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(54) **DEVICE FOR LAPAROSCOPIC TUBAL LIGATION**

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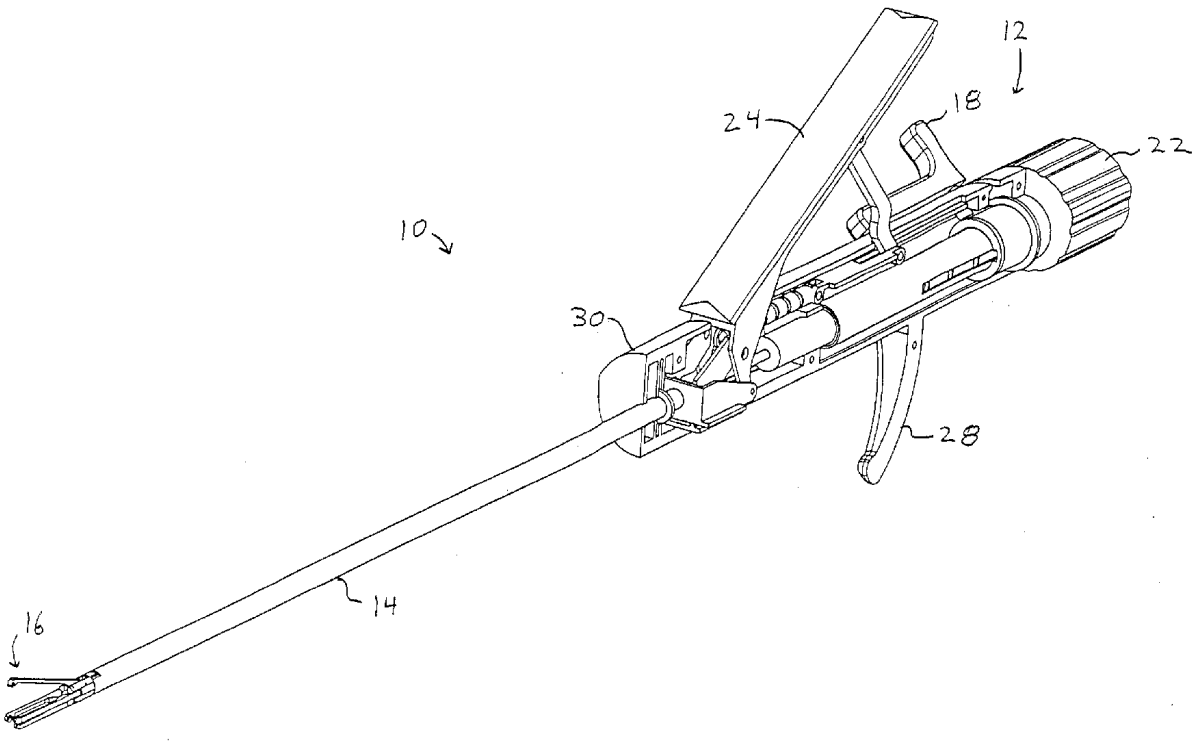
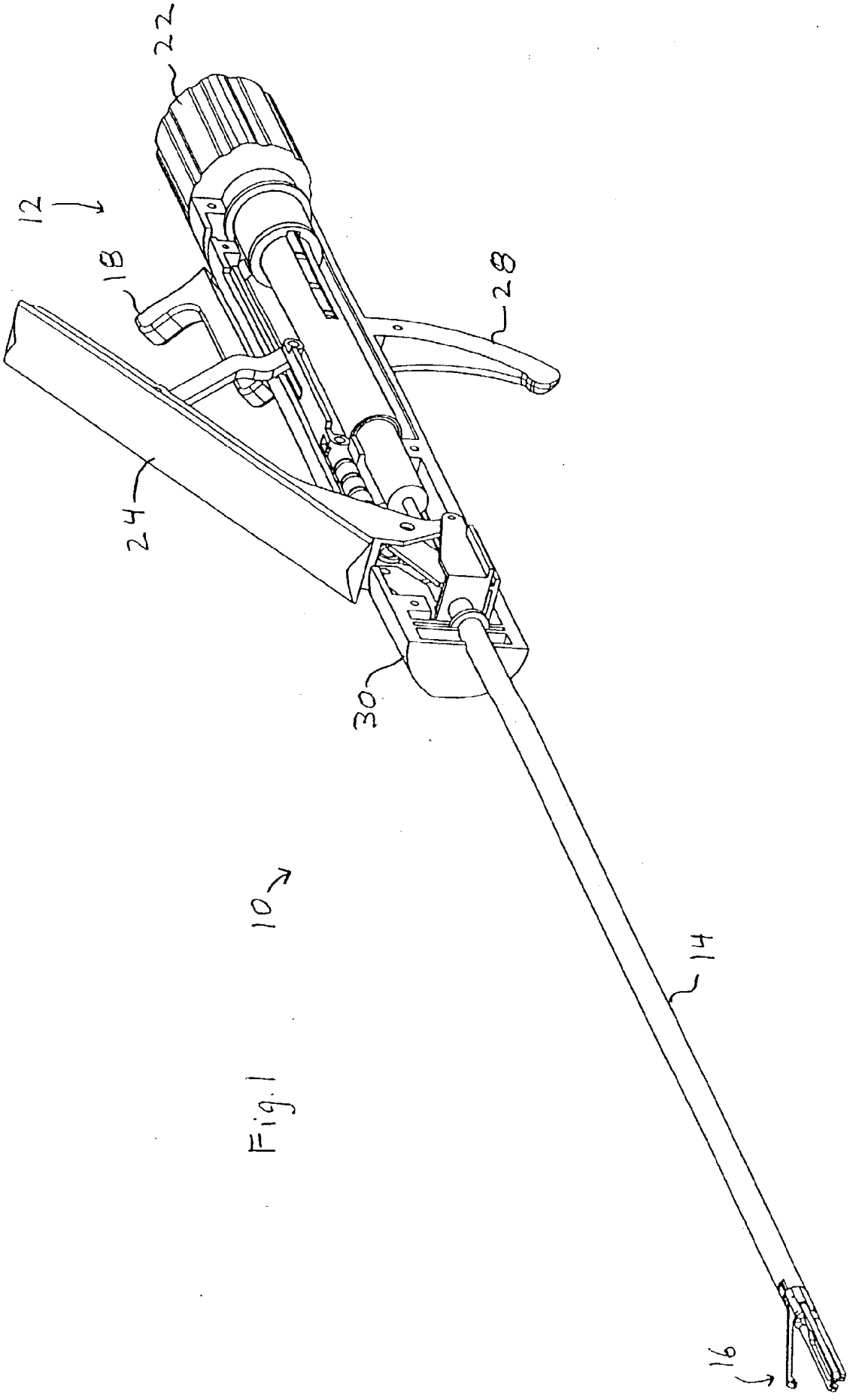
(57) **ABSTRACT**

The present disclosure relates to a ligating instrument and end effector assemblies for use in laparoscopic tubal ligation procedures. The ligating instrument includes an integral grasping assembly and an integral end effector actuator and is configured to perform a ligating procedure by operation of a single hand of a user. The ligating instrument includes an integral grasper assembly for grasping a tubular tissue section and removable end effector or suture deployment mechanism for holding open a suture to be positioned about the tubular section. The grasper is configured to draw the tubular section into the open loop of suture material and cinch the suture material about the tubular tissue section. A rotator knob may be provided to orient grasper members associated with the grasper assembly relative to the tissue section. An alternative end effector is provided to removably mount on the distal end of the ligating instrument and to cut that part of the tubular tissue section which needs to be removed after the tubular tissue section has been ligated. A relatively soft over mold section may be provided to at least partially enclose the handle of the ligating instrument in order to provide comfort and facilitate a surer grip of the instrument.





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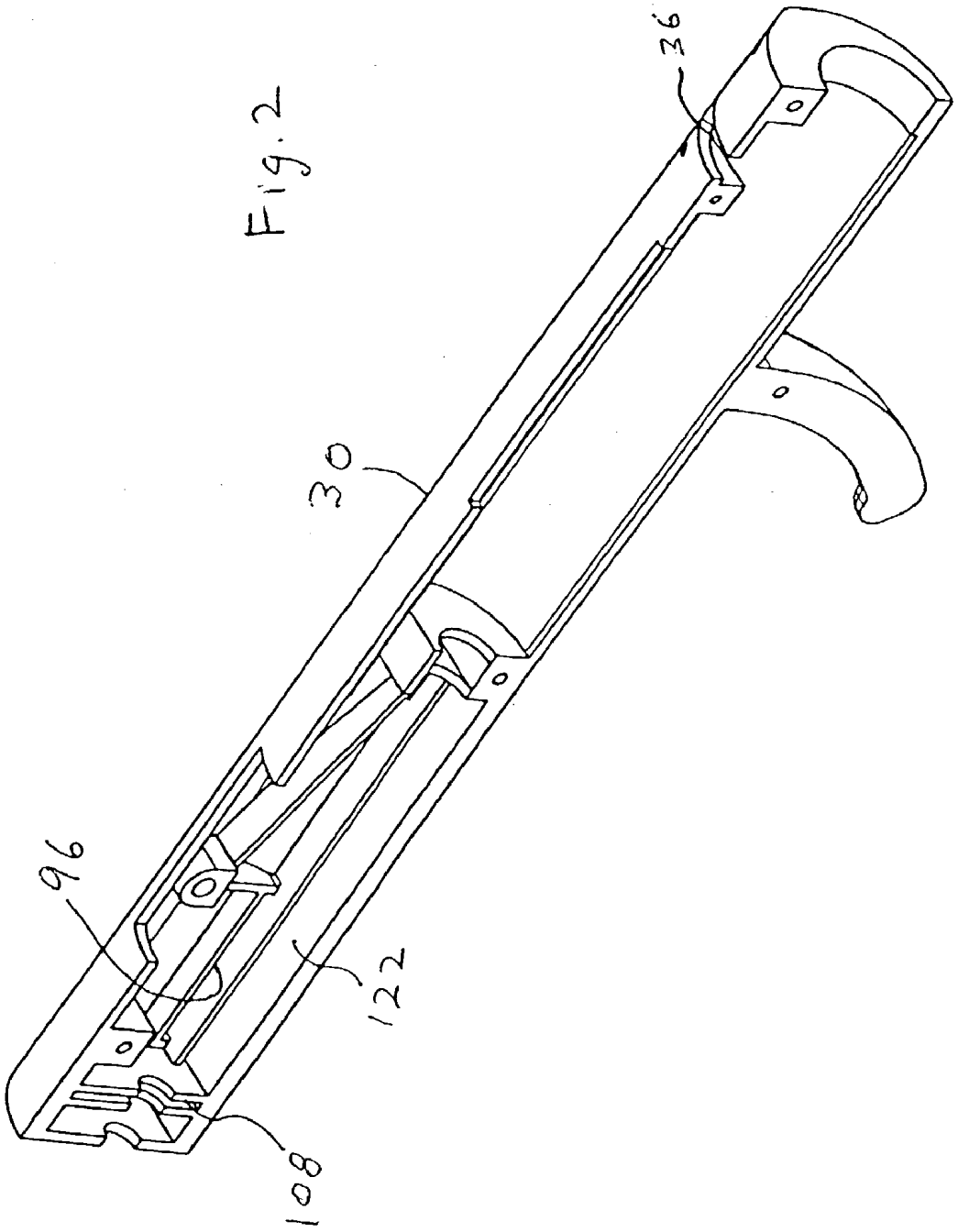

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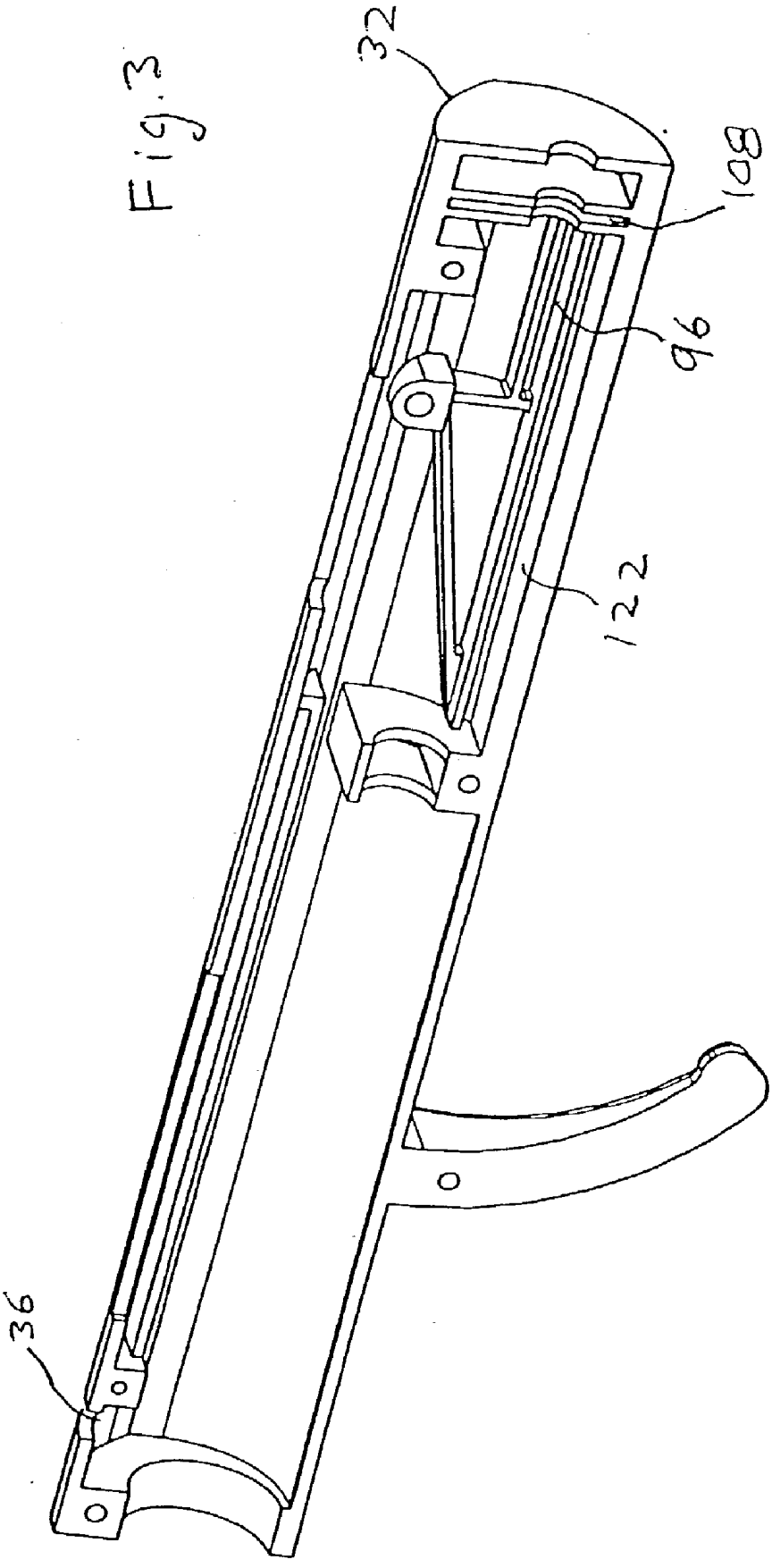

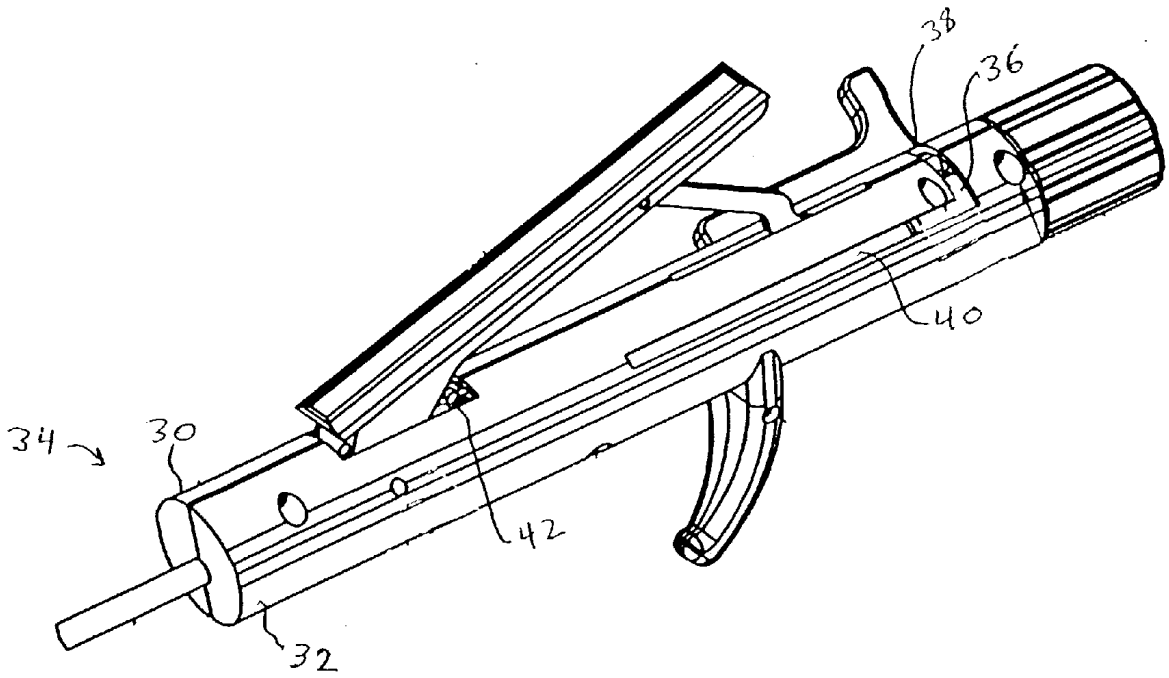

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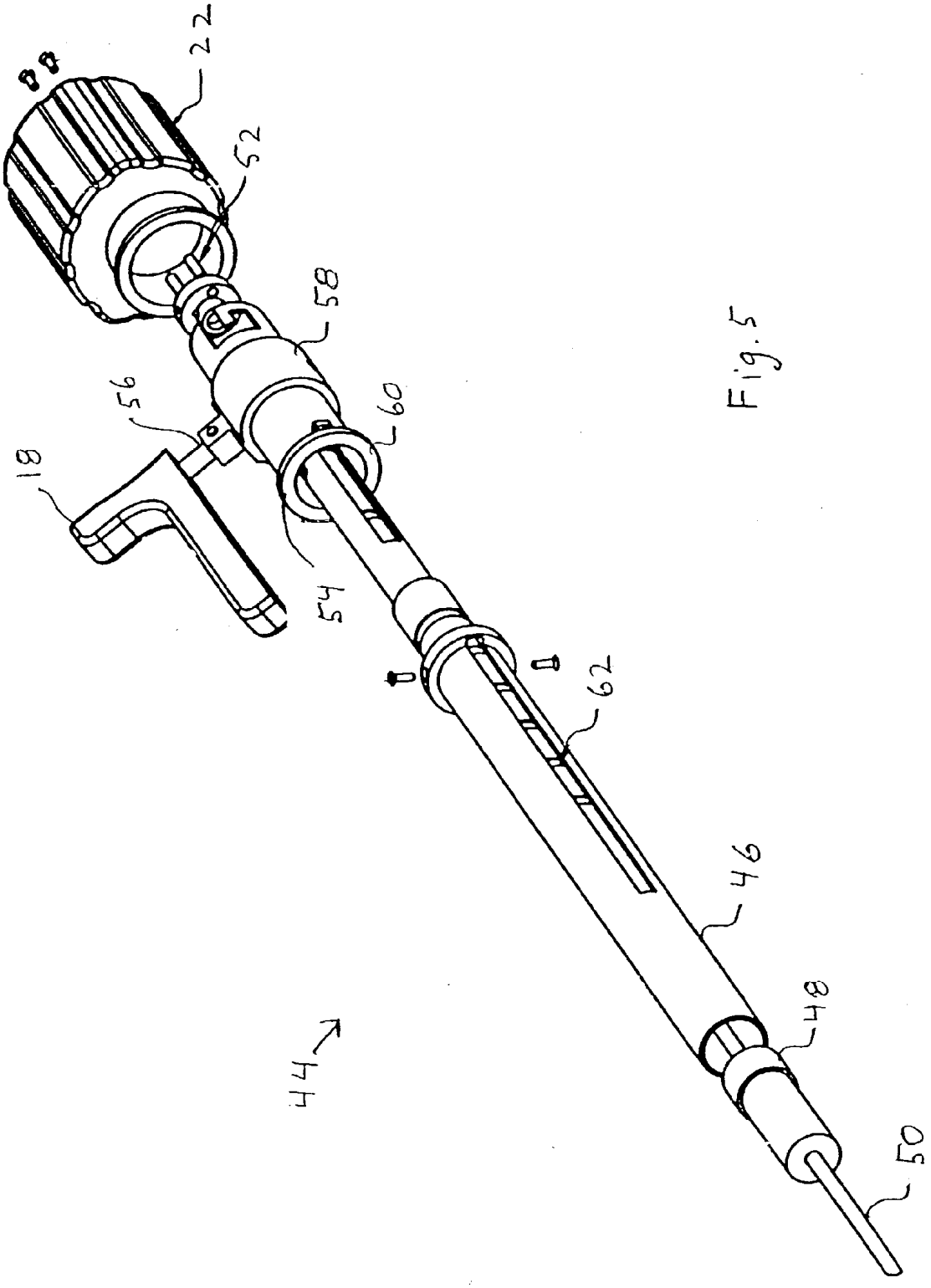

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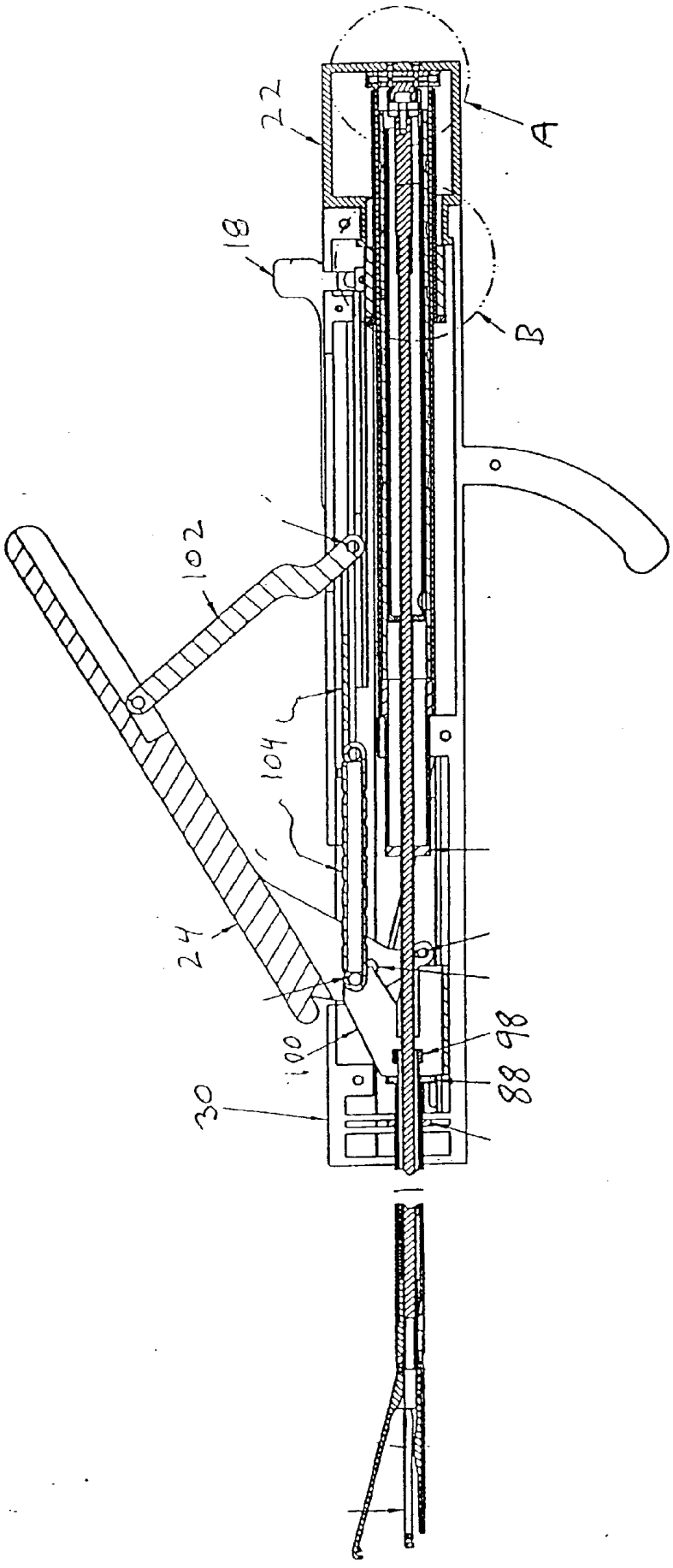

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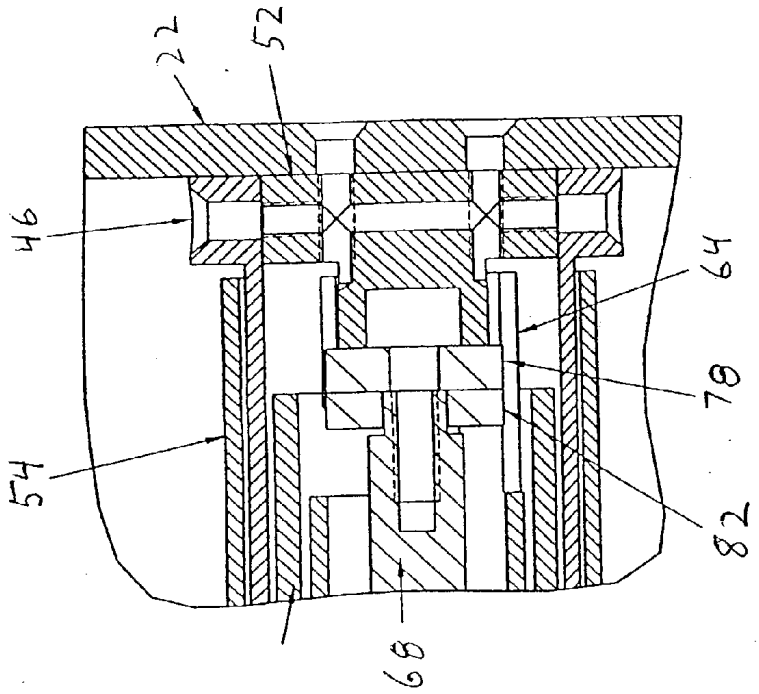

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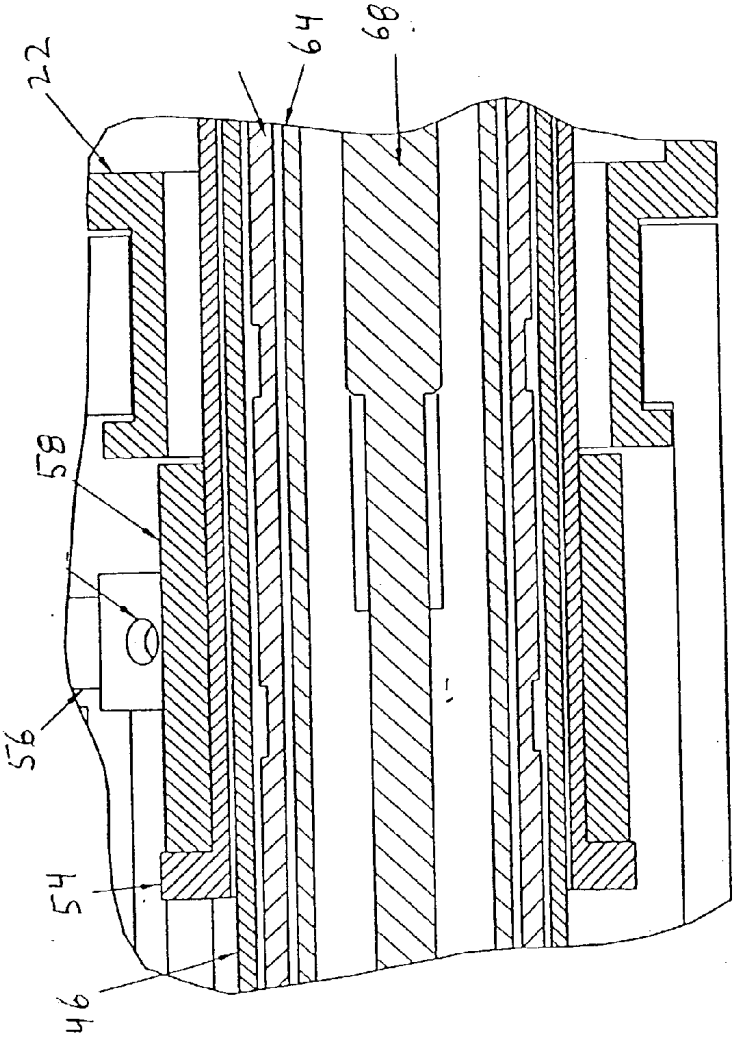

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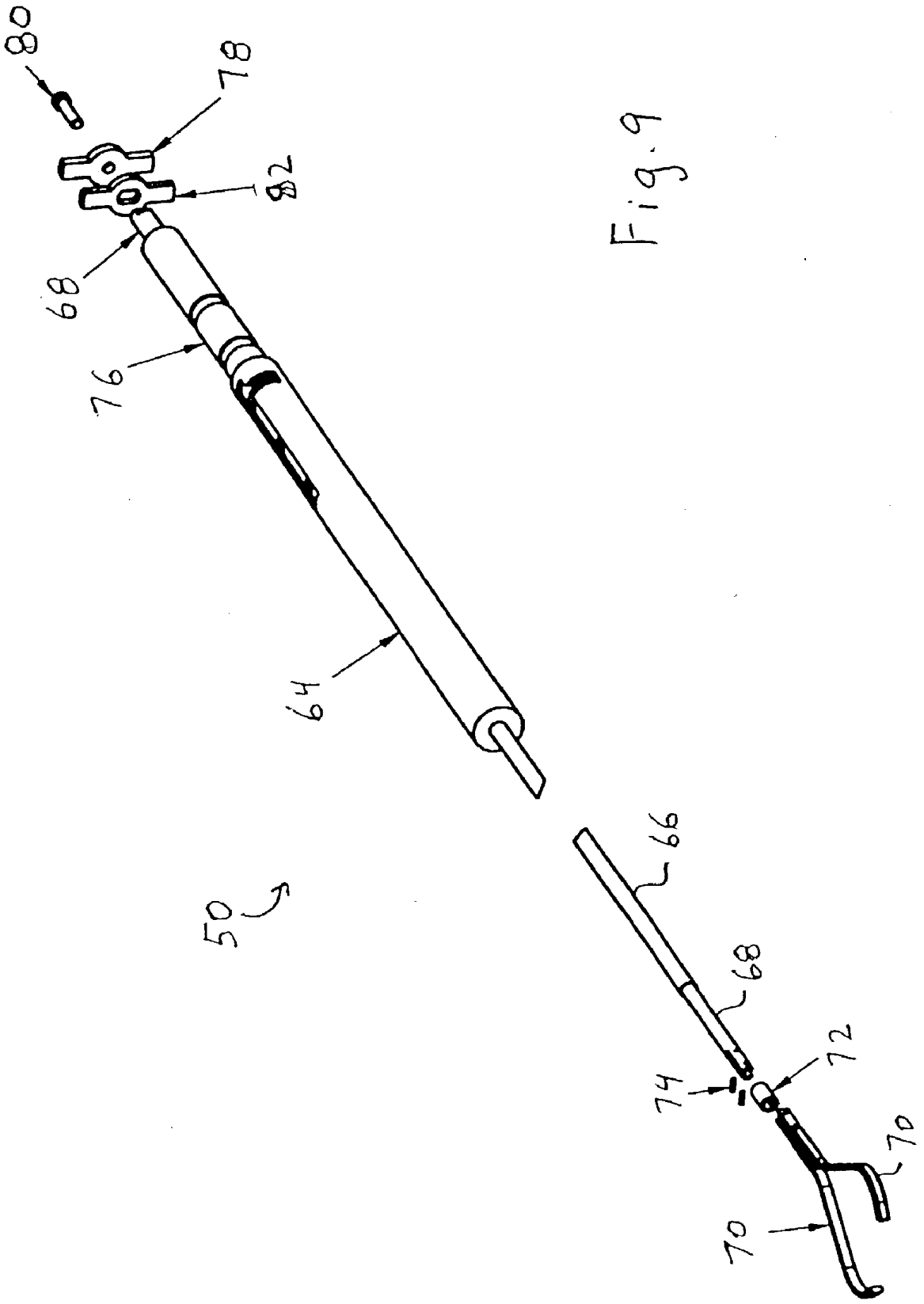

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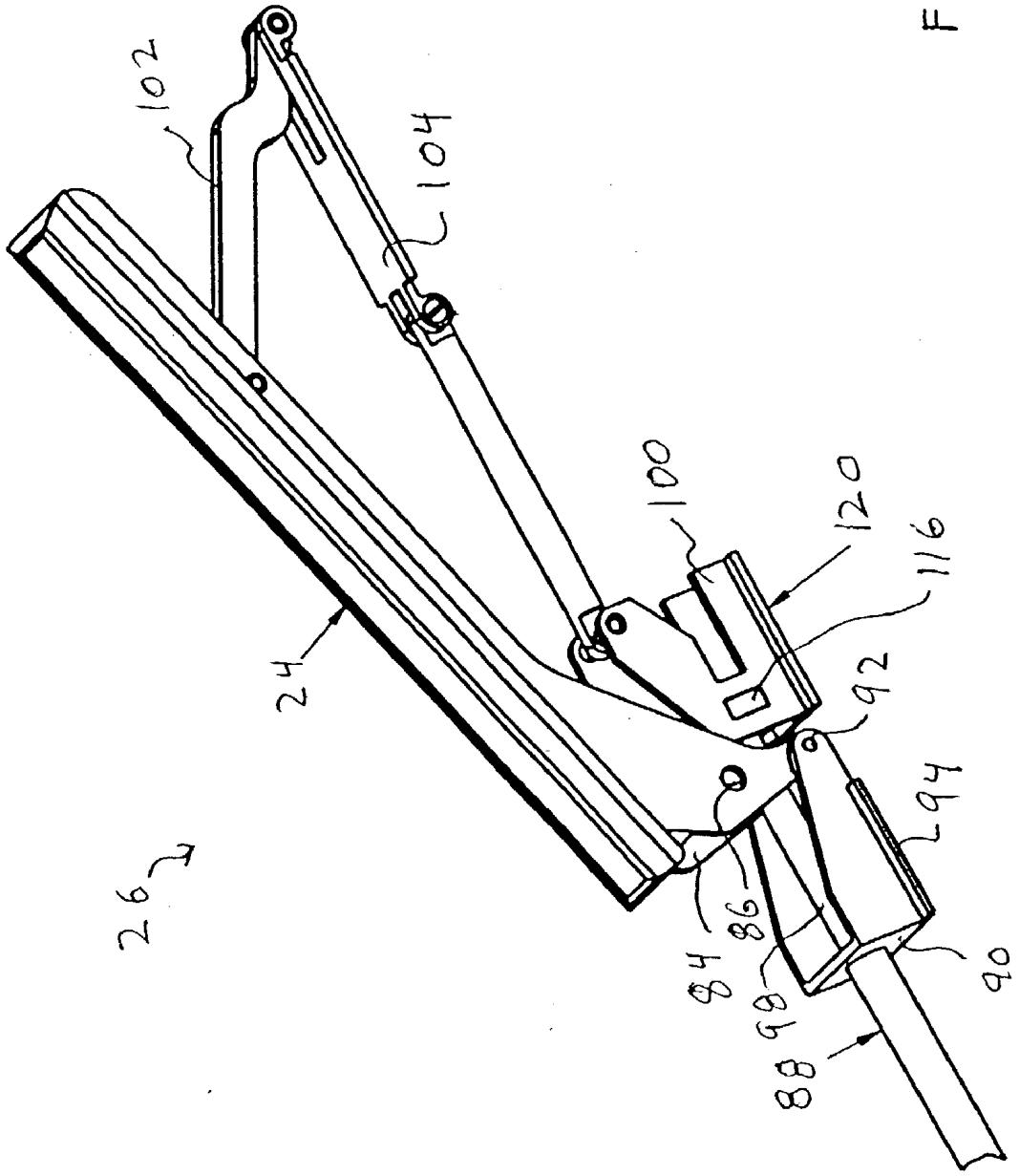

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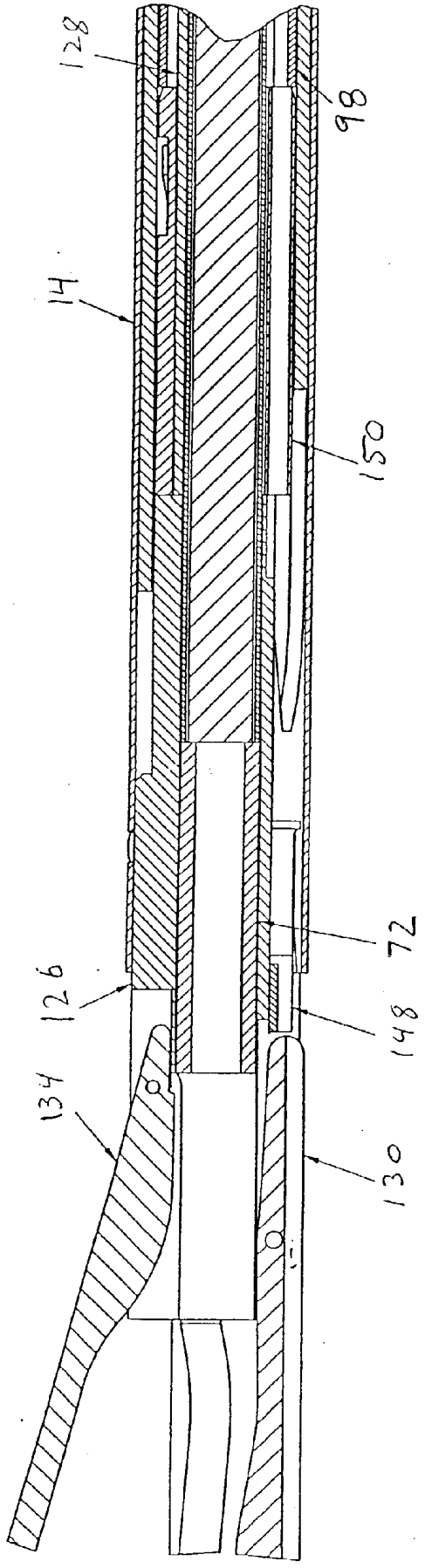

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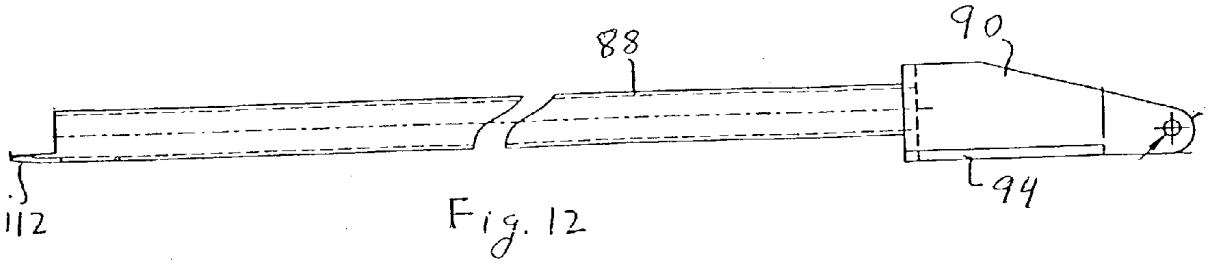

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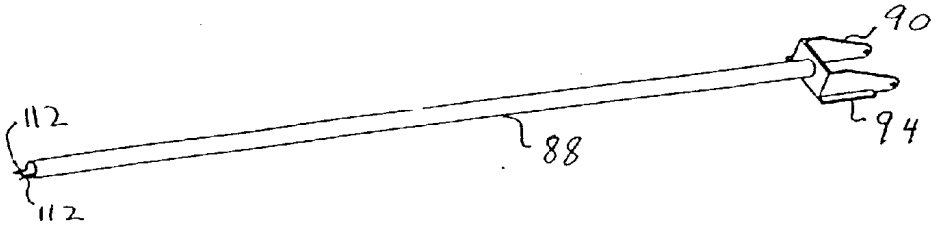

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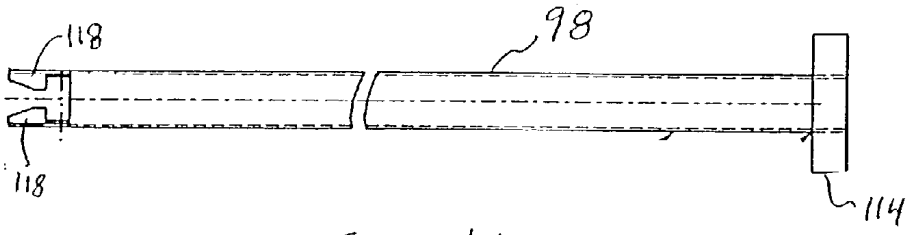

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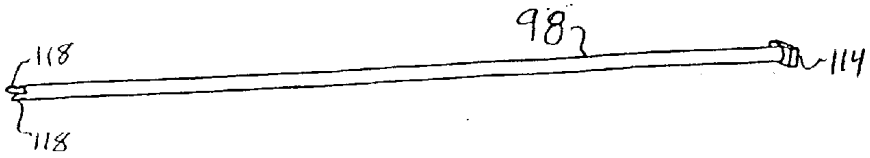

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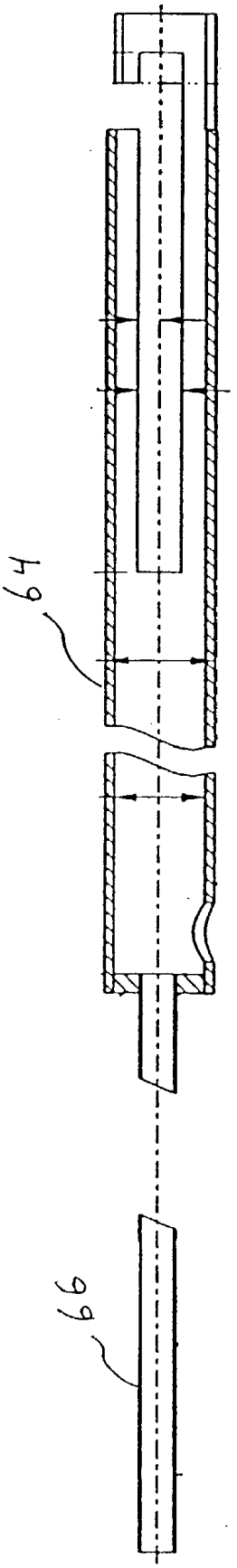

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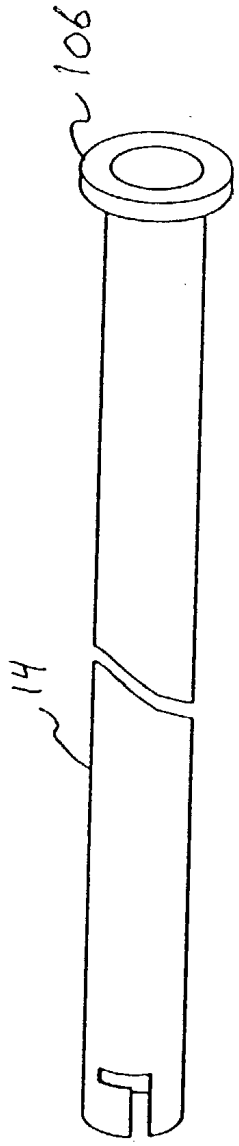

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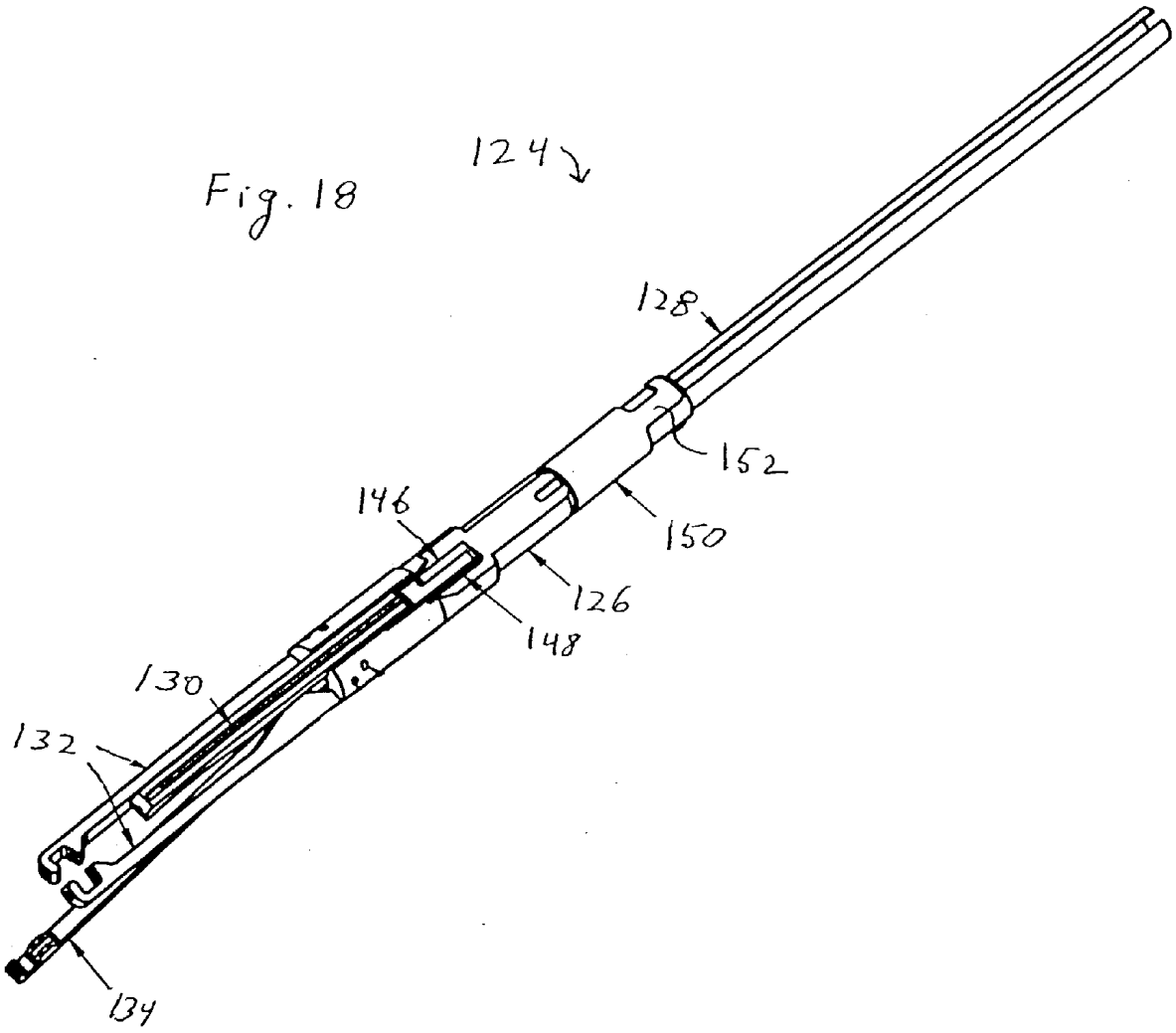

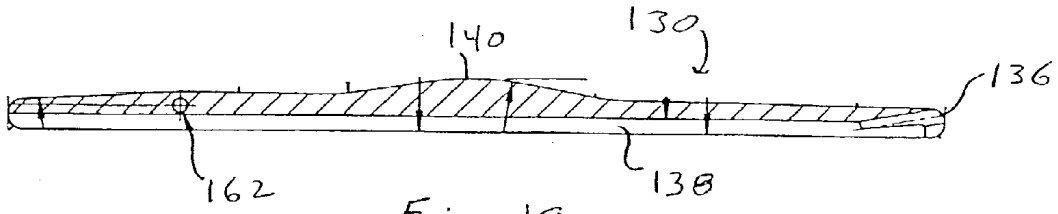

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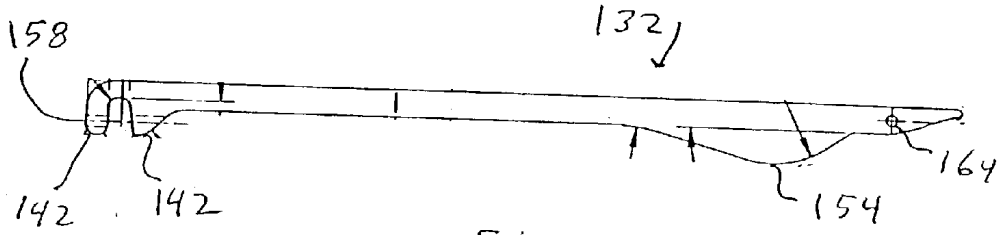

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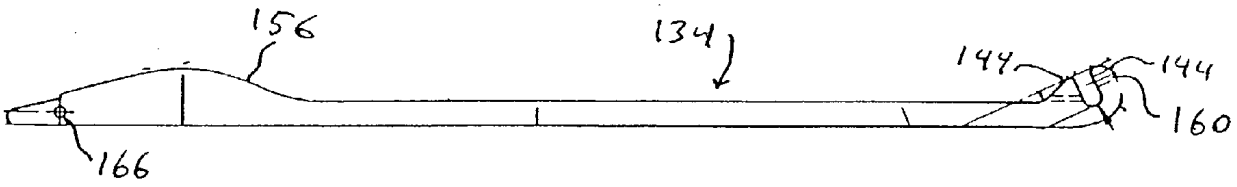

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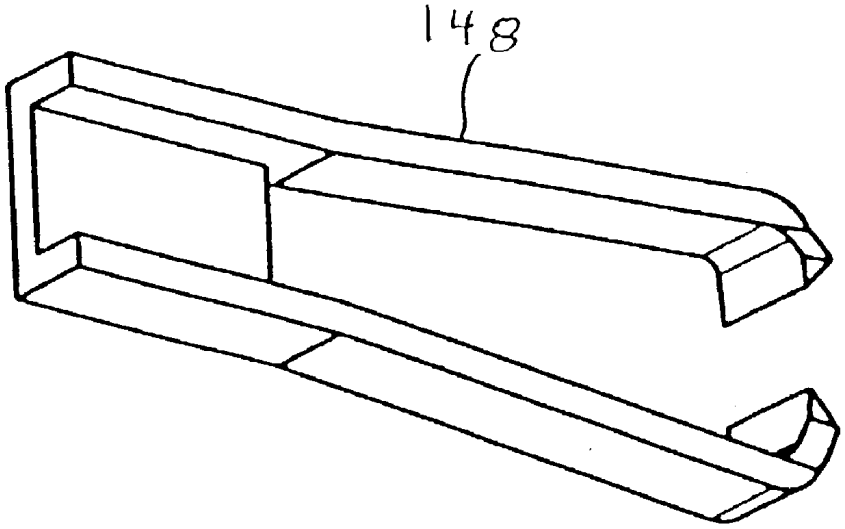

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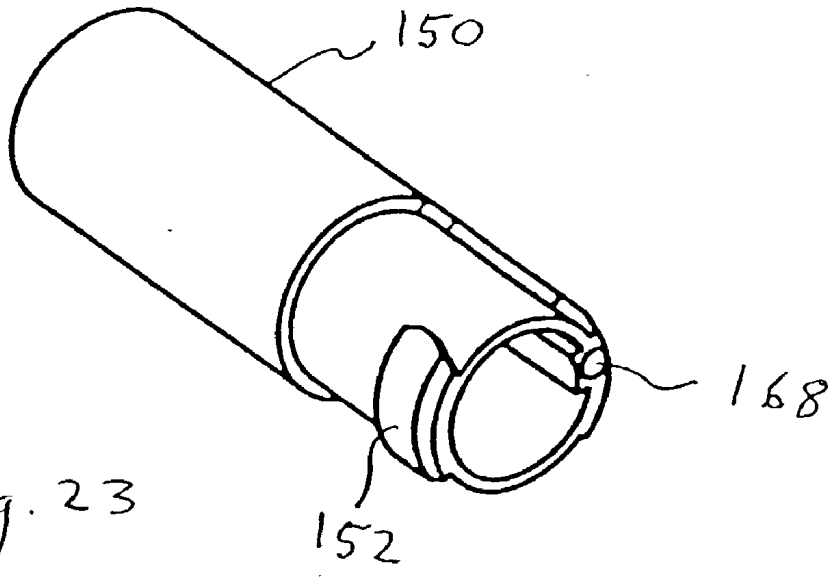

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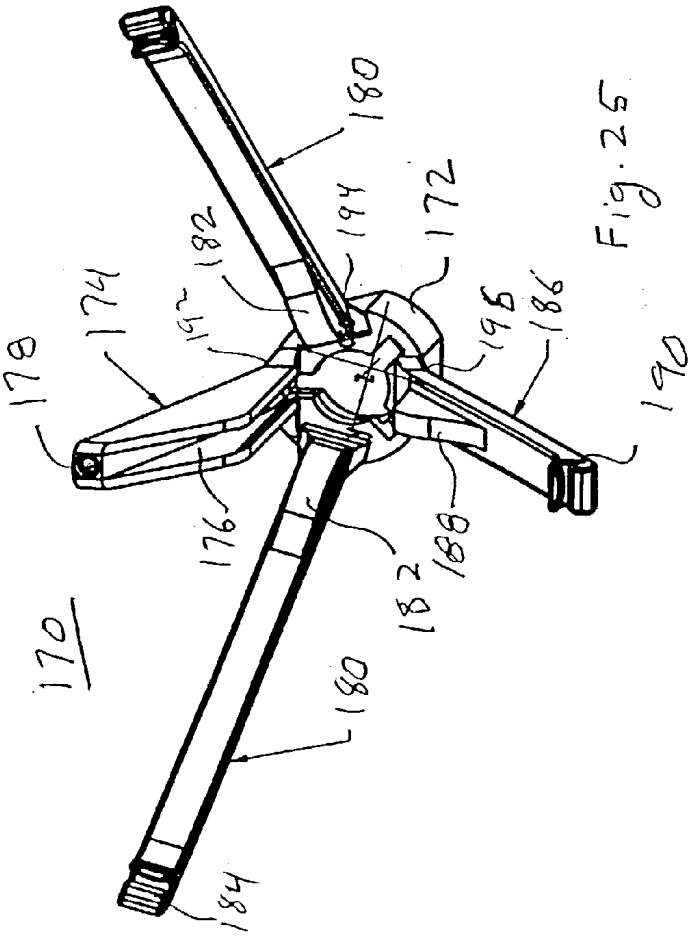
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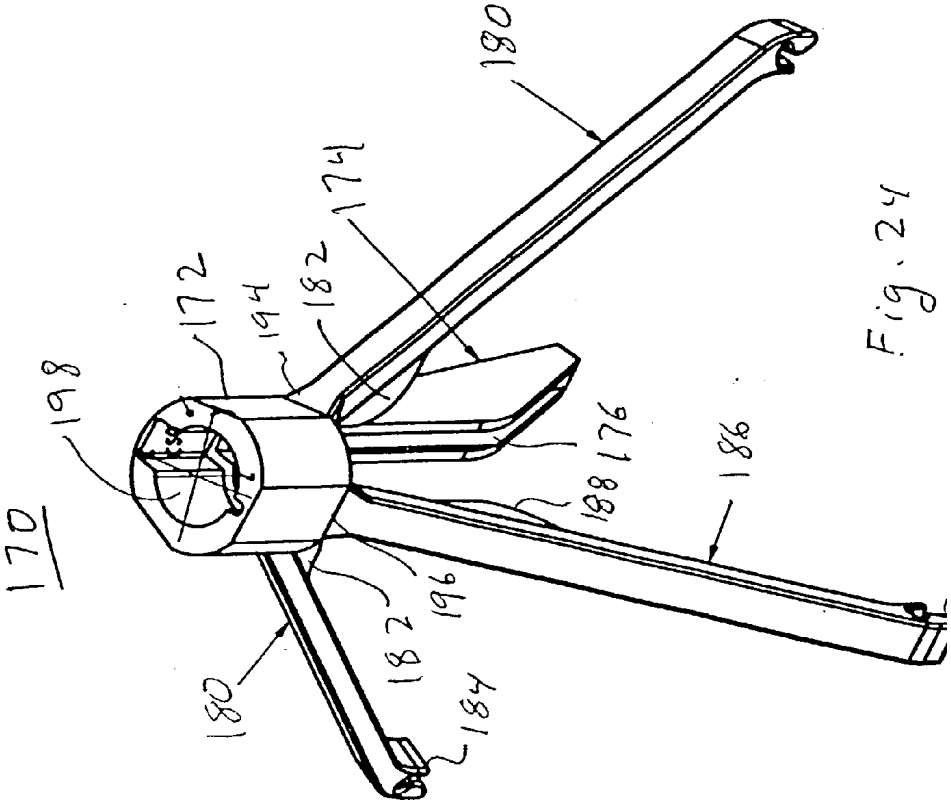
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Fig. 24

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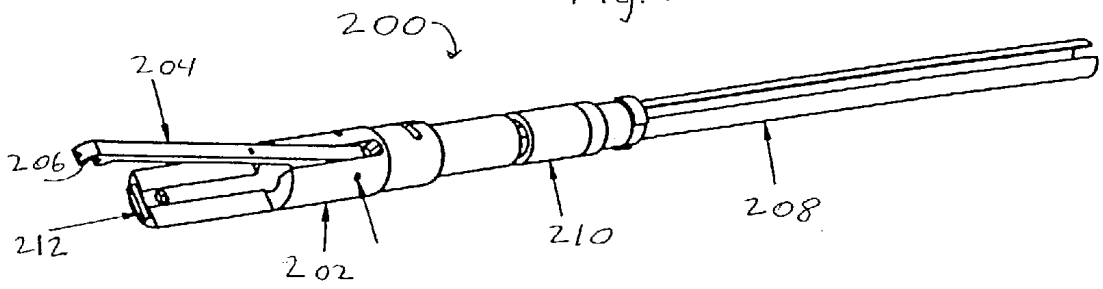

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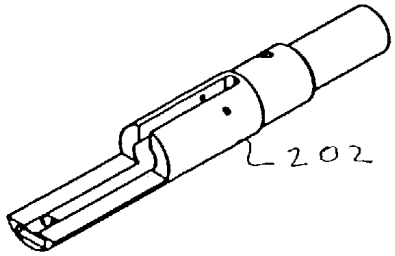

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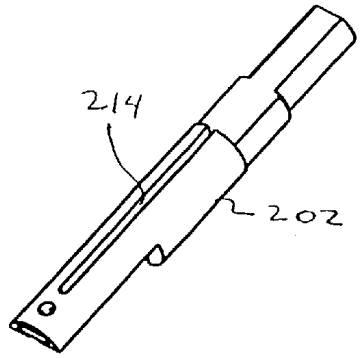

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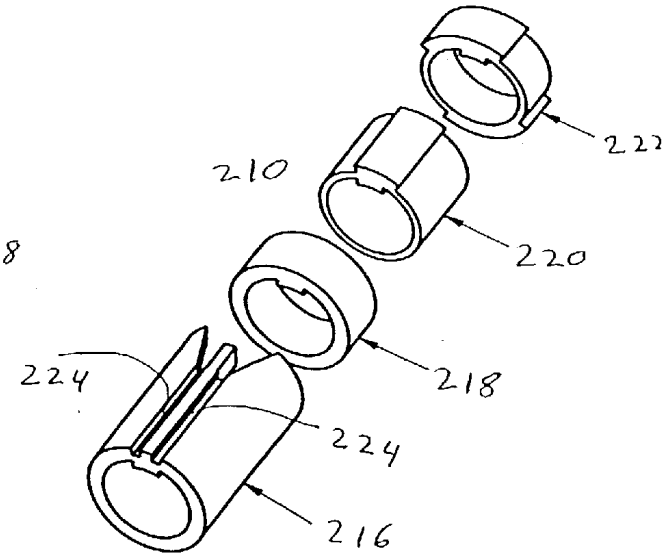

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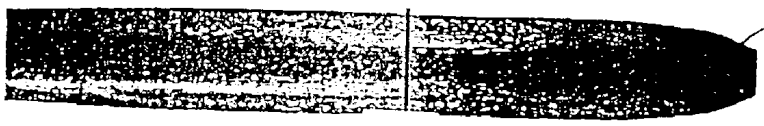

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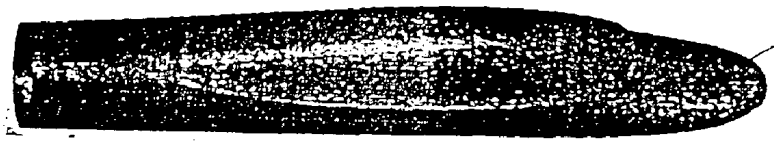

DEVICE FOR LAPAROSCOPIC TUBAL LIGATION

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present disclosure claims priority to U.S. Provisional Application Serial No. 60/248,436, filed Nov. 14, 2000, and entitled, "Device for Laparoscopic Tubal Ligation".

BACKGROUND

[0002] 1. Field of the Invention

[0003] The present invention relates to surgical devices and methods and, more particularly, to devices and methods for grasping a tissue segment and delivering a loop of suture material to the tissue segment with a single, one hand operable ligating instrument for the purpose of ligation.

[0004] 2. Description of Related Art

[0005] Modern surgical techniques often entail the use of endosurgery, wherein large incisions are avoided, and, instead, elongated instruments are inserted into and manipulated through trocars. Typically the surgical site, such as the peritoneum, is viewed remotely, and the surgeon works while watching a monitor.

[0006] Endoscopic applications of preknotted suture loops include the ligation of protruding pieces of tissue such as polyps or ends of blood vessels. Several devices are known in the art that deliver such suture loops to a site generally remote from the surgeon's hand and are remotely manipulable.

[0007] The tonsillotome of Longino (U.S. Pat. No. 1,468,599) contains a shank having a lumen wherein a suture loop resides and from which the loop is manipulable around a piece of tissue. Previously disclosed devices include those of Neivert (U.S. Pat. No. 1,833,687), who discloses a surgical snare comprising a fixed and a movable member capable of relative movement for tightening the snare loop that has been housed in the bore of the movable member.

[0008] The ligating loop device of Bueina (U.S. Pat. No. 5,242,459) has a shaft with a suture loop at its distal end, the loop having a slip knot. In addition, the device has a cutting element for severing the loop once it has been tightened. As with the device of Neivert, relative movement between two cylindrical members causes a tightening of the knot.

[0009] Noda et al. (U.S. Pat. No. 5,320,629) also contains relatively slidable members, one of which carries a suture with a slip knot at the end.

[0010] The endoscopic loop applying instrument of Kinet et al. (U.S. Pat. No. 5,405,351) both delivers the loop and cuts the free end of suture material.

[0011] The ligating instrument of Yoon (U.S. Pat. No. 5,486,186) also delivers a loop of suture material, the material extending through the lumen of an elongated device for being operated upon to tighten the loop around a piece of tissue. A cutter is also disclosed that is positioned within the lumen and is externally operable.

[0012] An exemplary device for ligating tissue is disclosed in U.S. Pat. No. 6,152,936 to Christy et al.(the entire disclosure of which is incorporated by reference herein) which discloses a novel suture management device including legs to hold a loop of suture material open to position around tissue.

[0013] A problem shared by the above devices is the need for multiple instruments and, more importantly, the need to use two hands to operate the instruments to grasp and ligate the tissue structure.

SUMMARY

[0014] There is disclosed a ligating instrument configured for single handed operation which includes integral grasping assembly to grasp a tissue section along with suture management assembly to hold open a loop of suture material such that the grasped tissue can be drawn through the material. The ligating instrument generally includes a handle assembly, an elongate tubular member extending distally from the handle assembly and an end effector mounted on a distal end of the elongate tubular member and operable to hold open a loop of material. A grasping member is extendable from a distal end of the elongate tubular member and a grasp actuator, integral with the handle assembly is provided such that actuation of the grasp actuator moves the grasping member relative to the distal end of the elongate tubular member.

[0015] The grasper assembly includes a grasper pusher which is configured to extend a pair of flexible legs beyond the distal end of an elongated tubular member of the ligating instrument in order to grasp tissue. Springs are provided to bias the grasper members in a retracted position within the elongated tubular member. Preferably a thumbwheel is provided at the proximal end of the instrument to rotate and orient the grasper legs relative to the tissue to be grasped.

[0016] The above described interval suture ligating mechanism including a lever configured to draw a suture held by an end effector about a tubular tissue section and cut the suture. A first end effector is provided for removable mounting on a distal end of the elongate tubular member of the ligating instrument and generally includes pivotal legs having fingers at their distal end for holding a section of suture in an open loop configuration. Preferably the legs have ramps formed on them such that upon advancement of the grasper members the legs are cammed open to hold the suture in an open condition. A cutter may be provided on the first end effector to cut the length of suture material upon actuation of the device.

[0017] A second end effector is provided and is removably mountable on the distal end of the elongate tubular member. The second end effector is configured such that upon actuation of the ligating instrument a continuous loop of suture material draws the tubular tissue section to be excised against a cutting blade associated with the second end effector. Preferably, the second end effector includes a single arm having a similar ramp which engages the grasper and maintains the loop in an open configuration.

[0018] A resilient or flexible material may be formed as an over mold over at least a portion of the handle of the ligating instrument in order to provide comfort to the user and ensure a firmer grip.

DESCRIPTION OF THE DRAWINGS

[0019] Various embodiments are described herein with reference to the drawings wherein:

[0020] **FIG. 1** is a perspective view of one embodiment of the disclosed ligating instrument with half of the handle body removed;

[0021] **FIG. 2** is a perspective view of a first handle body half;

[0022] **FIG. 3** is a perspective view of a second handle body half;

[0023] **FIG. 4** is a perspective view of the assembled first and second handle body halves;

[0024] **FIG. 5** is a perspective view of a handle subassembly of a grasper assembly;

[0025] **FIG. 6** is a sectional view of the handle assembly;

[0026] **FIG. 7** is a partial enlarged sectional view showing the area of detail A of **FIG. 6**;

[0027] **FIG. 8** is a partial enlarged sectional view showing the area of detail B of **FIG. 6**;

[0028] **FIG. 9** is a perspective view of a grasper subassembly of the grasp assembly;

[0029] **FIG. 10** is a perspective view of a handle subassembly of the handle assembly;

[0030] **FIG. 11** is a sectional view of the distal end of the ligating instrument;

[0031] **FIG. 12** is a side view of a cutter tube;

[0032] **FIG. 13** is a perspective view of the cutter tube;

[0033] **FIG. 14** is a side view of a pull tube;

[0034] **FIG. 15** is a perspective view of the pull tube;

[0035] **FIG. 16** is a side view, partly shown in section, of a grasp tube;

[0036] **FIG. 17** is a perspective view of an outer tube;

[0037] **FIG. 18** is a perspective view of a ligation squid assembly;

[0038] **FIG. 19** is a side view, in section, of a stiff deflecting leg;

[0039] **FIG. 20** is a side view of a pinned leg;

[0040] **FIG. 21** is a side view of a middle leg;

[0041] **FIG. 22** is a perspective view of the cutting blade of the ligation squid assembly;

[0042] **FIG. 23** is a perspective view of the suture spool of the ligation squid assembly;

[0043] **FIGS. 24 and 25** are perspective views of an alternative embodiment of a suture management squid device for use with a ligation squid assembly similar to that shown in **FIG. 18**;

[0044] **FIG. 26** is a perspective view of a transecting squid assembly for use with the disclosed ligating instrument;

[0045] **FIGS. 27 and 28** are perspective views of the squid body of **FIG. 26**;

[0046] **FIG. 29** is a perspective view, with parts separated, of the spool assembly of **FIG. 26**; and

[0047] FIGS. **30-32** are perspective views of an over molded handle for use with the disclosed ligating instrument.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0048] Referring to **FIG. 1, a** ligating instrument is shown which is configured to grasp and ligate a tubular structure with a single instrument while being operated by a single hand of the user. The disclosed ligating instrument **10** generally includes a handle assembly **12** and an elongated outer tube **14** extending distally from handle assembly **12**. Various removable end assemblies or single use loading units "SLLU's"**16** are removably mounted on a distal end of outer tube **14**. As used herein, the term "proximal" means the end of a component or part thereof closer to the operator while the term "distal" refers to that component or part thereof further from the operator. A grasper pusher **18** is movably mounted with respect to handle assembly **12** and functions along with a grasp subassembly **20** to extend and retract tissue grasp legs (described below) from the distal end of outer tube **14**. A handle thumbwheel **22** is rotatably mounted on a proximal end of handle assembly **12** and **13** provided to rotate tissue grasp legs relative to outer tube **14** to orient the grasp legs relative to tissue. A handle lever **24** is pivotably mounted to handle assembly **12** and functions with a handle subassembly **26** to actuate various SULU's **16**. Preferably, ligating instrument **10** is formed of steel, however, other biocompatible materials such as titanium, metals, plastics or ceramics can be used.

[0049] Ligating instrument **10** is particularly designed to be used in a single-handed fashion and includes an ergonomically curved depending leg **28** to facilitate one-handed use of ligating instrument **10**. Preferably, handle assembly **12** includes a first handle body half **30** (**FIG. 2**) and a second handle body half **32** (**FIG. 3**). First and second handle body halves **30** and **32**, respectively, are mirror images, i.e. complimentary components which combine to form a handle body **34** (**FIG. 4**). Referring for the moment to **FIGS. 2, 3** and **12**, outer tube **14** includes a proximal flange **106** which fits in channels **108** in first and second handle body halves **30, 32**. Outer tube **14** also has a bayonet type slot **110** at the distal end for receipt of various end assemblies.

[0050] As shown in FIGS. **2-4**, handle body **34** defines a transverse pusher slot **36** and a pair of longitudinal pusher slots **38** and **40** radially spaced apart and extending distally from transverse pusher slot **36**. By moving grasper pusher **18** through transverse pusher slot **36**, grasper pusher can be aligned with either of longitudinal pusher slots **38** or **40** to facilitate right or left handed use. Handle body **34** also defines an opening **42** for handle lever **24**.

[0051] Referring now to FIGS. **5-9**, grasp subassembly **20** will now be described. Referring initially to **FIG. 5, a** grasp handle subassembly **44** of grasper assembly **20** includes a grasp spring tube **46** having a rotatable plug **48** at a distal end of spring tube **46**. A grasper subassembly **50** of grasper assembly **20** extends through grasp handle subassembly **44** and extends distally therefrom through outer tube **14**. A grasper plug **52** is provided at a proximal end of grasp handle subassembly **44** to connect thumbwheel **22** to grasp

subassembly **20** and thereby allow grasp subassembly **20** to rotate about the longitudinal axis of ligating instrument **10** in order to orient grasper legs with respect to the tissue to be ligated.

[**0052**] Grasp handle subassembly **44** further includes a grasp collar **54** which is longitudinally slidable over grasp spring tube **46**.

[**0053**] As shown, grasper pusher **18** includes a thumbshaft **56** which is attached to a grasp clevis **58**. Grasp clevis **58** is rotatably mounted about grasp collar **54** so as to allow grasper pusher **18** and thumbshaft **56** to move through transverse pusher slot **36** in handle body **34**. This allows switching from right to left hand operation and visa versa. A distal edge of grasp clevis **58** abuts a flange **60** on grasp collar **54** to drive grasp collar **54** longitudinally in response to longitudinal movement of grasper pusher **18** and thumbshaft **56** through one of longitudinal pusher slots **38** or **40** in handle body **34**.

[**0054**] Grasp handle subassembly **44** also includes a spring **62** positioned inside spring tube **46** which biases grasp collar **54** and thus grasper pusher **18** proximally. Grasp collar **54** is connected to grasper subassembly **50** of grasper subassembly **20** as described below.

[**0055**] Referring now to **FIG. 9**, grasper subassembly **50** of grasp subassembly **20** will now be described. As noted above, grasper subassembly **50** extends through outer tube **14** and handle subassembly **44**. A proximal end of grasper subassembly is connected to grasp collar **54**. Grasper assembly **50** generally includes a grasp tube **64** movably mounted within grasp spring tube **46**. A grasp tube extension **66** extends distally from grasp tube **46** and through outer tube **14** to a distal end thereof. (See also, **FIG. 16**)

[**0056**] A return spring driver assembly **68** extends through grasp tube **64** and grasp tube extension **66**. A pair of flexible grasper legs **70** are mounted on a distal end of return spring driver assembly by means of an end piece **72** and pins **74**. When return spring driver assembly is in a proximal position relative to handle body **34**, grasper legs **70** are drawn into grasp tube extension **66** and assume a generally flat configuration. A second spring **76** is positioned within grasp tube **64**.

[**0057**] A first driver plate **78** is affixed to a proximal end of return spring driver assembly **68** by means of a pin **80**. A second driver plate **82** is movably mounted over driver assembly **68** and contacts second spring **76** and a proximal end of grasp tube **64**.

[**0058**] In operation, a first movement or throw of grasper pusher **18** within one of longitudinal pusher slots **38**, **40**, drives grasper subassembly **50** distally within grasp spring tube **46** against the bias of first spring **62**. This extends the distal end of grasp tube extension **66** out of the distal end of outer tube **14**. Further distal movement of grasper pusher **18** moves return spring driver assembly **68** distally against the further bias of second spring **76** to thereby extend grasper legs **70** out of and beyond the distal end of grasp tube extension **66** and thus beyond the distal end of outer tube **14** and allows the legs **70** to spring open to grasp tissue.

[**0059**] Referring now to FIGS. **6-8** and **10-11** there will now be described handle subassembly **26**. Referring initially to **FIG. 10**, handle subassembly **26** includes handle lever **24**, which has a drive bracket **84** pivotally mounted to handle body **34** by pins (not shown) which extend from first and second handle body halves **30** and **32** and into corresponding holes **86** in drive bracket **84**. Handle subassembly **26** also includes a cutter tube **88** having a mounting bracket **90** at its proximal end. Mounting bracket **90** is pinned to drive bracket **84** by pins **92**. Mounting bracket **90** includes a pair of lips **94** which are longitudinally guided by slots **96** in first and second handle body halves **30** and **32** (**FIGS. 2 and 3**). Thus, movement of handle lever **24** towards handle body **34** drives cutter tube **88** distally, while movement of handle lever **24** away from handle body **34** retracts cutter tube **88** in the proximal direction. Referring for the moment to **FIGS. 12 and 13**, cutter tube has projections **112** on the distal end to cam a cutting blade on an end assembly to cut suture material.

[**0060**] Handle subassembly **26** further includes a pull tube **98** having a fire clevis **100** affixed to a proximal end of pull tube **98**. As shown in **FIGS. 14 and 15**, pull tube **98** has a flange **114** at its proximal end which held in notches **116** in fire clevis **100** (**FIG. 10**). Pull tube **98** has projections **118** at a distal end to engage a corresponding suture spool on an end assembly to cinch a suture. Referring to **FIGS. 2, 3** and **10**, fire clevis **100** has lips **120** which are longitudinally guided in slots **122** in first and second handle body halves **30**, **32**.

[**0061**] Handle lever **24** has a handle link **102** pivotally mounted at a first end near the proximal end of handle lever **24**. A two part linkage **104** connects a second end of handle link **102** to fire clevis **100**. When handle lever **24** is moved toward handle body **34**, fire clevis **100**, and thus pull tube **98**, are drawn proximally within handle body **34**. Similarly when handle lever **24** is pivoted away from handle body **34**, pull tube **98** is moved distally within outer tube **14**.

[**0062**] Referring now to **FIG. 18**, there is disclosed an end effector or SULU particularly adapted to be used with ligating instrument **10**. Ligating squid assembly **124** generally includes a squid body **126** having a squid to **128** extending proximally from squid body **126**. A plurality of suture supporting legs are pivotally mounted to squid body **126** and extend distally therefrom. Specifically, a stiff leg **130** extends distally from squid body **126** and is configured to retain a segment of suture material and a slip knot at the end of stiff leg **130**. Squid body **126** also includes a pair of pinned legs **132** which are pivotally connected to squid body **126** and a middle leg **134** which is also pivotally connected to squid body **126**. Referring for the moment to **FIG. 19**, stiff leg **130** generally includes a guide slot **138** running partially along the length thereof as well as a suture hole formed in the distal end of stiff leg **130**. A length of suture (not shown) is threaded through suture hole **136** into guide slot **138** and the guide tube **140** connects guide slot **138** with suture hole **136**. A partial ramp **140** is formed on the underside of stiff leg **130** to partially flex stiff leg **130** away from the center line of the instrument as grasper legs **70** are extended past stiff leg **130**.

[**0063**] Referring to **FIG. 20**, there is illustrated one of a pair of pinned legs **132** which include fingers **142** at a distal end thereof to support a portion of a suture loop. Similarly, referring to **FIG. 21**, middle leg **134** also has fingers **142** to assist in maintaining an open suture loop.

[**0064**] Referring back to **FIG. 14**, ligation squid assembly **124** further includes a guide tube **146** in alignment with

guide slot **138** of stiff leg **130** to receive a length of suture therethrough. A cutting blade **148** is positioned adjacent to guide tube **146** and is flexible in response to engagement with projections **112** of cutting tube **88** so as to cam the cutting blade into engagement with the suture and sever it.

[**0065**] A ligating squid assembly **124** further includes a suture spool **150** slidably mounted about squid body **126**. Suture spool **150** is configured to retain a free end of a length of suture and, upon proximal movement of suture spool **150**, cinch a suture around tissue positioned within the loop of suture held by the squid arms. Arms **152** extend from a proximal end of suture spool **150** and are configured to engage projections **118** on pull tube **98** such that when pull tube **98** is retracted proximally it draws suture spool **150** and thus the length of suture proximally. As shown in **FIGS. 20 and 21**, pinned legs **132** and middle leg **134** include ramps **154** and **156**, respectively. Ramps **154** and **156** deflect legs **132** and middle leg **134** upon engagement with grasper legs **70** as grasper legs **70** are extended out the distal end of ligating instrument **10**.

[**0066**] Referring now to **FIGS. 24 and 25**, there is disclosed an integrally molded squid device for use with a ligation squid assembly similar to that of ligation squid assembly **124**. Molded squid device **170** is an integral structure, preferably formed of a plastic material. Squid device **170** generally includes a base **172** having a stiff leg **174** extending distally therefrom. Stiff leg **174** includes a channel **176** and a bore **178** for receipt of a length of suture. Squid device **170** further includes a pair of side legs **180** which have ramps **182** for engagement with a grasper device to bias legs **180** outwardly in a manner similar to that described hereinabove. Said legs **180** also have fingers **184** to releasably retain a section of suture and maintain it in an open loop configuration.

[**0067**] Molded squid device **170** further includes a bottom leg **186** having a ramp **188** for engagement with a grasper device. Bottom leg **186** also includes a fingers **190** to releasably retain a section of the suture material. Stiff leg **174**, side legs **180** and bottom leg **186** are connected to base **174** by living hinges **192**, **194**, and **196**, respectively. Base **172** also includes a socket **198** for mounting squid device to a modified ligating squid assembly.

[**0068**] It should be noted that by integrally molding squid device **170** as a unitary structure, squid device **170** takes advantage of the inherent flexibility characteristics of a living hinge to retain the legs in a generally collapsed configuration.

[**0069**] Referring now to **FIG. 26**, there is illustrated a unique transecting squid assembly for use with the disclosed ligating instrument **10** to cut the loop of tissue remaining after being ligated with the suture of ligating squid assembly **124**. Transecting squid assembly **200** is configured to be reusable and releasably mountable in the distal end of outer tube **14**. Transecting squid assembly **200** is provided to grasp and cut a previously ligated tissue section.

[**0070**] Transecting squid assembly **200** generally includes a squid body **202** having a middle leg **204** pivotally mounted on squid body **202** as shown. Middle leg **204** includes fingers **206** at its distal end to hold a portion of a continuous loop of wire in an open loop configuration. A squid tube **208** extends proximally from squid body **202** and is insertable within outer tube **14**. Transection squid assembly **200** further includes a spool assembly **210** slidably mounted on squid tube **208** and configured to secure a portion of a the loop of material. A pair of cutting blades **212** extend from the distal most tip of squid body **202**. Blades **212** are provided to cut anatomical tissue drawn against blades **212** by contraction of the closed loop of wire material.

[**0071**] Referring for the moment to **FIGS. 27 and 28**, an underside of squid body **202** includes a longitudinally extending wire channel **214** which is configured to retain and guide a segment of a continuous wire loop.

[**0072**] Referring now to **FIG. 29**, the spool assembly **210**, which is slidably mounted on squid tube **208** generally includes four subsections **216**, **218**, **220** and **222** which are welded together. A portion of a closed wire loop is secured within channels **224** in part **216**.

[**0073**] The above disclosed ligating instrument is particularly suitable for ligating anatomical tubular structures, such as, for example Fallopian tubes. The operation of ligating instrument **10** to ligate a Fallopian tube in the manner of an endoscopic, Pomeroy type procedure will now be described. Initially, a ligating squid assembly **124** is inserted and affixed to a distal end of ligating instrument **10**. As noted above, ligating squid assembly **124** includes a bayonet type fitting which engages the distal end of outer tube **14**. Prior to insertion in the body, the legs of ligation squid assembly **124** are in a collapsed configuration generally in alignment with the longitudinal axis of outer tube **14**. Handle lever **24** is in an open position and grasp pusher **18** is in a proximal most position. As noted hereinabove, the instrument is specifically designed to be operated with a single hand, i.e., a one hand use instrument. In grasping the instrument, the pinky and ring finger of the operable hand rest upon depending leg **28** while the middle finger and index finger rest upon handle lever **24**. The thumb is positioned adjacent grasp pusher **18**. As further noted hereinabove, by initially moving grasper pusher **18** through transverse slot **36** in handle body **34**, the ligating instrument **10** can be configured for case of use with either hand.

[**0074**] Ligating instrument **10** is then inserted into the body such that ligating squid assembly **124** is positioned adjacent a Fallopian tube. Thereafter, the thumb can be pushed against grasper pusher **18** driving grasper pusher **18** distally to initially extend grasp tube extension **66** towards the distal end of outer tube **14**. Further pressure through a second throw or distal distance of grasper pusher **18** extends grasper legs **70** out the distal end of outer tube **14**. As grasper legs **70** extend beyond the distal end of outer tube **14**, grasper legs **70** engage ramps **154** and **156** on pinned legs **132** and **134** camming legs **132** and **134** into an open position. Grasper legs **70** extend beyond the ends of legs **132** and middle leg **134** and are positioned about the tubular structure. It should be noted that as grasper legs extend out the distal end of outer tube **14** they extend through the open suture loop held by stiff leg **130**, pinned leg **132** and middle leg **134**.

[**0075**] Upon slow release of grasper pusher **18** against the bias of the return springs, grasper legs **70** grasp the anatomical tubular structure and draw a tubular structure through the open loop of suture material. Once grasper pusher **18** is returned to a fully proximal most position the fingers may be operated to actuate handle lever **24**. As

handle lever **24** is moved toward handle body **34**, pull tube **98**, which is attached at its distal end to spool **150** draws spool **150** and thus the attached section of suture material proximally thereby contracting the loop of suture material about the Fallopian tube and pulling the suture material free of the associated legs. It should be noted that the proximal movement of pull tube **98** is a fairly long throw relative to the forward movement of cutter tube **88** which also happens in response to depression of lever **24**. As cutter tube **88** is advanced it cams cutting blade **148** against the suture material at a point adjacent guide tube **146** to thereby sever the suture material. Grasper pusher **18** can then be advanced to release the now sutured and ligated Fallopian tube structure.

[**0076**] Ligating instrument **10** is then withdrawn from the body and ligating squid assembly **124** is removed from ligating instrument **10**.

[**0077**] In order to cut the now ligated loop section of tubular tissue structure, transecting squid assembly **200** is assembled onto the distal end of ligating instrument **10** and ligating instrument **10** is reinserted into the body adjacent the ligated Fallopian tube. Advancement of grasper pusher **18** again advances grasper legs **70** towards the anatomical tubular structure camming open the middle squid leg **204** of transecting squid assembly **200**. Grasper pusher **18** is again operated to regrasp the tissue with grasper leg **70** and draw it into the continuous wire loop of material supported by transacting squid assembly **200**. Handle lever **24** is then again actuated to draw spool assembly **210** proximally thereby drawing the ligated loop of tissue section adjacent and against cutting blade **212** which thereby severs the tissue section. The dissected tissue section remains grasped by grasper leg **70** and the instrument is removed leaving the free ends of the Fallopian tube ligated together by the loop of suture material.

[**0078**] The ligating instrument **10** is preferably provided as an instrument assembly containing one or more ligation squid assemblies **124** and a reusable transecting squib assembly **200**. Thus, a new ligating assembly **124** can be attached to ligation instrument **10** and the opposite Fallopian tube ligated in similar manner.

[**0079**] Referring to FIGS. **30-32**, there is disclosed an over molded part **226** for use with at least part of handle body **34**. Overmold **226** is formed of a relatively resilient material to increase the comfort in holding ligating instrument **10** and provide a better grip on ligating instrument **10**. Over mold **226** can be formed of various materials, such as, plastics, foams, etc.

[**0080**] It will be understood that various modifications can be made to the embodiments disclosed herein. For example, other SULU's having different functions may be used with the disclosed one handled instrument having an integral grasper. Therefore, the above description should not be construed as limiting but merely as exemplifications of preferred embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

1. A ligating instrument comprising:

a handle assembly;

an elongate tubular member extending distally from the handle assembly;

an end effector mounted on a distal end of the elongate tubular member and operable to hold open a loop of material;

a grasping member extendable from a distal end of the elongate tubular member; and

a grasp actuator integral with the handle assembly such that actuation of the grasp actuator moves the grasping member relative to the distal end of the elongate tubular member.

2. The ligating instrument as recited in claim 1, wherein actuation of the grasp actuator extends the grasping member distally of the distal end of the elongate tubular member.

3. The ligating instrument as recited in claim 2, wherein the grasping member is extended through the loop of material held by the end effector.

4. The ligating instrument as recited in claim 1, wherein the end effector is removably mounted to the distal end of the elongate tubular member.

5. The ligating instrument as recited in claim 1, further comprising an end effector actuator, integral with the handle assembly, the end effector actuator operable to hold open the loop of material.

6. The ligating instrument as recited in claim 5, wherein the grasp actuator and the end effector actuator are operable by the same single hand while the handle assembly is held by the single hand.

7. The ligating instrument as recited in claim 1, further comprising an over mold positioned at least partially about the handle assembly.

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摘要(译)

本公开涉及用于腹腔镜输卵管结扎手术的结扎器械和末端执行器组件。结扎器械包括整体抓握组件和整体末端执行器致动器，并且被配置为通过用户的单手操作来执行结扎手术。结扎器械包括用于抓握管状组织部分的整体式抓紧器组件和可拆卸的末端执行器或缝合线展开机构，用于保持打开缝合线以围绕管状部分定位。抓紧器构造成将管状部分拉入缝合材料的开环中并将缝合材料收紧在管状组织部分周围。可以提供旋转器旋钮以相对于组织部分定向与抓紧器组件相关联的抓握构件。提供一种替代的末端执行器，以可拆卸地安装在结扎器械的远端上，并切割管状组织切片的那部分，在管状组织切片结扎后需要将其移除。可以提供相对柔软的包覆模具部分以至少部分地包围结扎器械的手柄，以便提供舒适性并且有助于确保器械的抓握。