17/00 (2006.01)

(52) **U.S. Cl.** **606/1**

(57) **ABSTRACT**

A surgical instrument that includes an instrument shaft having proximal and distal ends, a tool disposed from the distal end of the instrument shaft, a control handle disposed from the proximal end of the instrument shaft, a distal motion member for coupling the distal end of the instrument shaft to the tool, a proximal motion member for coupling the proximal end of the instrument shaft to the handle, actuation means extending between the distal and proximal motion members for coupling motion of the proximal motion member to the distal motion member for controlling the positioning of the tool and a locking mechanism for fixing the position of the tool at a selected position and having locked and unlocked states.



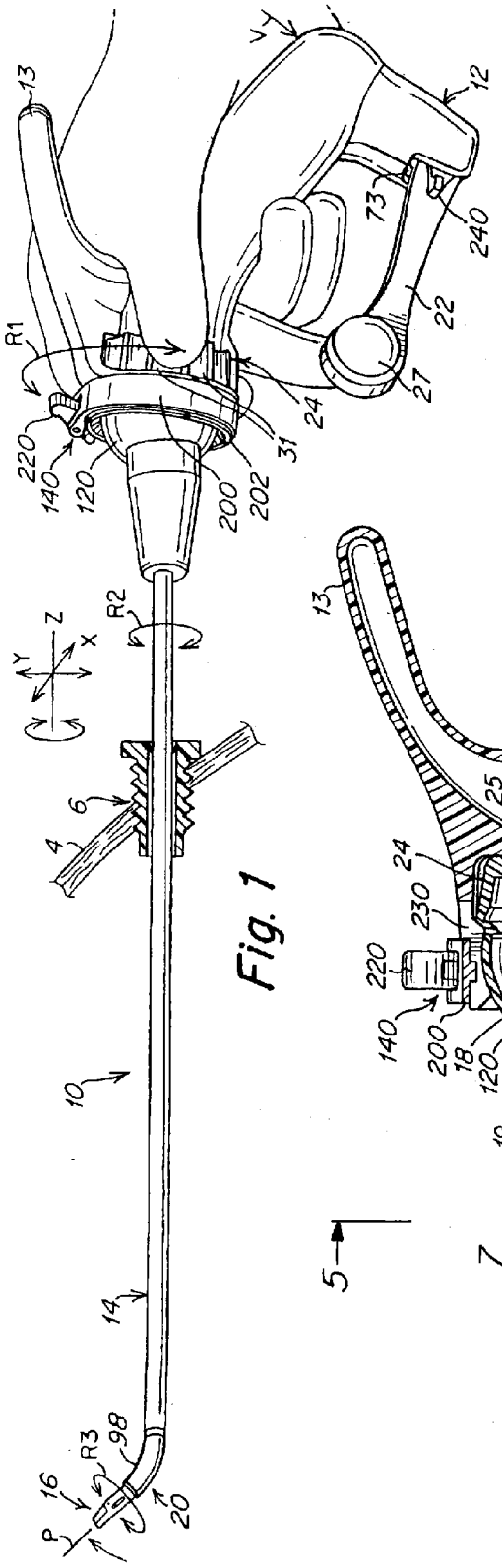

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Fig. 1

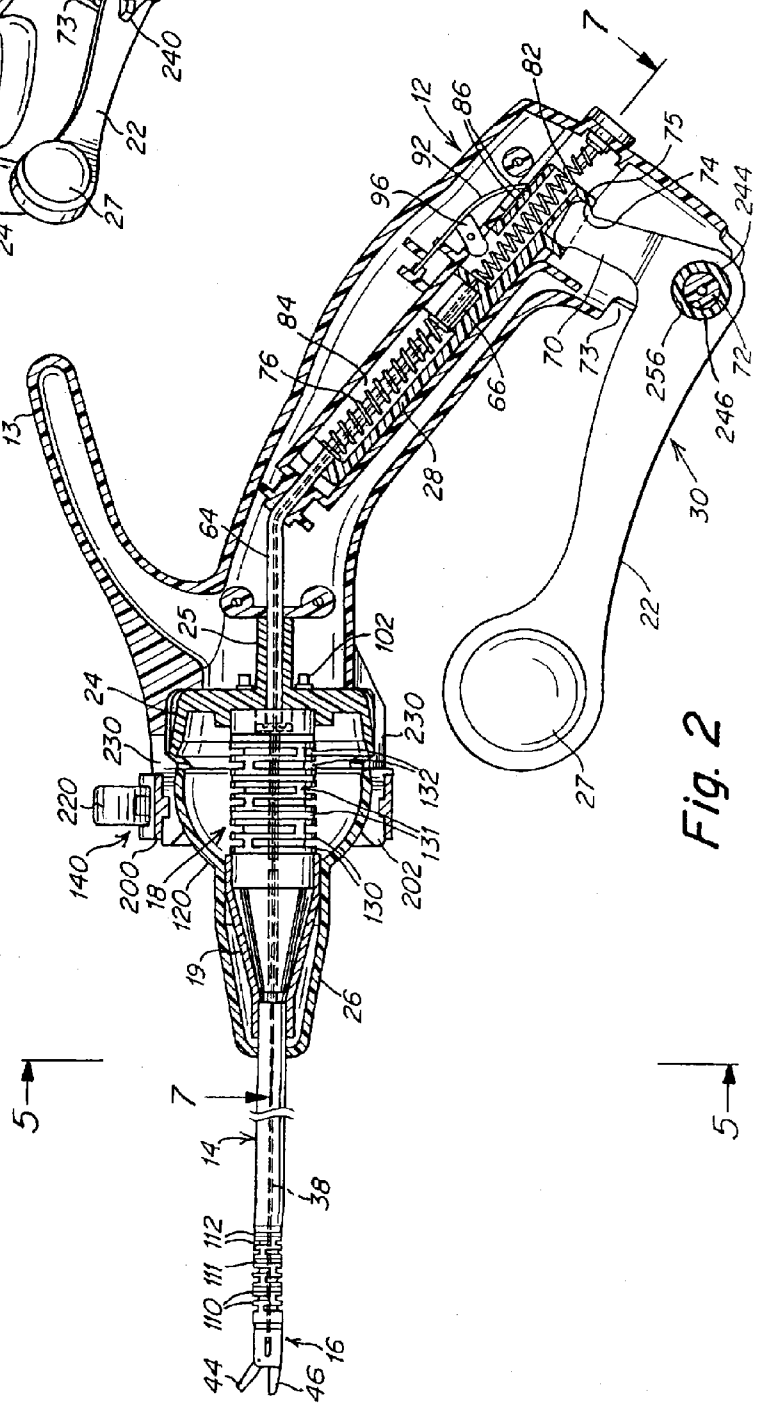
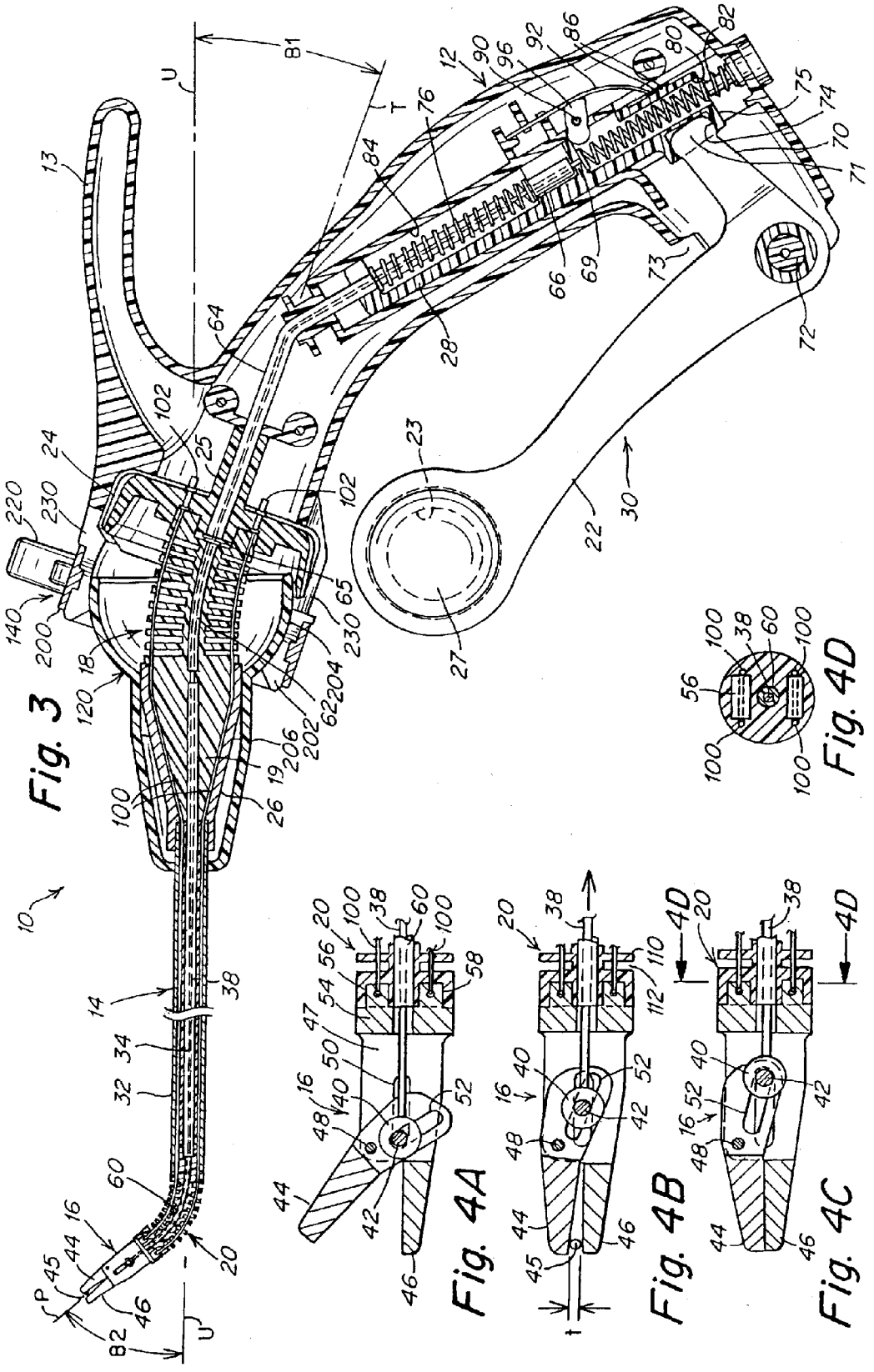

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Fig. 2


Fig. 3
Fig. 4A
Fig. 4B
Fig. 4C
Fig. 4D

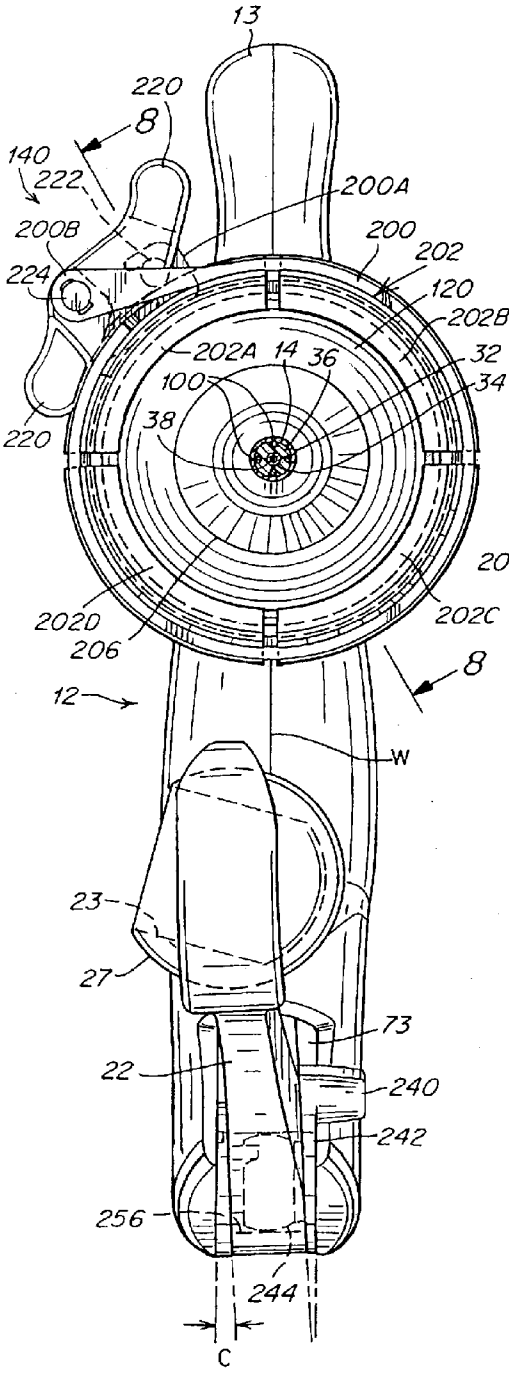

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Fig. 5

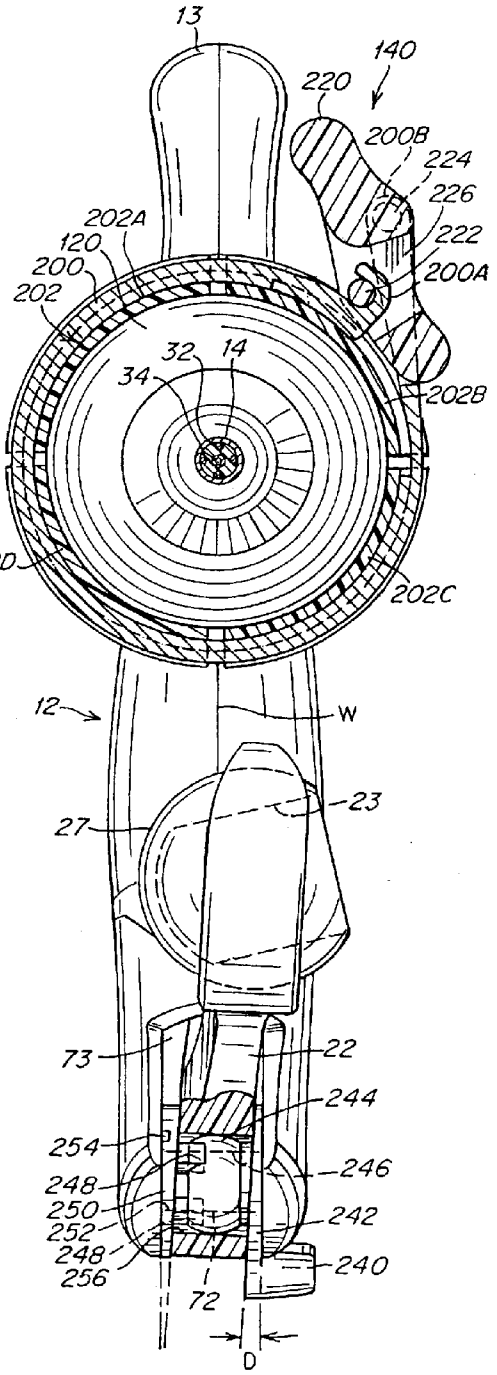

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Fig. 6

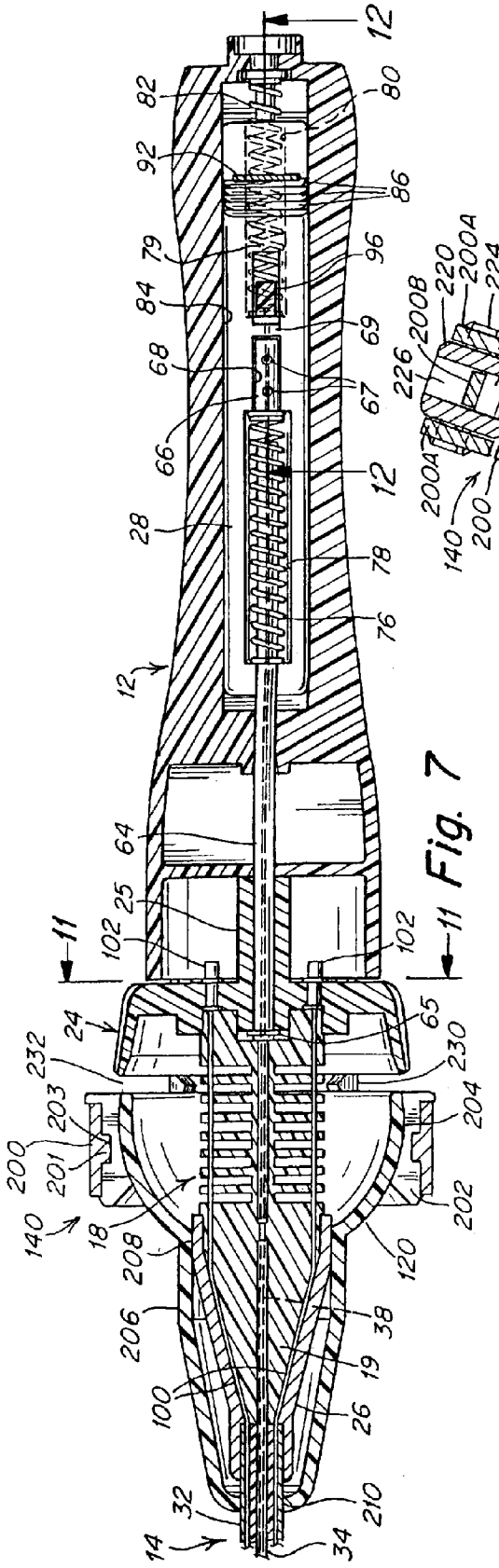


Fig. 7

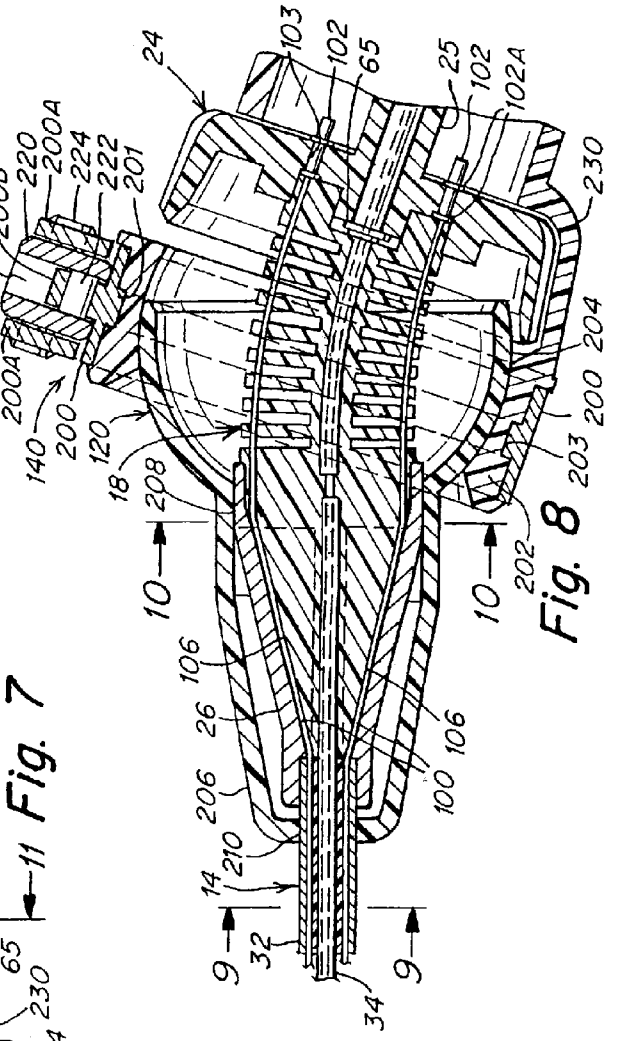


Fig. 8

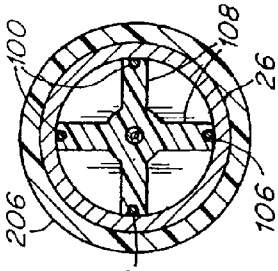


Fig. 10

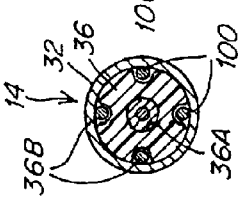


Fig. 9

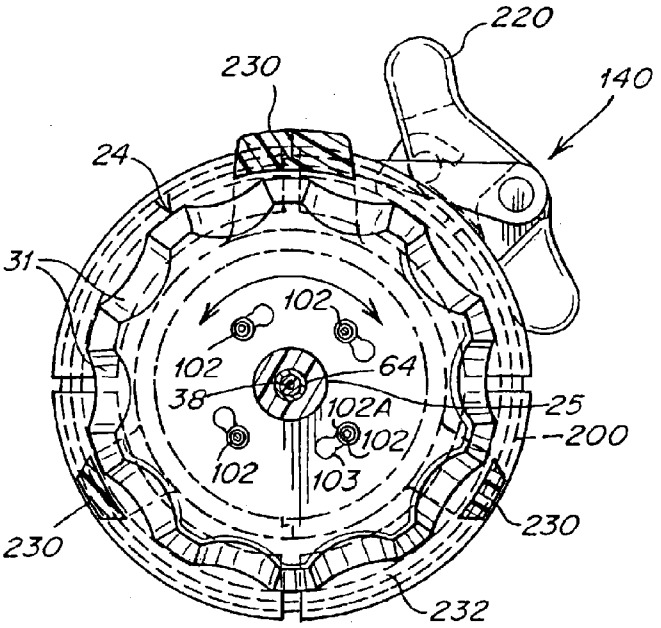

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Fig. 11

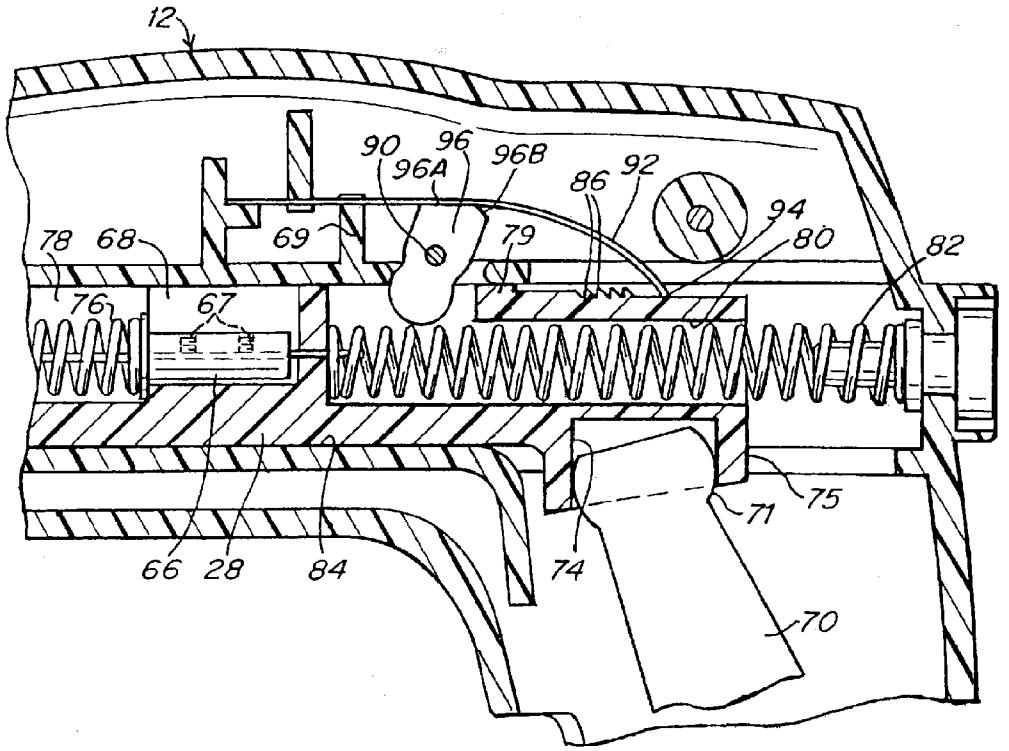

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Fig. 12

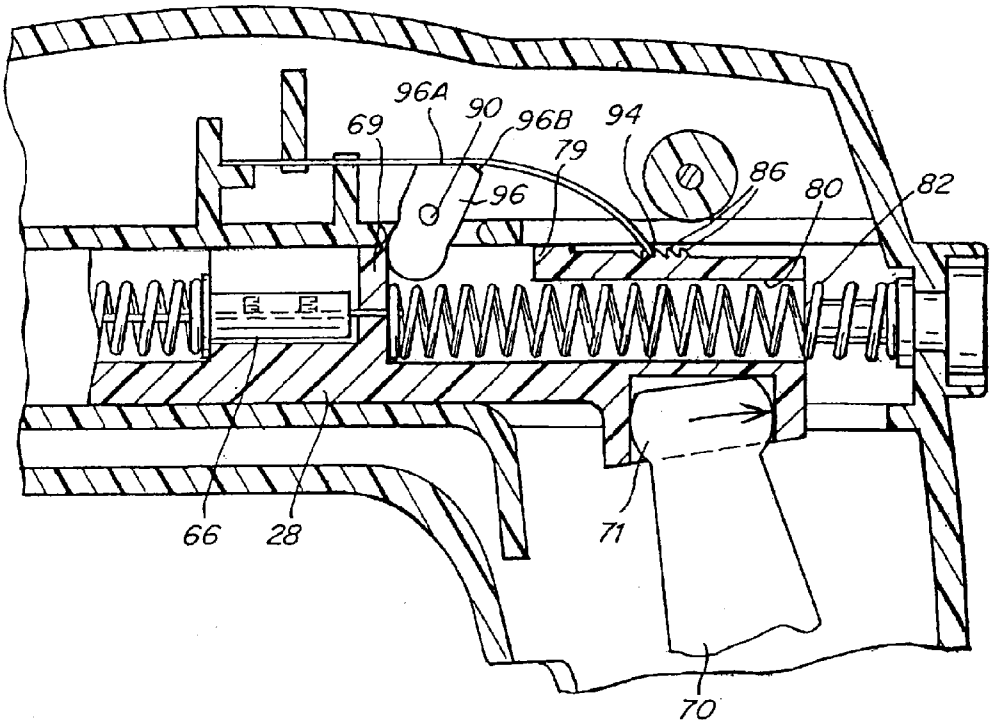

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Fig. 13

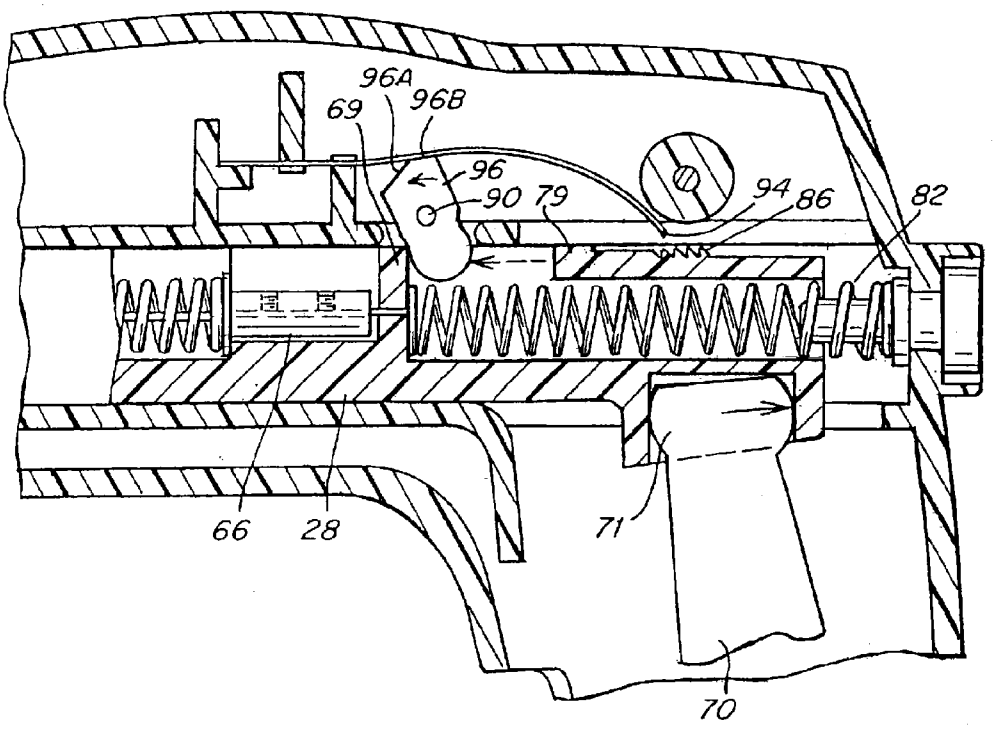

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Fig. 14

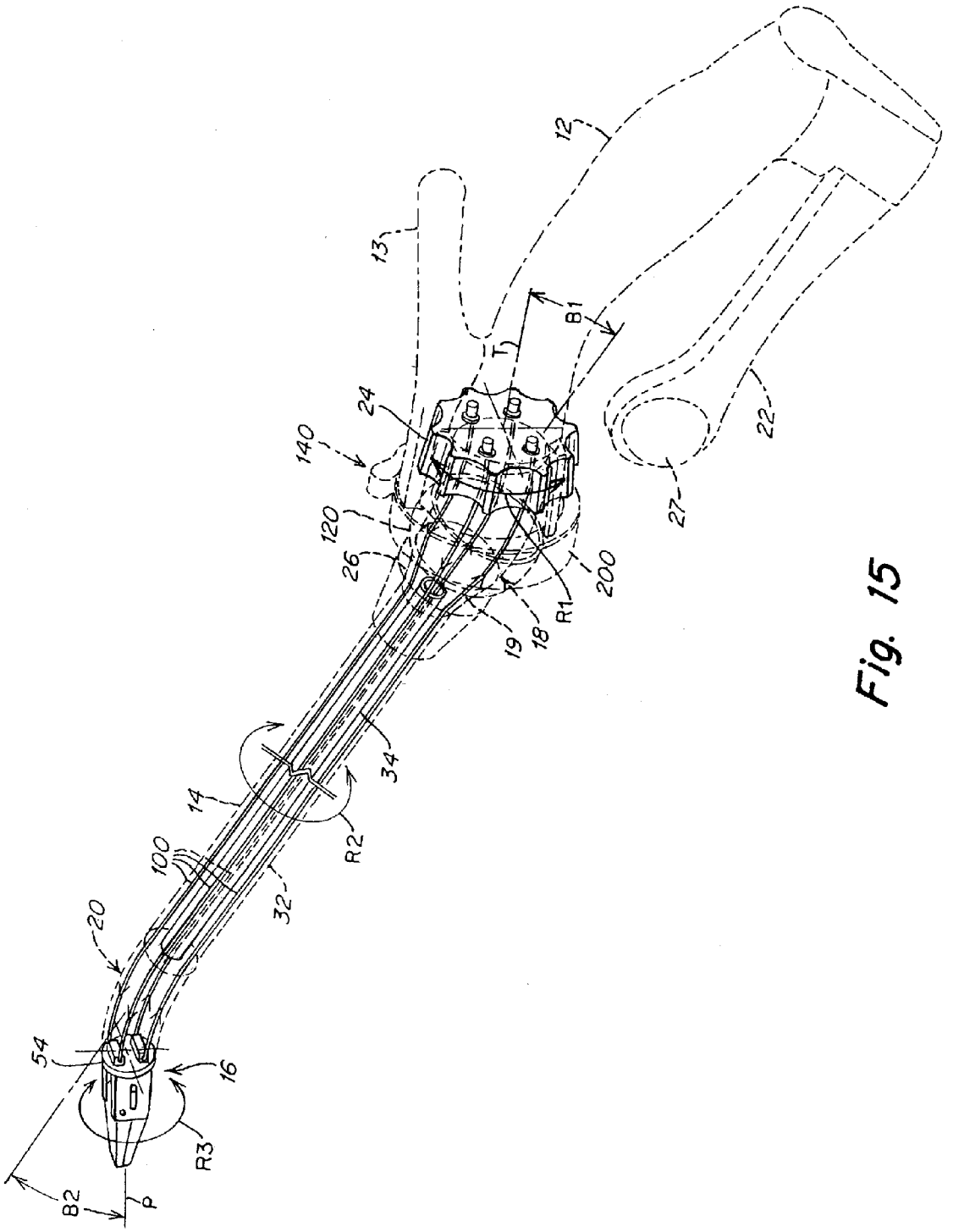

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Fig. 15

SURGICAL INSTRUMENT

RELATED APPLICATION

[0001] Priority for this application is hereby claimed under 35 U.S.C. §119(e) to commonly owned and co-pending U.S. Provisional Patent Application No. 60/844,130 which was filed on Sep. 13, 2006. The content of all of the aforementioned application is hereby incorporated by reference herein in its entirety.

TECHNICAL FIELD

[0002] The present invention relates in general to medical instruments, and more particularly to manually-operated surgical instruments that are intended for use in minimally invasive surgery or other forms of surgical or medical procedures or techniques. The instrument described herein is primarily for a laparoscopic procedure, however, it is to be understood that the instrument of the present invention can be used for a wide variety of other procedures, including intraluminal procedures.

BACKGROUND OF THE INVENTION

[0003] Endoscopic and laparoscopic instruments currently available in the market are extremely difficult to learn to operate and use, mainly due to a lack of dexterity in their use. For instance, when using a typical laparoscopic instrument during surgery, the orientation of the tool of the instrument is solely dictated by the location of the target and the incision. These instruments generally function with a fulcrum effect using the patients own incision area as the fulcrum. As a result, common tasks such as suturing, knotting and fine dissection have become challenging to master. Various laparoscopic instruments have been developed over the years to overcome this deficiency, usually by providing an extra articulation often controlled by a separately disposed control member for added control. However, even so these instruments still do not provide enough dexterity to allow the surgeon to perform common tasks such as suturing, particularly at any arbitrarily selected orientation. Also, existing instruments of this type do not provide an effective way to hold the instrument in a particular position. Moreover, existing instruments require the use of both hands in order to effectively control the instrument.

[0004] Accordingly, an object of the present invention is to provide an improved laparoscopic or endoscopic surgical instrument that allows the surgeon to manipulate the tool end of the surgical instrument with greater dexterity.

[0005] Another object of the present invention is to provide an improved surgical or medical instrument that has a wide variety of applications, through incisions, through natural body orifices or intraluminally.

[0006] A further object of the present invention is to provide an improved medical instrument that is characterized by the ability to lock the instrument in a pre-selected particular position.

[0007] Another object of the present invention is to provide a locking feature that is an important adjunct to the other controls of the instrument enabling the surgeon to lock the instrument once in the desired position. This makes it easier for the surgeon to thereafter perform surgical procedures without having to, at the same time, hold the instrument in a particular bent configuration. Still another object of the present invention is to provide an improved medical instrument that can be effectively controlled with a single hand of the user.

SUMMARY OF THE INVENTION

[0008] To accomplish the foregoing and other objects, features and advantages of the present invention there is provided a surgical instrument that comprises an instrument shaft having proximal and distal ends; a tool disposed from the distal end of the instrument shaft; a control handle coupled from the proximal end of the instrument shaft; a distal motion member for coupling the distal end of the instrument shaft to the tool; a proximal motion member for coupling the proximal end of the instrument shaft to the handle; actuation means extending between the distal and proximal motion members for coupling motion of the proximal motion member to the distal motion member for controlling the positioning of the tool; and a locking mechanism for fixing the position of the tool at a selected position and having locked and unlocked states with the locking mechanism including a ball and socket arrangement disposed about the proximal motion member and a cinch member for locking the ball and socket arrangement.

[0009] In accordance with other aspects of the present invention the surgical instrument may further include a rotation means disposed adjacent the control handle and rotatable relative to the control handle for causing a corresponding rotation of the instrument shaft and tool; at least the proximal motion member may comprise a proximal bendable member, with the rotation means comprising a rotation knob that is adapted to rotate the tool about a distal tool roll axis and being disposed between the control handle and proximal bendable member; the control handle may comprise a pistol grip handle having an engagement horn to assist in holding the handle; the rotation means may comprises a rotation knob that is disposed at the distal end of the handle and the horn is disposed proximally of the rotation knob and on the top of the pistol grip handle; preferably including an actuation lever supported from the pistol grip handle at a pivot point at the proximal end of the handle; the actuation lever may have a free end with a finger loop for receiving a users finger to control the lever; preferably including a tool actuation cable that extends from the tool to the handle, a slider for capturing the proximal end of the tool actuation cable and an actuation lever supported at the handle for controlling the translation of the slider; preferably including a slideway for receiving the slider, a pair of springs disposed in the slider and a rotational barrel disposed between the springs and for holding the proximal end of the tool actuation cable; the ball and socket arrangement may comprise a ball member having a partially spherical portion that mates with a concave socket in the handle; the handle may have a distal collar with the socket formed on the inner surface of the collar and the cinch member may include an annular cinch ring that is disposed about the distal collar; preferably including a tongue and groove interconnection between the cinch ring and collar so as to permit rotation therebetween while preventing axial movement; preferably including a pivot piece on the cinch ring having opposed locked and unlocked positions; and preferably the distal collar has one or more slots to enable the socket to be compressed about the ball member as the cinch ring is locked.

[0010] In accordance with another feature of the present invention there is provided a surgical instrument that comprises an instrument shaft having proximal and distal ends; a

tool disposed from the distal end of the instrument shaft; a control handle disposed from the proximal end of the instrument shaft; a distal motion member for coupling the distal end of the instrument shaft to the tool; a proximal motion member for coupling the proximal end of the instrument shaft to the handle; actuation means extending between the distal and proximal motion members for coupling motion of the proximal motion member to the distal motion member for controlling the positioning of the tool; said control handle including a pistol grip handle; an actuation lever for controlling the tool and pivotally supported from the handle; and an adjustment member mounted on the lever for adjusting the attitude or angle of the actuation lever relative to a center plane of the handle.

[0011] In accordance with still other aspects of the present invention there is provided a surgical instrument wherein the adjustment member includes an adjustment lever for changing the attitude or angle between positive and negative values; wherein the adjustment member includes a beveled washer means; wherein the adjustment lever is supported from the same pivotal support as for the actuation lever; further including an engagement horn to assist in holding the handle and a rotation knob disposed at the distal end of the handle and the horn is disposed proximally of the rotation knob and on the top of the pistol grip handle.

[0012] In accordance with still another feature of the present invention there is provided a medical instrument having a proximal control handle and a distal tool that are intercoupled by an elongated instrument shaft that is meant to pass internally of an anatomic body, proximal and distal movable members that respectively intercouple the proximal control handle and the distal tool with the instrument shaft, cable actuation means disposed between the movable members, the control handle having proximal and distal ends, an actuation lever for controlling the distal tool, means for pivotally supporting the actuation lever from the proximal end of the handle at one side thereof, a horn and means for fixedly supporting the horn from the distal end of the handle at an opposite side thereof.

[0013] In accordance with other aspects of the present invention there is provided a medical instrument wherein the cable actuation means includes a set of actuation cables that are sufficiently rigid so that each cable is capable of either a pulling or pushing action in controlling the tool; including constraining means for each cable so as to substantially restrain each cable as it extends between the proximal and distal movable members; wherein the control handle includes a pistol grip handle and the actuation lever includes an adjustment member mounted on the lever for adjusting the attitude or angle of the actuation lever relative to a center plane of the handle.

[0014] In accordance with a further feature of the present invention there is provided a medical instrument having a proximal control handle and a distal tool that are intercoupled by an elongated instrument shaft that is meant to pass internally of an anatomic body, proximal and distal movable members that respectively intercouple the proximal control handle and the distal tool with the instrument shaft, cable actuation means disposed between the movable members, for controlling the positioning of the distal tool, and means for constraining the cable means along its length so as to enable both a pulling action and a pushing action thereof.

[0015] In accordance with further aspects of the present invention there is provided a medical instrument wherein the cable means are constrained along substantially the entire length thereof; and wherein the constraining means includes a shaft filler disposed in the instrument shaft about the cable means.

[0016] In accordance with still another feature of the present invention there is provided a medical instrument having a proximal control handle and a distal tool that are intercoupled by an elongated instrument shaft that is meant to pass internally of an anatomic body, proximal and distal movable members that respectively intercouple the proximal control handle and the distal tool with the instrument shaft, cable actuation means disposed between the movable members, for controlling the positioning of the distal tool, and a locking mechanism having locked and unlocked positions, disposed about the proximal movable member and manually controlled so as to fix the position of the proximal movable member relative to the handle in the locked position thereof.

[0017] In accordance with other aspects of the present invention there is provided a medical instrument wherein the locking mechanism comprises a ball member and a compressible hub that defines a socket member; wherein the hub is a split hub and the locking mechanism further includes a cinch ring disposed about the split hub and a locking lever mounted on the cinch ring for closing the cinch ring about the hub to lock the hub against the ball member; wherein the cinch ring interlocks with the hub but is able to rotate relative thereto when in the unlocked position; and including a rotation control member adjacent to the proximal movable member for controlling the orientation of the distal movable member and tool.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] It should be understood that the drawings are provided for the purpose of illustration only and are not intended to define the limits of the disclosure. The foregoing and other objects and advantages of the embodiments described herein will become apparent with reference to the following detailed description when taken in conjunction with the accompanying drawings in which:

[0019] FIG. **1** is a perspective view of a preferred embodiment of the instrument of the present invention illustrating the instrument being grasped by a user and further schematically illustrating the instrument disposed at an operative site;

[0020] FIG. **2** is a cross-sectional side view of the instrument of FIG. **1** by itself and with the cross- sectional view primarily illustrating the proximal or handle end of the instrument;

[0021] FIG. **3** is an enlarged cross-sectional side view showing the instrument of FIG. **2** in an angled relationship and with the jaws closed on a needle;

[0022] FIGS. **4**A-**4**C are illustrative cross-sectional side views at the distal end of the medical instrument, and with the movable jaw in different respective positions;

[0023] FIG. **4**D is a radial cross-sectional view taken along line **4**D-**4**D of FIG. **4**C;

[0024] FIG. **5** is a cross-sectional front view of the instrument of FIG. **1** as taken along line **5**-**5** of FIG. **2** and showing the locking lever in its locked position;

[0025] FIG. **6** is a cross-sectional front view of the instrument illustrated in FIG. **5** showing the locking lever in its unlocked position, and further illustrating some components of the instrument broken away to illustrate certain adjustments that can be made to accommodate the user of the instrument;

[0026] FIG. **7** is a cross-sectional plan view taken along line **7-7** of FIG. **2**;

[0027] FIG. **8** is a fragmentary cross-sectional view taken along line **8-8** of FIG. **5** but showing the instrument in an angled relationship;

[0028] FIG. **9** is an enlarged cross-sectional view at the instrument shaft taken along line **9-9** of FIG. **8**;

[0029] FIG. **10** is a cross-sectional view at the adapter of the instrument as taken along line **10-10** of FIG. **8**;

[0030] FIG. **11** is a cross-sectional view at the rotation knob of the instrument as taken along line **11-11** of FIG. **7**;

[0031] FIGS. **12-14** are somewhat schematic enlarged fragmentary cross-sectional views of the handle basically taken along line **12-12** of FIG. **7** showing the operation of the jaw clamping lever means for different positions thereof; and

[0032] FIG. **15** is a schematic perspective view of the instrument illustrated herein.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0033] The instrument of the present invention may be used to perform minimally invasive procedures. "Minimally invasive procedure," refers herein to a surgical procedure in which a surgeon operates through a small cut or incision, the small incision being used to access the operative site. In one embodiment, the incision length ranges from 1 mm to 20 mm in diameter, preferably from 5 mm to 10 mm in diameter. This procedure contrasts those procedures requiring a large cut to access the operative site. Thus, the flexible instrument is preferably used for insertion through such small incisions and/or through a natural body lumen or cavity, so as to locate the instrument at an internal target site for a particular surgical or medical procedure. The introduction of the surgical instrument into the anatomy may also be by percutaneous or surgical access to a lumen, vessel or cavity, or by introduction through a natural orifice in the anatomy.

[0034] In addition to use in a laparoscopic procedure, the instrument of the present invention may be used in a variety of other medical or surgical procedures including, but not limited to, colonoscopic, upper GI, arthroscopic, sinus, thorasic, prostate, transvaginal, orthopedic and cardiac procedures. Depending upon the particular procedure, the instrument shaft may be rigid, semi-rigid or flexible.

[0035] Although reference is made herein to a "surgical instrument," it is contemplated that the principles of this invention also apply to other medical instruments, not necessarily for surgery, and including, but not limited to, such other implements as catheters, as well as diagnostic and therapeutic instruments and implements.

[0036] There are a number of unique features embodied in the instrument of the present invention. For example, there is provided a locking mechanism that is constructed using a ball and socket arrangement disposed about the proximal motion member that follows the bending action and in which an annular cinch ring is used to retain the ball and socket arrangement in a fixed particular position, and thus also maintain the proximal and distal bendable members in a particular bent condition, or in other words locked in that position. The cinch ring includes a locking lever that is conveniently located adjacent to the instrument handle and that is easily manipulated to lock and unlock the cinch ring and, in turn, the position of the end effector. The cinch ring is also preferably rotatable to that the locking lever can be positioned conveniently or can be switched (rotated) between left and right handed users. This lock control allows the surgeon one less degree of freedom to concentrate on when performing certain tasks. By locking the bendable sections at a particular position, this enables the surgeon to be more hands-free for controlling other degrees of freedom of the instrument such as manipulation of the rotation knob to, in turn, control the orientation of the end effector.

[0037] Another feature of the present invention relates to the manner in which the bending is carried out. In the past, relatively small diameter flexible cables have been used to control bending between the proximal and distal bendable members. However, this has caused a somewhat uneven control in that there was only a "pulling" action by one cable while the opposite cable relaxed. The present invention uses a more rigid cable arrangement so that the bending occurs with both a "pulling" action as well as an opposed "pushing" action. To do this the cables are of larger relative diameter and somewhat rigid, but still have to have sufficient flexibility so that they can readily bend. Also, the cables are constrained along their length so as to prevent cable deflection or buckling, particularly during the "pushing" phase of a cable.

[0038] Still another feature is the pistol grip arrangement and the control lever which has an end gimbal construction that provides for a more precise control of the actuation lever and the corresponding actuation of the end effector. Also the control lever in accordance with the present invention is provided with a means to control the attitude of the control lever to compensate for different configurations of hands, particularly to compensate for the different length fingers of a user.

[0039] FIG. **1** is a perspective view of one embodiment of the surgical instrument **10** of the present invention. In this surgical instrument both the tool and handle motion members or bendable members are capable of bending in any direction. They are interconnected via cables (preferably four cables) in such a way that a bending action at the proximal member provides a related bending at the distal member. The proximal bending is controlled by a motion or deflection of the control handle by a user of the instrument. In other words the surgeon grasps the handle and once the instrument is in position any motion (deflection) at the handle immediately controls the proximal bendable member which, in turn, via cabling controls a corresponding bending or deflection at the distal bendable member. This action, in turn, controls the positioning of the distal tool.

[0040] The proximal member is preferably generally larger than the distal member so as to provide enhanced ergonomic control. In the illustrated embodiment the ratio of proximal to distal bendable member diameters may be on the order of three to one. In one version in accordance with the invention there may be provided a bending action in which the distal bendable member bends in the same direction as the proximal bendable member. In an alternate embodiment the bendable, turnable or flexible members may be arranged to bend in opposite directions by rotating the actuation cables through 180 degrees, or could be controlled to bend in virtually any other direction depending upon the relationship between the distal and proximal support points for the cables.

[0041] As has been noted the, amount of bending motion produced at the distal bending member is determined by the dimension of the proximal bendable member in comparison to that of the distal bendable member. In the embodiment described the proximal bendable member is generally larger than the distal bendable member, and as a result, the magnitude of the motion produced at the distal bendable member is

greater than the magnitude of the motion at the proximal bendable member. The proximal bendable member can be bent in any direction (about 360 degrees) controlling the distal bendable member to bend in either the same or an opposite direction, but in the same plane at the same time. Also, as depicted in FIG. **1**, the surgeon is able to bend and roll the instrument's tool about its longitudinal axis T to any orientation simply by rolling the axial rotation knob about rotation direction R**1**.

[0042] In this description reference is made to bendable members. These members may also be referred to as turnable members, bendable sections or flexible members. In the descriptions set out herein, terms such as "bendable section," "bendable segment," "bendable member," or "turnable member" refer to an element of the instrument that is controllably bendable in comparison to an element that is pivoted at a joint. The term "movable member" is considered as generic to bendable sections and joints. The bendable elements of the present invention enable the fabrication of an instrument that can bend in any direction without any singularity and that is further characterized by a ready capability to bend in any direction, all preferably with a single unitary or uni-body structure. A definition of a "unitary" or "uni-body" structure is ---- a structure that is constructed only of a single integral member and not one that is formed of multiple assembled or mated components----.

[0043] A definition of these bendable members is --an instrument element, formed either as a controlling means or a controlled means, and that is capable of being constrained by tension or compression forces to deviate from a straight line to a curved configuration without any sharp breaks or angularity--. Bendable members may be in the form of unitary structures, such as shown herein in FIGS. **1** and **2**, may be constructed of engageable discs, or the like, may include bellows arrangements or may comprise a movable ring assembly. For other forms of bendable members refer to co-pending applications Ser. Nos. 11/505,003 filed on Aug. 16, 2006 and 11/523,103 filed on Sep. 19, 2006, both of which are hereby incorporated by reference herein in their entirety.

[0044] FIG. **1** shows a preferred embodiment of the instrument of the present invention. Further details are illustrated in FIGS. **2** through **15**. FIG. **1** depicts the surgical instrument **10** in position, as may occur during a surgical procedure. For example, the instrument may be used for laparoscopic surgery through the abdominal wall, such as shown at **4** in FIG. **1**. For this purpose there is provided an insertion site at which there is disposed a cannula or trocar **6**. The shaft **14** of the instrument **10** is adapted to pass through the cannula or trocar **6** so as to dispose the distal end of the instrument at the operative site. The end effector **16** is depicted in FIG. **1** at such an operative site with the cannula or trocar **6** at the incision point in the skin **4**. The embodiment of the instrument shown in FIG. **1** is typically used with a sheath **98** to keep bodily fluids from entering the distal bending member **20**.

[0045] A rolling motion can be carried out with the instrument of the present invention. This can occur by virtue of the rotation of the rotation knob **24** relative to the handle **12** about axis T (refer to FIG. **3**). This is represented in FIG. **1** by the rotation arrow R**1**. When the rotation knob **24** is rotated, in either direction, this causes a corresponding rotation of the instrument shaft **14**. This is depicted in FIG. **1** by the rotational arrow R**2**. This same motion also causes a rotation of the distal bendable member and end effector **16** about an axis that corresponds to the instrument tip, depicted in FIGS. **1** and **3** as about the longitudinal tip or tool axis P.

[0046] Any rotation of the rotation knob **24** while the instrument is locked (or unlocked) maintains the instrument tip at the same angular position, but rotates the orientation of the tip (tool). For a further explanation of the tip rotational feature refer to co-pending application Ser. No. 11/302,654, filed on Dec. 14, 2005, particularly FIGS. **25-28**, which is hereby incorporated by reference in its entirety.

[0047] The handle **12**, via proximal bendable member **18**, may be tilted at an angle to the instrument shaft longitudinal center axis. This tilting, deflecting or bending may be considered as in the plane of the paper. By means of the cabling this action causes a corresponding bend at the distal bendable member **20** to a position wherein the tip is directed along an axis and at a corresponding angle to the instrument shaft longitudinal center axis. The bending at the proximal bendable member **18** is controlled by the surgeon from the handle **12** by manipulating the handle in essentially any direction including in and out of the plane of the paper in FIG. **1**. This manipulation directly controls the bending at the proximal bendable member. Refer to FIG. **3** in which there is shown the axis U corresponding to the instrument shaft longitudinal axis. Refer also to the proximal bend angle B**1** between axes T and U, and the corresponding distal bend angle B**2** between axes U and P.

[0048] Thus, the control at the handle is used to bend the instrument at the proximal motion member to, in turn, control the positioning of the distal motion member and tool. The "position" of the tool is determined primarily by this bending or motion action and may be considered as the coordinate location at the distal end of the distal motion member. Actually, one may consider a coordinate axis at both the proximal and distal motion members as well as at the instrument tip. This positioning is in three dimensions. Of course, the instrument positioning is also controlled to a certain degree by the ability of the surgeon to pivot the instrument at the incision point (cannula **6**). The "orientation" of the tool, on the other hand, relates to the rotational positioning of the tool, from the proximal rotation control member, about the illustrated distal tip or tool axis P.

[0049] In the drawings a set of jaws is depicted, however, other tools or devices may be readily adapted for use with the instrument of the present invention. These include, but are not limited to, cameras, detectors, optics, scope, fluid delivery devices, syringes, etc. The tool may include a variety of articulated tools such as: jaws, scissors, graspers, needle holders, micro dissectors, staple appliers, tackers, suction irrigation tools and clip appliers. In addition, the tool may include a non-articulated tool such as: a cutting blade, probe, irrigator, catheter or suction orifice.

[0050] The surgical instrument of FIG. **1** shows a preferred embodiment of a surgical instrument **10** according to the invention in use and may be inserted through a cannula at an insertion site through a patient's skin. Many of the components shown herein, such as the instrument shaft **14**, end effector **16**, distal bending member **20**, and proximal bending member **18** may be similar to and interact in the same manner as the instrument components described in the co-pending U.S. application Ser. No. 11/185,911 filed on Jul. 20, 2005 and hereby incorporated by reference herein in its entirety. Many other components shown herein, particularly at the handle end of the instrument may be similar to components described in the co-pending U.S. application Ser. No. 11/528,

134 filed on Sep. 27, 2006 and hereby incorporated by reference herein in its entirety. Also incorporated by reference in their entirety are U.S. application Ser. No. 10/822,081 filed on Apr. 12, 2004; U.S. application Ser. No. 11/242,642 filed on Oct. 3, 2005 and U.S. application Ser. No. 11/302,654 filed on Dec. 14, 2005, all commonly owned by the present assignee.

[0051] As illustrated in FIGS. **3-8**, the control between the proximal bendable member **18** and distal bendable member **20** is provided by means of the bend control cables **100**. In the illustrated embodiment four such control cables **100** are provided in order to provide the desired all direction bending. However, in other embodiments of the present invention fewer or less numbers of bend control cables may be used. The bend control cables **100** extend through the instrument shaft **14** and through the proximal and distal bendable members such as shown in FIGS. **3** and **4**. The bend control cables **100** are constrained along substantially their entire length so as to facilitate both "pushing" and "pulling" action in accordance with one aspect of the present invention as discussed in further detail hereinafter. The cables **100** are also constrained as they pass over the conical cable guide portion **19** of the proximal bendable member, and through the proximal bendable member. Refer, for example, to FIGS. **7** and **8**.

[0052] The locking means of the present invention interacts with the novel ball and socket arrangement to lock and unlock the positioning of the cables which in turn control the angle of the proximal bending member and thus the angle of the distal bendable member and end effector. This lock control allows the surgeon one less degree of freedom to concentrate on when performing certain tasks. By locking the bendable sections at a particular position, this enables the surgeon to be more hands-free for controlling other degrees of freedom of the instrument such as manipulation of the rotation knob **24** and, in turn, orientation of the end effector.

[0053] The instrument shown in FIG. **1** is of a pistol grip type. However, the principles of the present invention may also apply to other forms of handles such as a straight in-line handle. In FIG. **3** there is shown a jaw clamping means **30** that is comprised mainly of the lever **22** which has a single finger hole for controlling the lever and also includes a related release function controlled directly by the lever **22** rather than a separate release button. The release function is used to release the actuated or closed tool, and is discussed in further detail hereinafter.

[0054] In the instrument that is illustrated the handle end of the instrument may be tipped in any direction as the proximal bendable member is constructed and arranged to enable full 360 degree bending. This movement of the handle relative to the instrument shaft bends the instrument at the proximal bendable member **18**. This action, in turn, via the bend control cables **100**, bends the distal bendable member in the same direction. As mentioned before, opposite direction bending can be used by rotating or twisting the control cables through 180 degrees from one end to the other end thereof. Refer to the schematic perspective view of FIG. **15** for an illustration of the straight cabling used in the illustrated instrument.

[0055] In the embodiment described herein, the handle **12** is in the form of a pistol grip and includes a horn **13** to facilitate a comfortable interface between the action of the surgeon's hand and the instrument. The tool actuation lever **22** is shown in FIGS. **1-3** pivotally attached at the base of the handle. The lever **22** actuates a slider **28** that controls a tool actuation cable **38** that extends from the slider to the distal end of the instrument. The cable **38** controls the opening and closing of the jaws, and different positions of the lever control the force applied at the jaws.

[0056] The shape of the handle allows for a comfortable and substantially one-handed operation of the instrument as shown in FIG. **1**. As shown in FIG. **1**, the surgeon may grip the handle **12** between his palm and middle finger with the horn **13** nestled in the crook between his thumb and forefinger.

[0057] This frees up and positions the forefinger and thumb to rotate the rotation knob **24** using the finger indentions **31** that are disposed on the peripheral surface of the rotation knob, as depicted in FIG. **11**. In both locked and unlocked positions of the instrument the rotation knob is capable of controlled rotation to control axial rotation at the tip of the instrument about the distal tool tip axis P, as represented by the rotation arrow R**3** in FIG. **1**.

[0058] In the disclosed embodiment there is provided at the tool closing lever **22** a fingertip engaging recess **23** in a gimbaled ball **27**. The free end of the lever **22** supports the gimbaled ball **27** which has a through hole or recess **23** which receives one of the fingers of the user. The ball **27** is free to at least partially rotate in three dimensions in the lever end. The surgeon may grip the handle between the palm, ring and pinky fingers with the horn **13** nestled in the crook between his thumb and forefinger and operate the rotation knob **24** as previously described. The surgeon may then operate the jaw clamping lever **22** with the forefinger or middle finger.

[0059] The gimbal is in the form of a ball in a socket, in which the ball **27** is free to be rotated in the socket, and in which the socket is defined in the lever free end. In this embodiment, rather than having the hole or recess **23** go completely through the ball there is preferably provided a blind hole in the ball. This blind hole is shown in FIGS. **5** and **6**. The ball is free to rotate in the lever end and thus the ball can also be rotated to alternate positions corresponding to either a right-handed (FIG. **5**) or left-handed (FIG. **6**) user. The blind hole (in comparison to a through hole) enables the user to have a firmer grip of the lever and thus enhanced control of the lever action.

[0060] Reference is now made to FIGS. **2-4**. In this instrument the distal bendable member **20** is shown without any protective sheath so as to show some of the details of the distal bendable member **20**. The distal bendable member is comprised of spaced discs **110** that define therebetween spaced slots **112**. Ribs **111** may connect between adjacent discs in a manner similar to that described in the afore-mentioned U.S. application Ser. No. 11/185,911.

[0061] Refer also now to FIGS. **4A-4D** for further details of the tool end of the instrument. FIG. **4A** depicts the jaws in a fully open position. FIG. **4B** depicts the jaws grasping a needle. FIG. **4C** depicts the jaws fully closed. FIG. **4D** is a cross-sectional view taken along line **4D-4D** of FIG. **4C**. The end effector **16** is comprised of a pair of jaws **44** and **46**. The jaws **44** and **46** may be used to grasp a needle **45** or other item as shown in FIG. **3**. The upper jaw **44** fits within a channel **47** in the lower jaw **46**. A pivot pin **48** is used between the jaws to enable rotation therebetween. A translation pin **42** extends through the slot **50** of jaw **46** and the slot **52** of jaw **44** and engages with the hole in the distal cable end connector **40**. The connector **40** is secured to the very distal end of the jaw actuator cable **38** and is positioned within a channel of the jaw **44**. When the lever **22** is in its rest position, as depicted in FIG. **2**, the jaws are fully open. In that position the pin **42** is at a more distal location maintaining the jaws in an open position.

As the cable **38** is pulled, such as proximally in FIG. **3**, then the pin **42** moves to the right in the slots **50** and **52** causing the jaws **44** and **46** to pivot toward a closed position.

[0062] FIGS. **4**A-**4**D also depicts an end wall or plate **54** of the jaw **46**. One end of the distal bendable member **20** is urged against this end wall **54**. The member **20** may be secured to the wall **54** by an appropriate means. In one embodiment, the cabling tension itself of the instrument holds the members together. On the end wall **54** there are disposed a pair of anchors **56** and **58** for the flex control cables **100**. FIG. **4**D illustrates four such cables **100**. The distal end of the distal bendable member **20** may be provided with pockets for receiving the anchors **56** and **58**. The anchors **56** and **58** are firmly attached to the end wall **54**. Refer also to FIG. **15** for an illustration of the cabling and the connections thereof at opposite ends of each cable **100**.

[0063] The rotation knob **24** is provided with a proximal hub **25** which supports the proximal end of the proximal bending member **18**. During assembly, the cables **100** which protrude from the proximal end of the proximal bending member **18**, after the assembly of the end effector **16**, inner and outer shafts **32**, **34**, adapter **26** and proximal bending member **18**, are passed through the four terminal wire crimps or lugs **102** which are keyed into passages in the hub **25**. The cables are tensioned and crimped and excess cable material is trimmed off. This arrangement holds all the elements together between the end effector **16** and the rotation knob hub **25** and, in turn, the rotation knob **24**.

[0064] As indicated previously, the rotation knob **24** is formed with a hub **25** on its proximal side that is supported on the center wire conduit **64** which extends from the rotation knob **24** back to the slider **28**. An e-ring **65** retains the hub **25** in a rotational relationship relative to the conduit **64**. The conduit **64** is supported in a fixed position by internal means of the handle **12**. The knob **24** is readily accessible through a gap **232** between the split hub **202** and the distal end of the handle. See the gap **232** in FIG. **7**. The rotation knob **24** has four keyhole shaped slots **103** (FIG. **11**) that mate with terminal wire crimps **102**A-**102**D that enables a "push-pull" effect on the cables **100** when the handle is bent in relation to the shaft in contrast to past versions where the cables were in a spring-loaded "pull" relationship relative to the rotation knob. Because of this "push-pull" action, biasing springs associated with each cable are not used.

[0065] As indicated previously, the end effector or tool **16** is actuated by means of a jaw actuation mechanism or jaw clamping means **30** which is comprised primarily of the elongated lever **22**. The lever **22** is supported from the housing at the lever pivot pin **72**. Refer to FIGS. **2** and **3**. The closing of the lever **22** against the handle **12** acts upon the slider **28** which is used to capture the very proximal end of the actuation cable **38**. When the slider **28** is in the position depicted in FIG. **2**, it is noted that the end effector jaws are fully open. In that position the slider **28** is disposed at the more distal end of the slideway **84**. The slideway **84** is part of the internal support in the handle **12**. When the slider **28** is moved proximally, as depicted in FIG. **3**, then the jaws are moved toward a closed position grasping the needle **45**.

[0066] The instrument shaft **14** includes an outer shaft tube **32** that may be constructed of a light weight metal material or may be a plastic material. See the cross-sectional view of FIG. **9** taken through the instrument shaft. The proximal end of the tube **32** is received by the adaptor **26**, as depicted in FIGS. **7** and **8**. The distal end of the tube **32** is secured to the distal bendable member **20**. Within the outer shaft tube **32** there is provided a support tube **34** that is preferably constructed of a plastic material. Tube **34** extends between the distal bendable or flexible member **20** and the proximal bendable or flexible member **18**. The jaw actuator cable **38** extends within this support tube **34**.

[0067] One of the features of the present invention is the cable scheme that uses bend control cables that are relatively stiff and yet are bendable. The stiffer cables allow for, not only "pulling", but also "pushing" action thereof. This enables enhanced control via the cabling as control is provided, not only when a cable is "pulled", but also when a cable is "pushed". This makes for a more uniform control via the cables. To enable, not only a "pulling" action, but also a "pushing" action, the cables **100** are supported in relatively narrow lumens or passageways to prevent buckling when being pushed. This is facilitated by, inter alia, the provision of a shaft filler **36**. To allow for the "pushing" action in particular the cables are confined so that they do not distort within the instrument itself

[0068] The shaft filler **36** is disposed between the tubes **32** and **34** and is used to hold the cables in place within the instrument shaft itself. As can be seen in FIG. **9**, the shaft filler has a central lumen **36**A for the inner shaft support tube **34** and four lengthwise grooves **36**B that accommodate and allow a snug sliding fit for the cables **100**. The conical portion **19** of the proximal bending member **18** has four cable guide grooves **106** disposed at 90 degree intervals about its outer surface that capture each cable in a sliding relationship with the adapter **26**. Each of the guide grooves is formed in a separate diametrically disposed wing **108** of the conical portion **19**. The adaptor **26** may also be provided with accommodating grooves for the cables **100**. Refer also to the cross-sectional view of FIG. **10** for an illustration of the cable guide and constraining arrangement. Thus, the cables are constrained along their length in grooves or passages. Each of the cables is preferably unsupported for only a short distance such as the distance of the slots **132** shown in FIGS. **2** and **3**, or like slots at the distal bendable member.

[0069] The jaw actuator cable **38** terminates at its respective ends at the end effector (connector **40**) and the rotation barrel **66** (see FIG. **3**). Within each of the bendable sections or bendable members **18** and **20** there is provided a plastic tube. This includes a distal tube **60** and a proximal tube **62**. Both of these tubes may be constructed of a plastic such as polyetheletherkeytone (PEEK). The material of the tubes is sufficiently rigid to retain the cable **38** and yet is flexible enough so that it can readily bend with the bending of the bendable members **18** and **20**. The tubes have a sufficient strength to receive and guide the cable, yet are flexible enough so that they will not kink or distort, and thus keep the cable in a proper state for activation, and also defines a fixed length for the cable. The tubes are longitudinally stiff, but laterally flexible.

[0070] The proximal bendable member **18**, like the distal bendable member **20**, may also be constructed as a unitary or uni-body slotted structure including a series of flexible discs **130** that define therebetween slots **132**, as shown in FIG. **2**. A "unitary" or "uni-body" structure may be defined as one that is constructed for use in a single piece and does not require assembly of parts. Connecting ribs **131** are illustrated as extending between adjacent discs **130**. Both of the bendable members preferably have a rib pattern in which the ribs are disposed at a preferred 60 degree variance from one rib to an

adjacent rib. This has been found to provide an improved bending action. It was found that by having the ribs disposed at intervals of less than 90 degrees therebetween improved bending was possible. The ribs may be disposed at intervals of from about 35 degrees to about 75 degrees from one rib to an adjacent one. By using an interval of less than 90 degrees the ribs are more evenly distributed. As a result the bending motion is more uniform at any orientation. In the present invention both of the bendable members may be made of a highly elastic polymer such as PEBAX (Polyether Block Amide), but could also be made from other elastic and resilient materials.

[0071] The lever **22** in FIG. **2** is shown in the lowermost position which may be considered as the "at rest" position. This is also substantially the same position illustrated in FIGS. **7** and **12**. This would be achieved by either action of the return spring **82** in the bore **80** of the slider **28** in certain instruments or by the surgeon manually moving the lever to that position in other embodiments of the instrument where a return spring is not used.

[0072] FIGS. **2** and **3** illustrate the lever **22** passing through a slot **73** in the handle and being mounted to a pivot pin **72**. An arm **70** of the lever **22** has a cylindrical head **71** which mates with a recess **74** in a boss **75** at the proximal end of the slider **28**. The slider **28** sits in the slideway **84** and moves proximally and distally in response to the lever position and/or return spring action. The slider **28** carries the rotatable barrel **66** clamped to the push/pull cable **38** by means of the set screws **67** or the like. The barrel **66** is rotatable in response to the rotation of the instrument shaft and end effector. Refer also to FIG. **7** for further details of the slider mechanism. The barrel **66** sits in a slot **68** which is open to a contiguous slot **78** at one end and is closed by a wall **69** at its other end. The wall **69** has a through hole which acts as a guide for the push/pull cable **38** that protrudes from the proximal end of the barrel **66**, and thus guides the barrel action itself. The barrel **66** is urged against the wall by a compression spring **76** that is disposed in the slot **78**. The position of the lever, as depicted in FIG. **2** has the jaws fully open as also shown in FIG. **4**A. Refer to co-pending Ser. No. 11/528,134 filed on Sep. 27, 2006 for further details of the operation of the lever and slider.

[0073] The jaw clamping lever **22** is also adjustable for left and right handed operation as well as a range of adjustment from angle C in FIG. **5** to angle D in FIG. **6**. This is accomplished by means of a cam lever **240** at the base of the handle that rotates approx. 180 degrees about shaft **72** that also supports jaw clamping lever **22**. The control by the lever **240** may also be by rotation through other angles. The cam lever **240** basically adjusts the attitude of the clamping lever **22** relative to a center line or center plane of the handle as represented by the line or plane W in FIGS. **5** and **6** which illustrate the opposite direction attitudes depending on the position of the lever **240**. This adjustment can be made based on whether the user is right handed or left handed, or can be made on the basis of some other characteristic of the hand of the user such as finger length.

[0074] The cam lever **240** includes a wedge shaped washer **242** with a truncated ball **244** formed on the inside sloped surface of the washer portion. The ball and washer have a through hole **246** that fits over shaft **72** and allows the lever to pivot about the shaft **72** upwardly or downwardly from a front to rear position relative to the base of the handle as seen in FIGS. **5** and **6**. The ball **244** has mating features shown at **248** in FIG. **6** and preferably in the form of two slots that mate with two lugs on a cam disk **250**. These mating features synchronize rotation of the lever **240** and cam disk **250**. Cam disk **250** is also basically a wedge shaped washer with a through hole **252** that allows it to pivot on shaft **72** in response to the rotation of cam lever **240**. Cam disk **250** is illustrated in FIG.

[0075] **6** as having two detents **254** on its outer face that interact with two bumps (not shown) on the side of slot **73** to preferably hold it in either of the two positions shown in FIGS. **5** and **6**. The ball **244** sits in the bore **256** of lever **22** and allows lever **22** to change angle in response to rotation of the cam lever **240** and the relative positions of the angled faces of disks **242** and **250**.

[0076] The jaw clamping means **30** uses a ratcheting and release mechanisms and is shown in a series of positions in FIGS. **12-14**. The ratcheting mechanism is illustrated by the leaf spring **92** with an angled end **94** that engages teeth **86** on the slider **28** as lever **22** is squeezed. FIG. **12** shows the mechanism in an initial position, such as the position shown in FIG. **2** corresponding to an open position of the jaws. FIG. **13** shows the clamping lever at an advanced position with the end **94** of the spring **92** engaging one of the teeth **86** on the slider **28**. For release of the jaws, the lever **22** is squeezed all the way to the position of FIG. **14** at which point, wall **69** contacts latch **96** and rotates latch **96** counterclockwise around pivot **90** until spring **92** is lifted out of engagement with the teeth **86** by the latch face **96**B engaging the underside of the spring **92**. FIG. **14** shows the leaf spring **92** being lifted so as to disengage from the ratchet teeth **86**. This action leaves the slider **28** free to move to the left as seen in FIG. **14** until wall **79** contacts and rotates the latch **96** clockwise around pivot **90** until face **96**A is aligned with the underside of the spring, allowing it to drop into place for engagement with the end of the slider **28** just to the rear of the teeth **86**, as in the position illustrated in FIG. **12**.

[0077] The spring **92** and the teeth **86** form a ratchet arrangement in which the lever **22** may be clicked through a number of positions in closing the end effector and tightening the jaws of the end effector about an item such as a needle. As the lever **22** is depressed inwardly toward the handle, then the free end **94** of the latch spring **92** engages with various teeth on the slider. The jaws are tightened by each successive click until the item being grasped is fully engaged. In order to release the actuation sequence, rather than using a separate release button, the lever **22** is simply moved to its most inward position such as illustrated in FIG. **14** where the latch **96** engages the wall **79**. This pivots the latch to a position where it lifts the spring **92** thus disengaging the spring from the teeth on the slider and enabling the slider to thus move under spring bias to its released position.

[0078] The locking mechanism or angle locking means **140** of the present invention includes a ball and socket arrangement that is basically disposed over the proximal bendable member and that follows the bending at the proximal bendable member. The locking mechanism has locked and unlocked positions, is disposed about the proximal movable or bendable member and is manually controlled so as to fix the position of the proximal movable member relative to the handle in the locked position thereof. The locking mechanism comprises a ball member and a compressible hub that defines a socket member. In the disclosed embodiment the hub is a split hub and the locking mechanism further includes a cinch ring disposed about the split hub and a locking lever mounted on the cinch ring for closing the cinch ring about the hub to lock the hub against the spherical ball member. The cinch ring

interlocks with the hub but is able to rotate relative thereto when in the unlocked position.

[0079] The "ball" part is basically formed by the ball member **120**, while the "socket" part is basically formed by an extension of the handle, namely the split hub **202**. The locking mechanism locks the proximal bendable member in a desired position and by doing that also locks the position of the distal bendable member and tool. The proximal bending member **18**, although it is enclosed the ball and socket arrangement, still allows the instrument shaft **14** and the proximal bending member **18**, along with the cabling **100**, to rotate freely while also allowing the axis of the instrument shaft to be angled relative to the axis of the handle in a free, or alternately, locked mode.

[0080] For this purpose refer to the ball member **120** which is shown in further detail in FIGS. **5-8**. The ball member **120** includes a distal neck **206** that is contiguous with a partially spherical ball end having a spherical outer surface **204**. The neck **206** is basically disposed over the adaptor **26** and conical portion **19** of the proximal bendable member **18**, while the ball portion is mainly disposed over the primary part of the proximal bendable member **18**. The ball member **120** is adapted to sit within a socket that is formed in the handle in the form of a hub **202** that can be collapsed about the ball member **120** by radially compressing the cinch ring **200**.

[0081] The ball member **120** is gimbaled in a split hub **202** that is comprised of four quadrants **202**A-**202**D that can be clamped against the spherical surface **204** of the ball member **120** by means of the cinch ring **200**. Refer to FIG. **8**. The split hub **202** is supported at the distal end of the handle by means of three struts **230** that are spaced approximately 120 degrees apart (see FIG. **11**). The ball member **120** has a neck portion **206** that provides support for the distal end of the proximal bendable member **18**. In this regard a bearing surface **208** is provided, as illustrated in FIGS. **7** and **8**, between the proximal end of the neck **206** and the adaptor **26**. This enables the proximal bendable member, along with the adaptor **26** to be free to rotate relative to the ball member **120**. FIGS. **7** and **8** also illustrate a bearing surface at **210** between the very distal end of the neck **206** and the outer tube **32**. These bearing surfaces **208**, **210** may be formed by actual bearings at those locations.

[0082] FIGS. **5-8** illustrate the cinch ring **200**. Refer also to FIGS. **2** and **3** for an illustration of the cinch ring **200**. The cinch ring **200** is an annular member that has an internal ridge or spline **201** that is adapted to mate with a channel or groove **203** in the outer surface of the split hub **202**. This combination of a channel and ridge limits the annular cinch member to just rotation about the hub **202**. FIG. **8** also shows that each of the portions **200**A-**200**B of the split hub connects to the instrument handle via respective struts **230** (see also FIG. **11**). When the cinch ring **200** is closed this, in turn, closes the slotted hub and essentially compresses the socket (hub **202**) against the spherical surface **204** of the ball member **120**. The locking of the ball member thus fixes the position of the proximal bendable member, and, in turn, the distal bendable member and tool.

[0083] The cinch ring **200** is operated by means of an over-center locking lever **220** that is connected to ends **200**A and **200**B of the cinch ring **200** by means of the pins **222** and **224**, respectively. FIG. **5** illustrates the lock lever **220** in a locked position while FIG. **6** illustrates the lock lever in a released or unlocked position. The end **200**A of the cinch ring **200** is in the form of a detachable hook that snap fits over pin **222** and sits in a slot **226** of the lever **220** when the ring is locked. The other end **200**B of the cinch ring **200** is in the form of two bales that snap fit over pin **224** formed on the sides of the lever **220**. The cinch ring **200** is free to rotate around the split hub **202** when lever **220** is released by means of the spline **201** that rides in the groove **203** in the circumference of the split hub **202**. This allows for left or right handed operation of the instrument. FIG. **5** illustrates a set up for a right handed operation with the angle locking lever **220** shown in a locked position and FIG. **6** illustrates a set up for a left handed operation, with the angle locking lever **220** shown in an unlocked position.

[0084] When the locking lever **220** is moved to its locked position this compresses the cinch ring **200** closing the hub against the spherical outer surface **204** of the ball member **120**. This locks the handle against the ball member **120** holding the ball member in whatever position it is in when the locking occurs. By holding the ball member in a fixed position this, likewise, holds the proximal bendable member in a particular position and fixed in that position. This, in turn, maintains the distal bendable member and tool at a fixed position, but the instrument orientation can be controlled via the control of the rotation knob which controls the orientation of the instrument tip by enabling rotation of the distal bendable member and tool about the tip axis P (see FIG. **3**).

[0085] The instrument of the present invention provides an improved instrument, particularly from the standpoint of ease of use by the surgeon. The tool actuation lever arrangement permits fine control by the user, particularly with the instrument arrangement that has the recessed gimbal where the finger of the user can be readily engaged with the lever. This arrangement also enables the instrument to be readily adapted for either right-handed or left-handed control by simply rotating the gimbal in its socket between opposite positions. It is also preferred that the recess in the gimbal be formed by a blind hole (with a bottom wall) as this has been found to provide enhanced manual control of the lever positioning.

[0086] Another improvement of the instrument of the present invention relates to the ease with which the tool can be controlled including the convenient placement of the rotation member and the convenient placement of the locking arrangement where the users thumb and forefinger can be readily used to control both tip rotation as well as locking These functions can be performed with a single hand and without requiring the user to move the hand position.

[0087] Having now described a limited number of embodiments of the present invention it should now be apparent to one skilled in the art that numerous other embodiments and modifications are contemplated as falling within the scope of the present invention as defined by the appended claims. For example, in another version of the present invention a different form of instrument tip rotation means may be used such as a slide mechanism to control distal rotation about the tool tip axis. Even with such alternate means a locking function may still be associated with the instrument to provide the lock function. The locking means described herein has been illustrated for use with a pistol grip handle, however, this locking means may also be provided on an in-line instrument such as the type illustrated in Ser. No. 11/185,911 filed on Jul. 20, 2005. Also, in the instrument that is described herein the movable members have been illustrated as bendable sections, and more particularly, as unitary bendable sections. However, the movable members may alternatively be of other constructions including, but not limited to, engageable discs, bellows

arrangements, a movable ring assembly or ball and socket members. For other forms of bendable members refer to co-pending provisional applications Ser. No. 60/802,885 filed on May 23, 2006 and 60/811,046 filed on Jun. 5, 2006, both of which are hereby incorporated by reference herein in their entirety. Also, in the instrument that is described herein the ball and socket arrangement has the ball part on a separate member that mates with a socket associated with the handle. In still another embodiment of the present invention the ball and socket arrangement may comprise a separate socket member that mates with a protruding ball of the handle.

What is claimed is:

1. A surgical instrument comprising:
an instrument shaft having proximal and distal ends;
a tool disposed from the distal end of the instrument shaft;
a control handle coupled from the proximal end of the instrument shaft;
a distal motion member for coupling the distal end of said instrument shaft to said tool;
a proximal motion member for coupling the proximal end of said instrument shaft to said handle;
actuation means extending between said distal and proximal motion members for coupling motion of said proximal motion member to said distal motion member for controlling the positioning of said tool;
and a locking mechanism for fixing the position of the tool at a selected position and having locked and unlocked states;
said locking mechanism including a ball and socket arrangement disposed about said proximal motion member and a cinch member for locking said ball and socket arrangement.

2. The surgical instrument of claim **1** further including a rotation means disposed adjacent the control handle and rotatable relative to the control handle for causing a corresponding rotation of the instrument shaft and tool.

3. The surgical instrument of claim **2** wherein at least said proximal motion member comprises a proximal bendable member, said rotation means comprises a rotation knob that is adapted to rotate the tool about a distal tool roll axis and said rotation knob is disposed between said control handle and proximal bendable member.

4. The surgical instrument of claim **1** wherein said control handle comprises a pistol grip handle having an engagement horn to assist in holding the handle.

5. The surgical instrument of claim **4** wherein said rotation means comprises a rotation knob that is disposed at the distal end of the handle and said horn is disposed proximally of the rotation knob and on the top of the pistol grip handle.

6. The surgical instrument of claim **4** including an actuation lever supported from said pistol grip handle at a pivot point at the proximal end of the handle.

7. The surgical instrument of claim **6** wherein said actuation lever has a free end with a finger loop for receiving a users finger to control the lever.

8. The surgical instrument of claim **1** including a tool actuation cable that extends from said tool to said handle, a slider for capturing the proximal end of said tool actuation cable and an actuation lever supported at said handle for controlling the translation of said slider.

9. The surgical instrument of claim **8** including a slideway for receiving said slider, a pair of springs disposed in said slider and a rotational barrel disposed between said springs and for holding the proximal end of said tool actuation cable.

10. The surgical instrument of claim **1** wherein the ball and socket arrangement comprises a ball member having a partially spherical portion that mates with a concave socket in the handle.

11. The surgical instrument of claim **10** wherein said handle has a distal collar with the socket formed on the inner surface of the collar and said cinch member includes an annular cinch ring that is disposed about said distal collar.

12. The surgical instrument of claim **11** including a tongue and groove interconnection between said cinch ring and collar so as to permit rotation therebetween while preventing axial movement.

13. The surgical instrument of claim **12** including a pivot piece on said cinch ring having opposed locked and unlocked positions.

14. The surgical instrument of claim **11** wherein said distal collar has one or more slot to enable the socket to be compressed about the ball member as the cinch ring is locked.

15. A surgical instrument comprising;
an instrument shaft having proximal and distal ends;
a tool disposed from the distal end of the instrument shaft;
a control handle disposed from the proximal end of the instrument shaft;
a distal motion member for coupling the distal end of said instrument shaft to said tool;
a proximal motion member for coupling the proximal end of said instrument shaft to said handle;
actuation means extending between said distal and proximal motion members for coupling motion of said proximal motion member to said distal motion member for controlling the positioning of said tool;
said control handle including a pistol grip handle;
an actuation lever for controlling said tool and pivotally supported from said handle;
and an adjustment member mounted on said lever for adjusting the attitude of the actuation lever relative to a center plane of the handle.

16. The surgical instrument of claim **15** wherein said adjustment member includes an adjustment lever for changing the attitude between positive and negative values.

17. The surgical instrument of claim **16** wherein said adjustment member includes a beveled washer means.

18. The surgical instrument of claim **16** wherein said adjustment lever is supported from the same pivotal support as for the actuation lever.

19. The surgical instrument of claim **15** further including an engagement horn to assist in holding the handle and a rotation knob disposed at the distal end of the handle and said horn is disposed proximally of the rotation knob and on the top of the pistol grip handle.

20. In a medical instrument having a proximal control handle and a distal tool that are intercoupled by an elongated instrument shaft that is meant to pass internally of an anatomic body, proximal and distal movable members that respectively intercouple said proximal control handle and said distal tool with said instrument shaft, cable actuation means disposed between said movable members, said control handle having proximal and distal ends, an actuation lever for controlling said distal tool, means for pivotally supporting said actuation lever from the proximal end of said handle at one side thereof, a horn and means for fixedly supporting said horn from the distal end of said handle at an opposite side thereof.

21-31. (canceled)

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