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(54) **GENERAL UTERINE MANIPULATOR AND SYSTEM**

**Publication Classification**

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(57) **ABSTRACT**

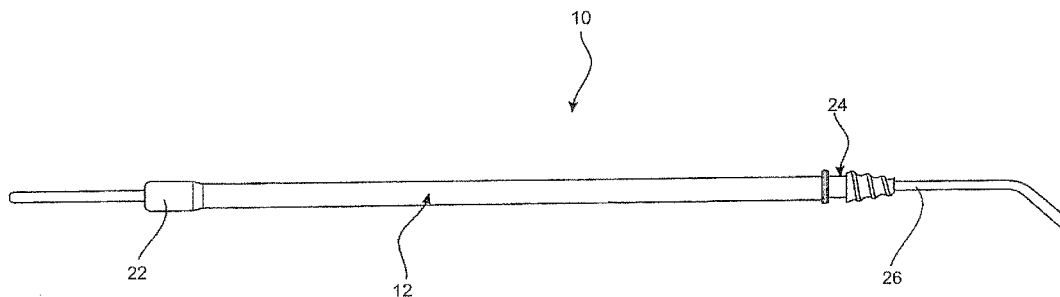
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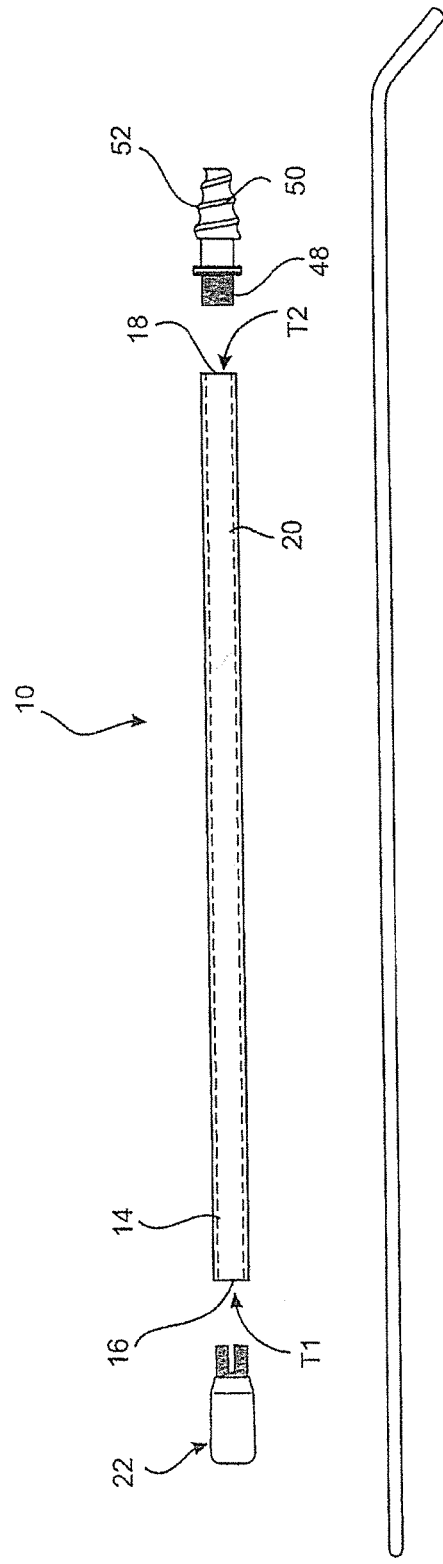
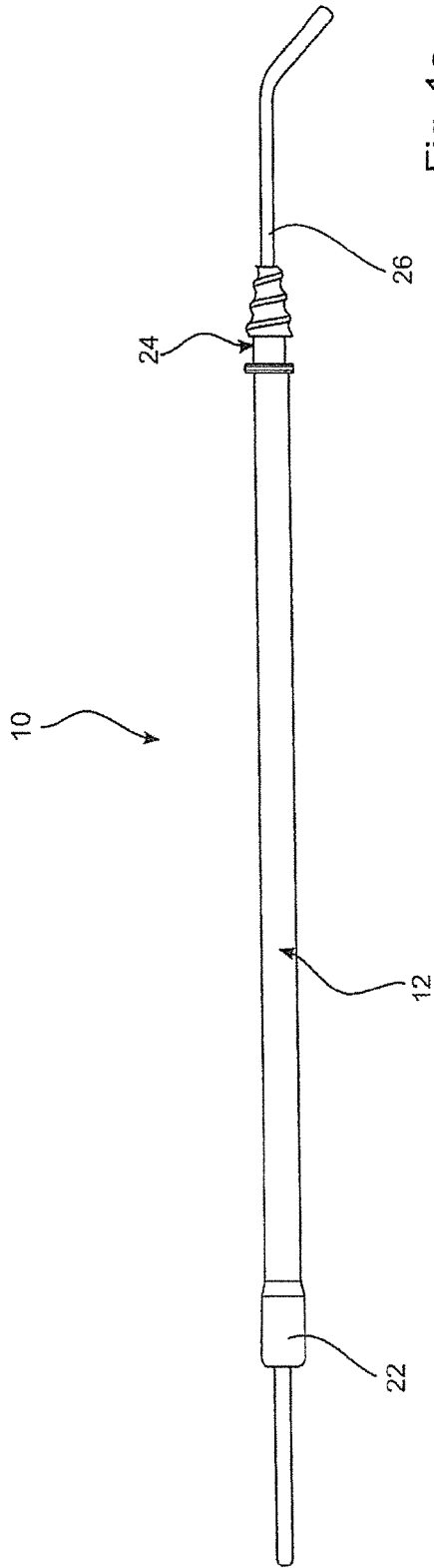
A general uterine manipulator **10** incorporates an elongated hollow tube **12** defining an internal passage **14**. Tube **12** has opposite first and second ends **16** and **18**, formed with internal threads **T1** and **T2**; and a smooth continuous outer surface **20** of constant outer diameter. A first fitting comprising a tail screw **22** is screwed into thread **T1** and a second fitting cervical screw **24** is screwed in thread **T2**. An inner manipulator rod **26** extends through the first fitting **22**, tube **12**, and second fitting **24**. A range of alternate first and second fitting is provided. A forceps holder **70** is attachable to the tube **12** between ends **16** and **18**. The manipulator **10** may also support a cervical funnel **90** and a plug **92**.

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 13/625,255, filed on Sep. 24, 2012, which is a continuation-in-part of application No. PCT/AU2012/000332, filed on Mar. 30, 2012.

(60) Provisional application No. 61/472,705, filed on Apr. 7, 2011.





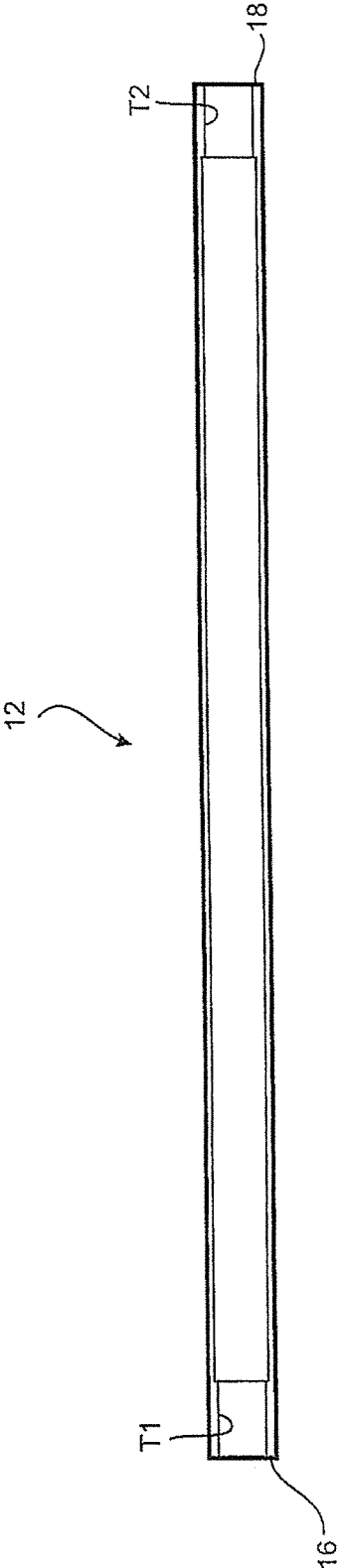


Fig. 2

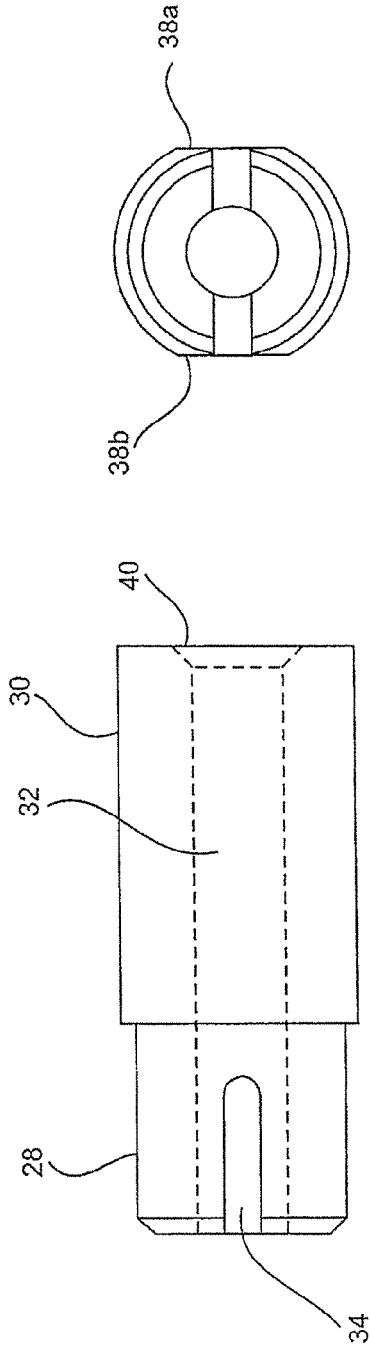


Fig. 4

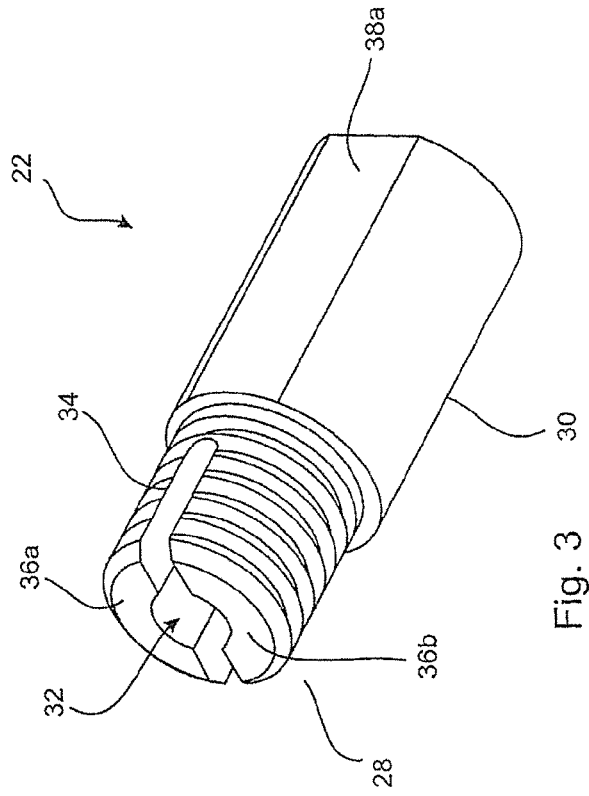


Fig. 3

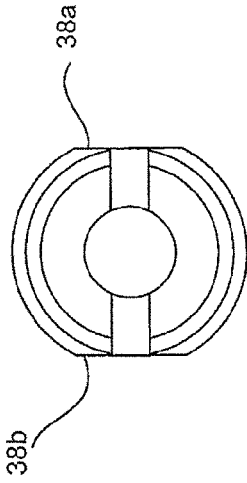


Fig. 5

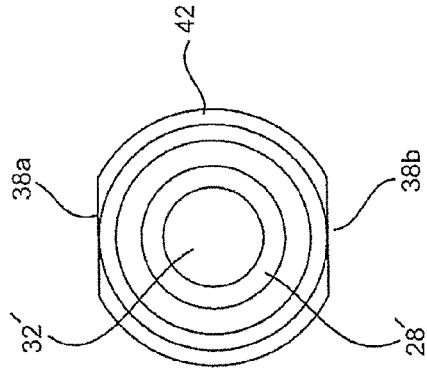


Fig. 8

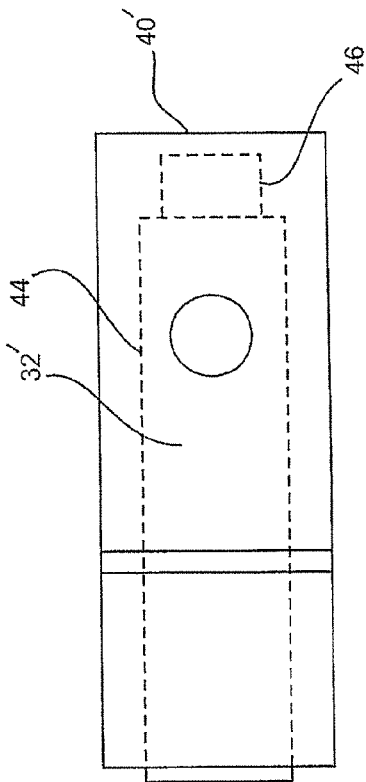


Fig. 7

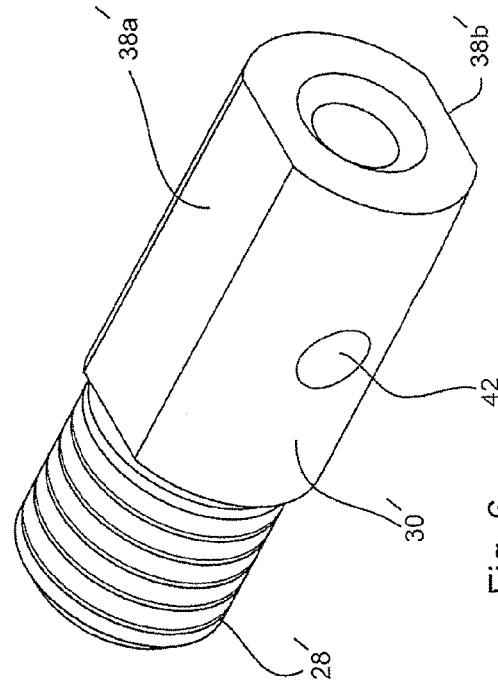


Fig. 6

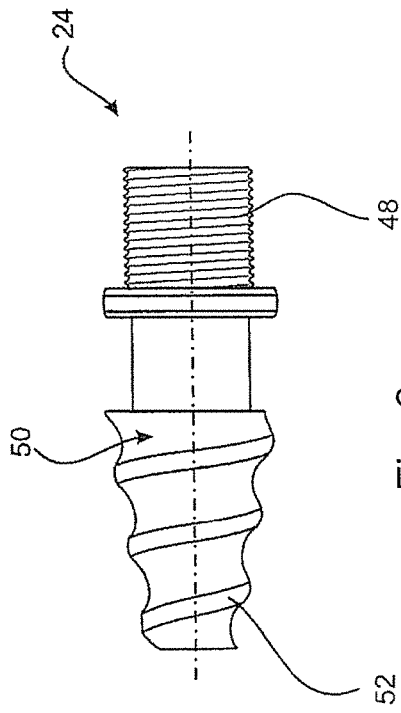


Fig. 9a

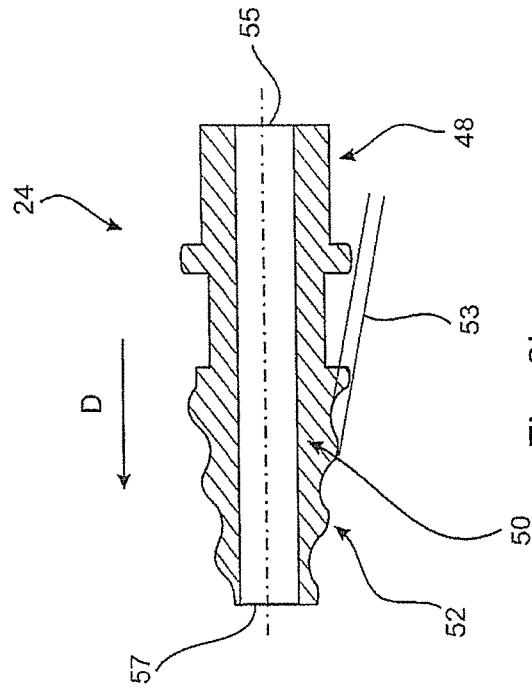


Fig. 9b

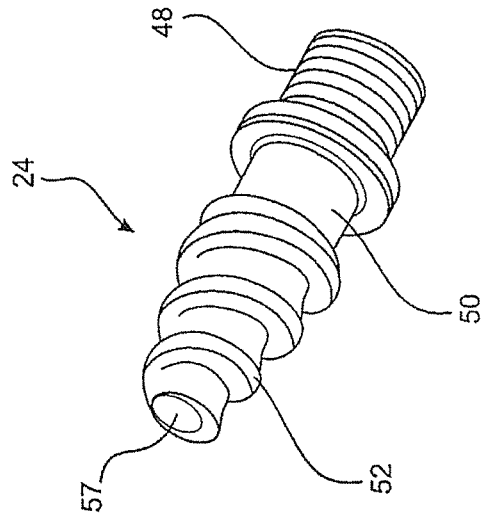
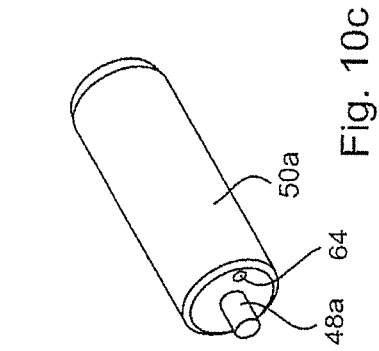
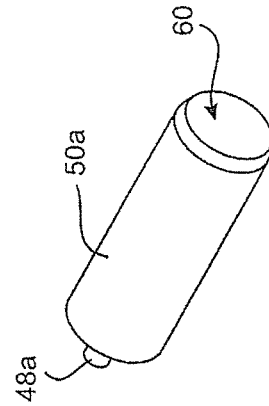
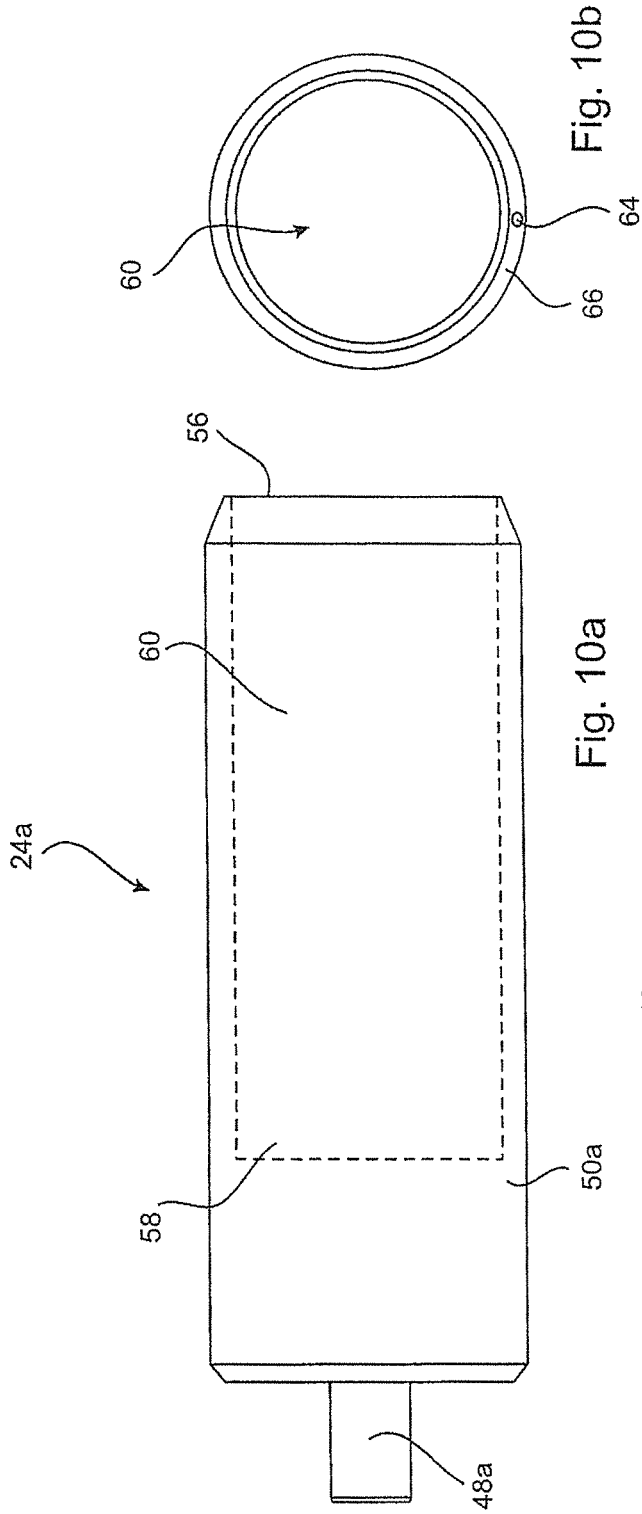


Fig. 9c



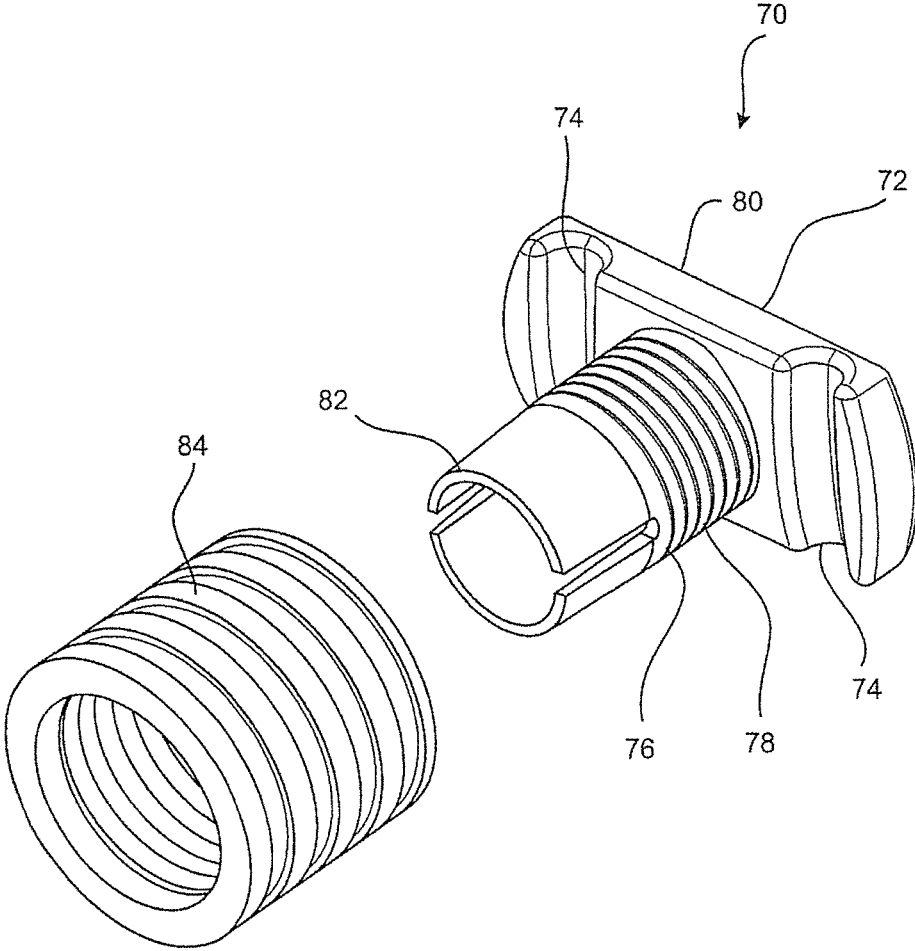


Fig. 11



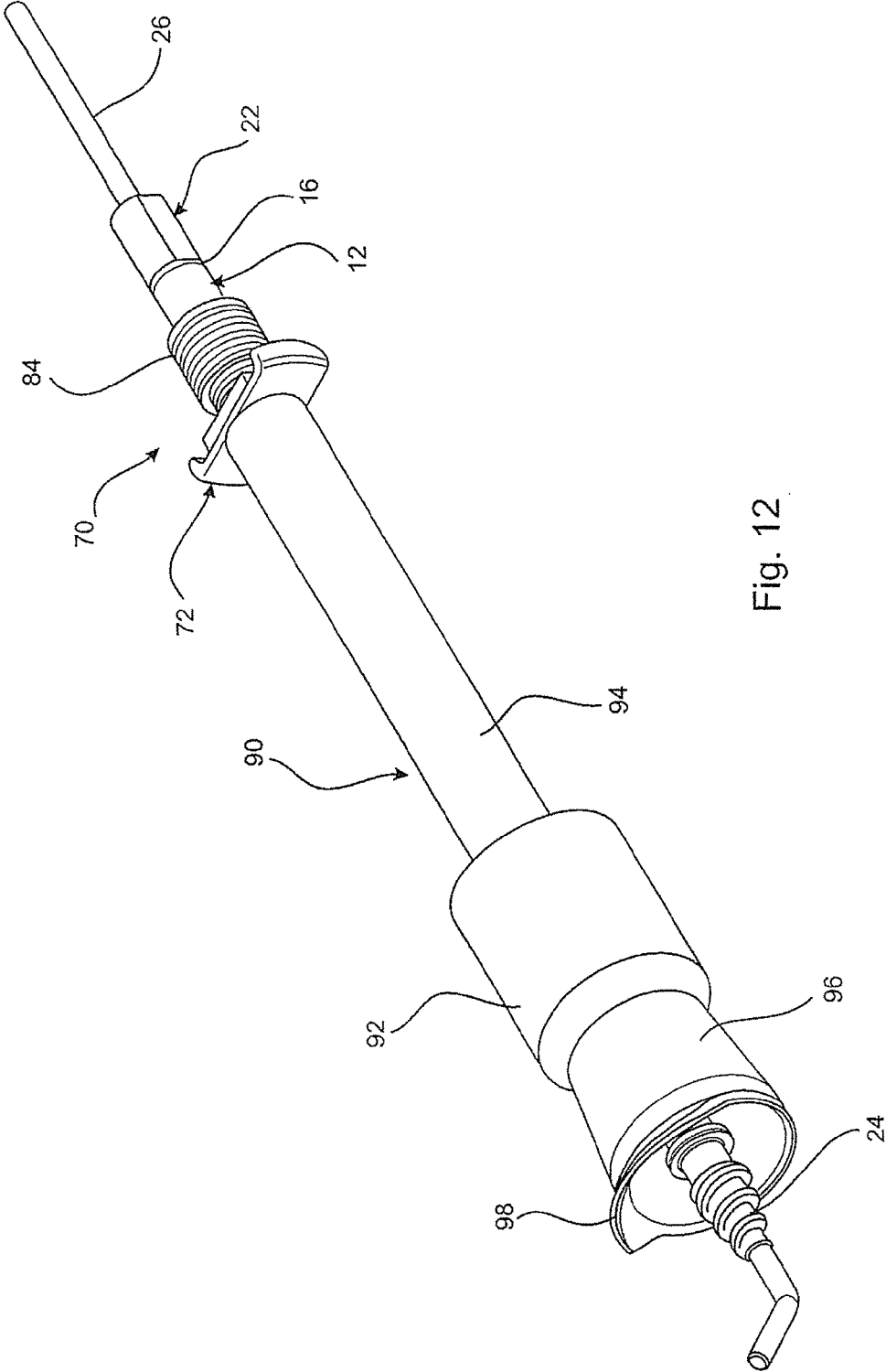


Fig. 12

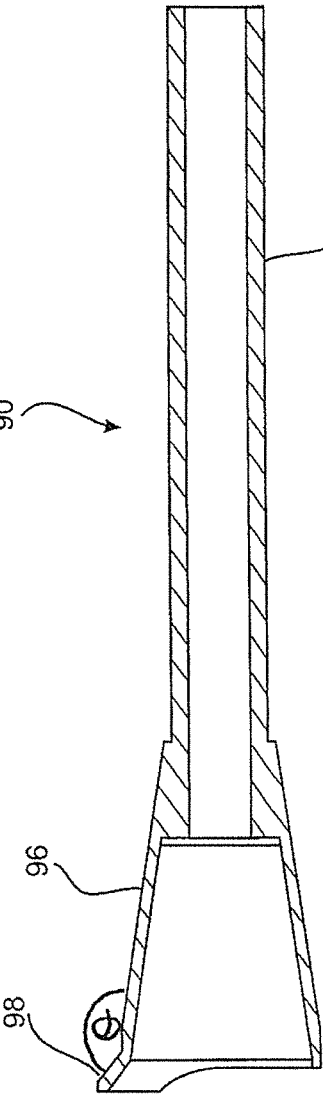


Fig. 13b

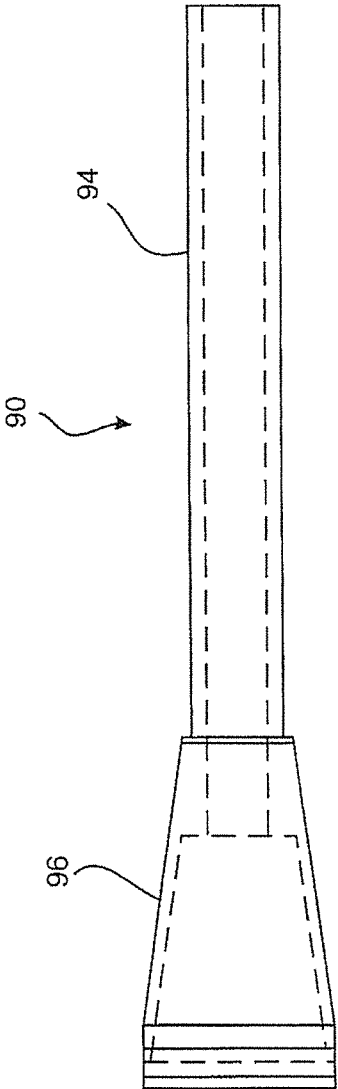


Fig. 13a

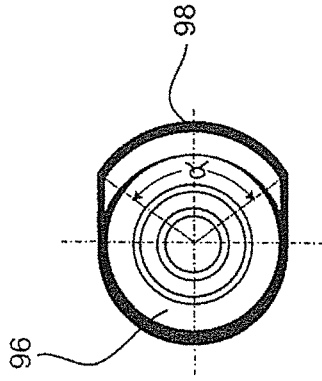


Fig. 13c

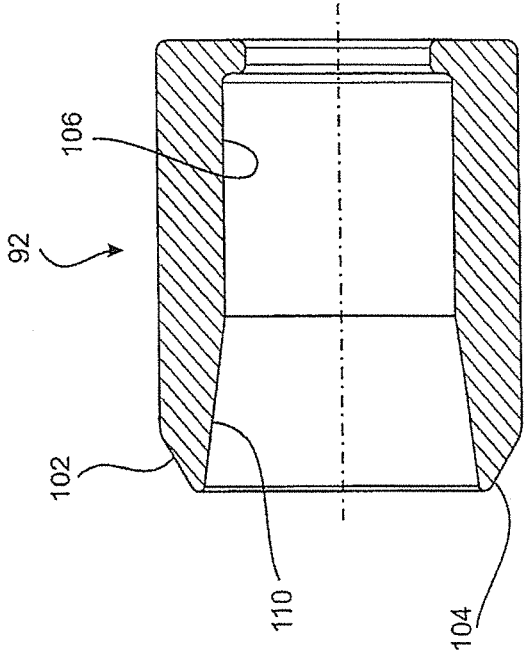


Fig. 14b

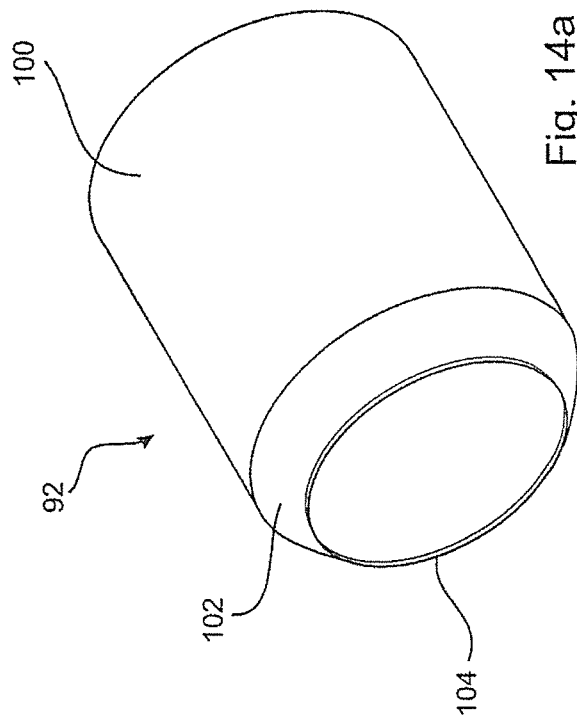


Fig. 14a

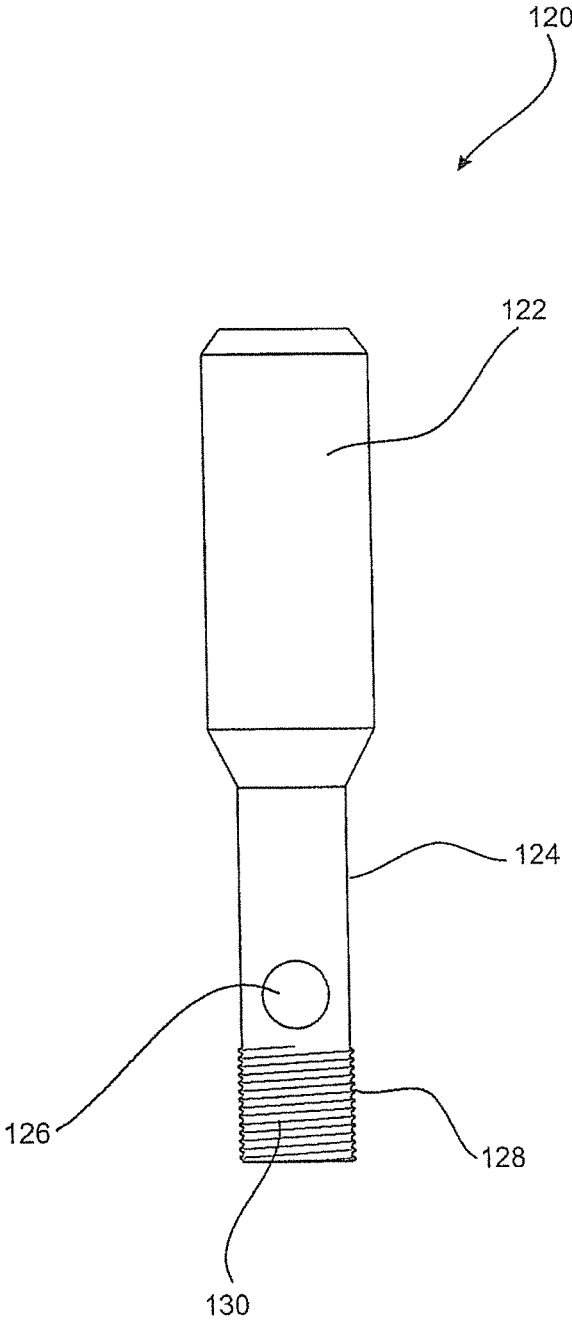


Fig. 15

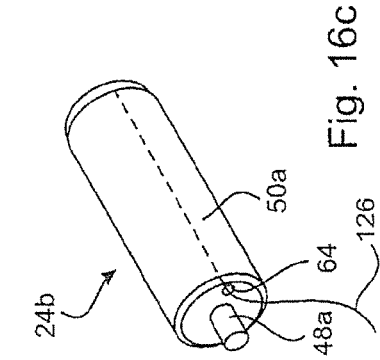
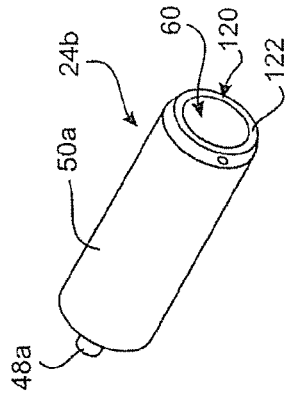
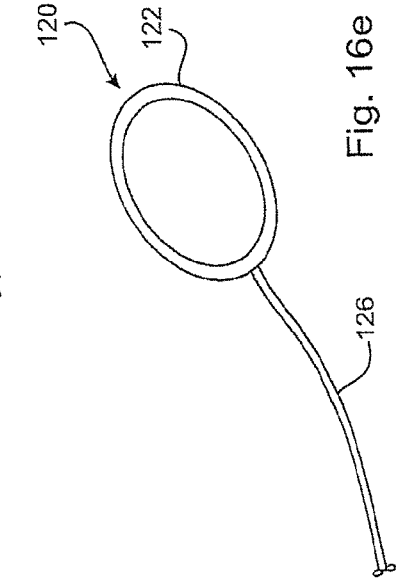
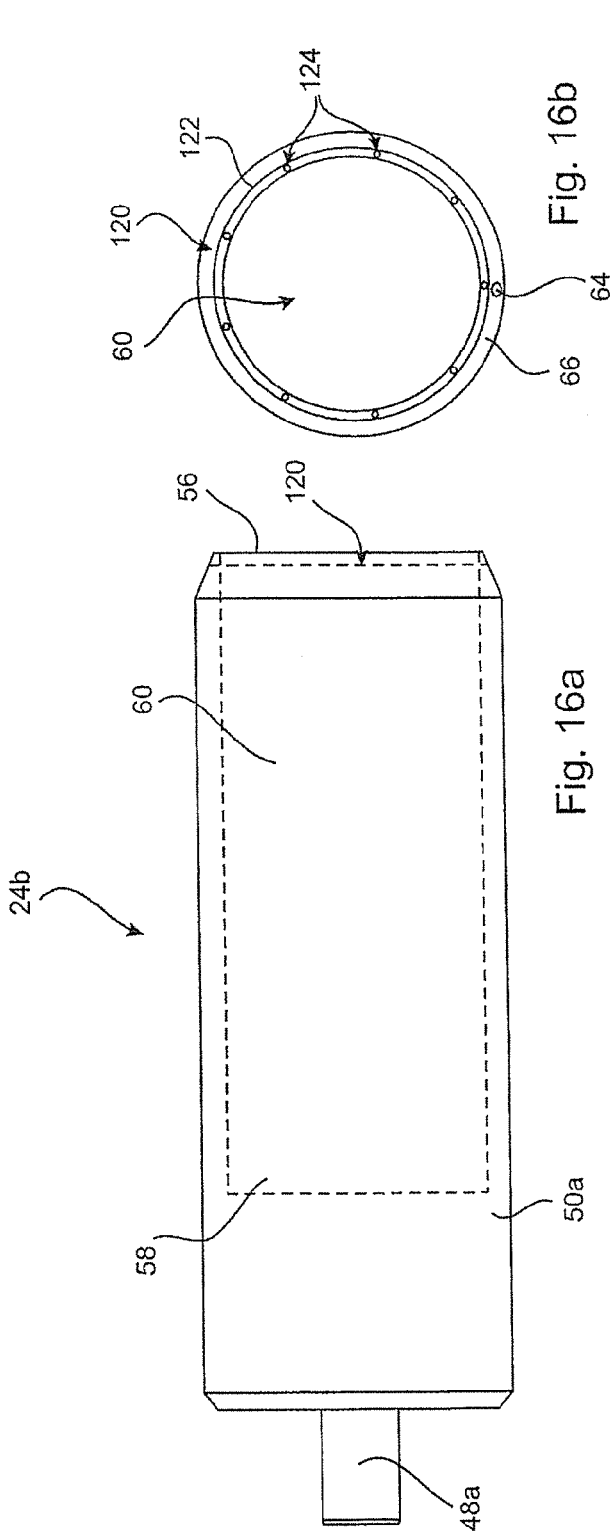


Fig. 16e

Fig. 16f

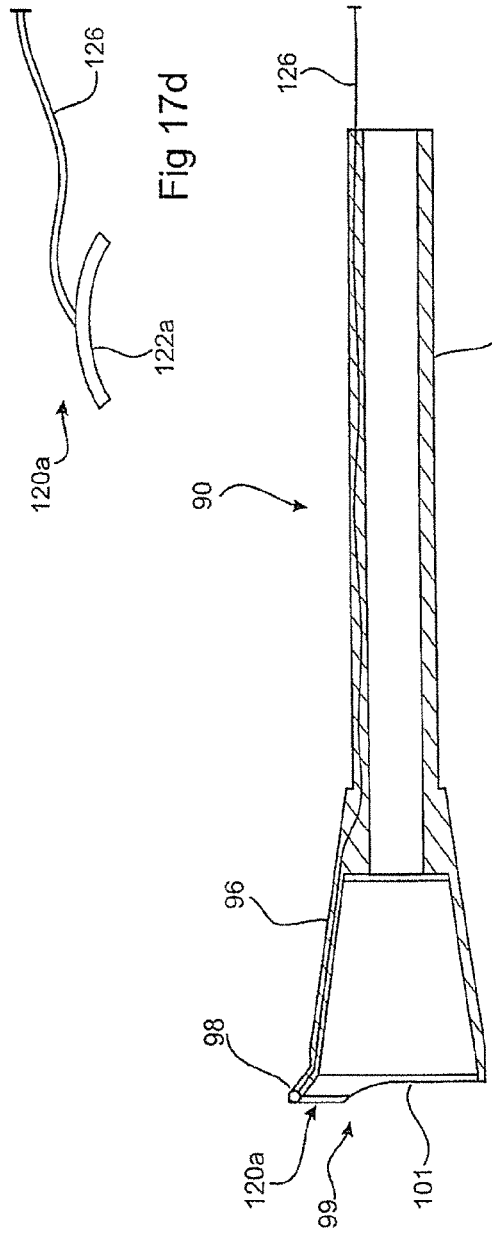


Fig. 17d

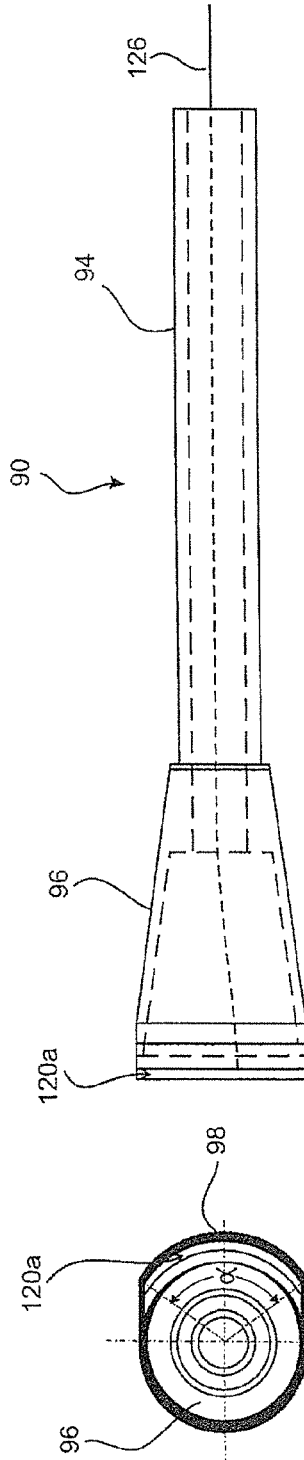
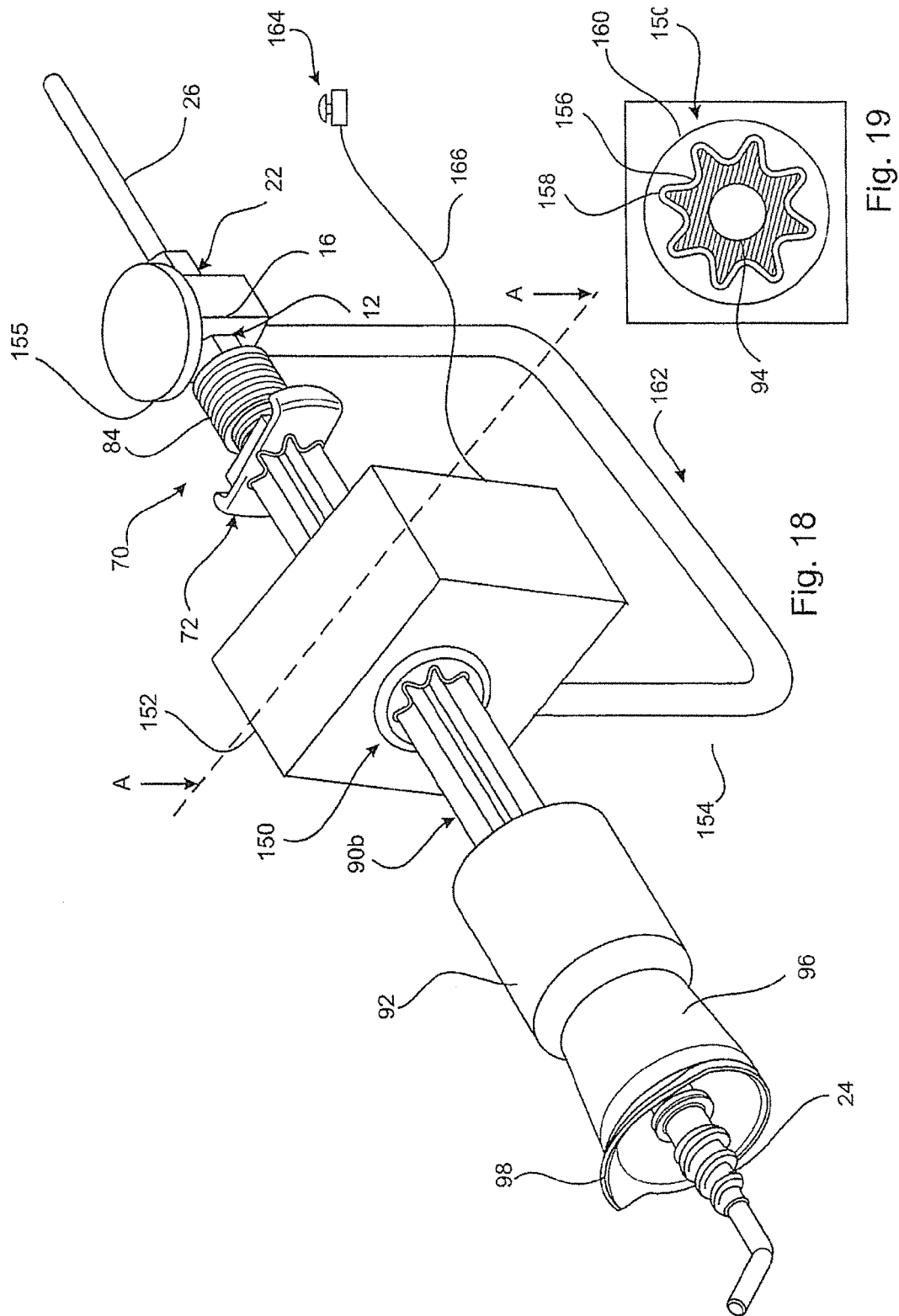
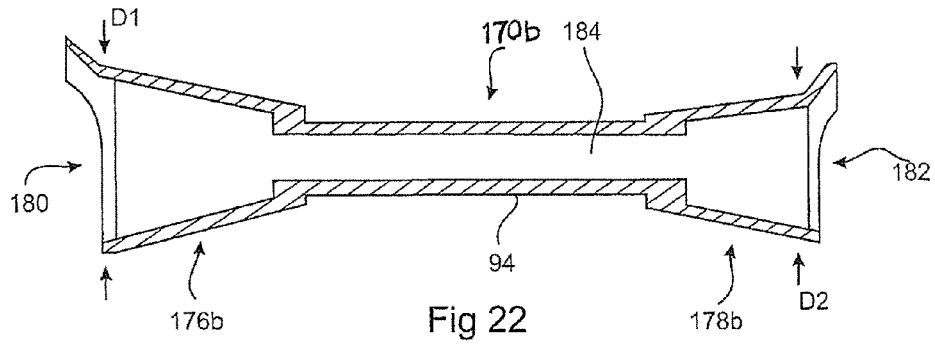
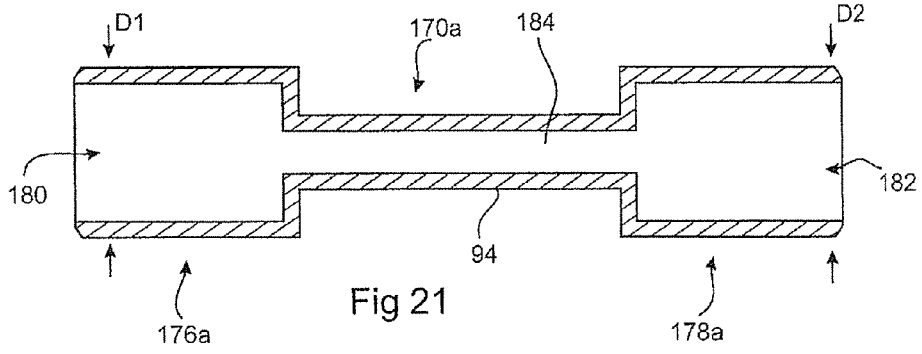
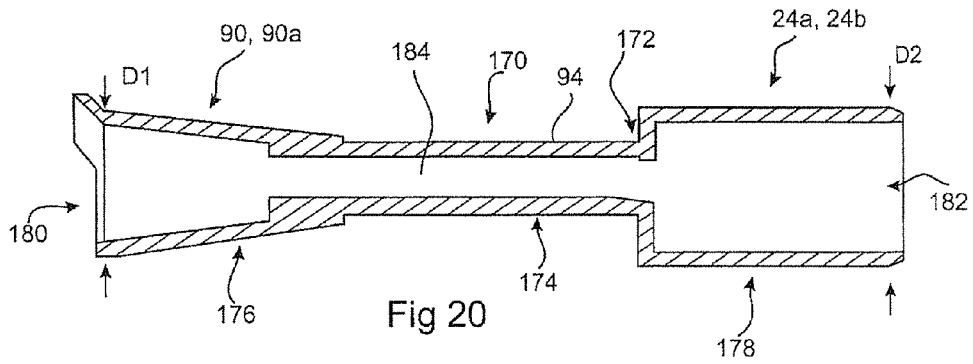


Fig. 17c

Fig. 17b

Fig. 17a







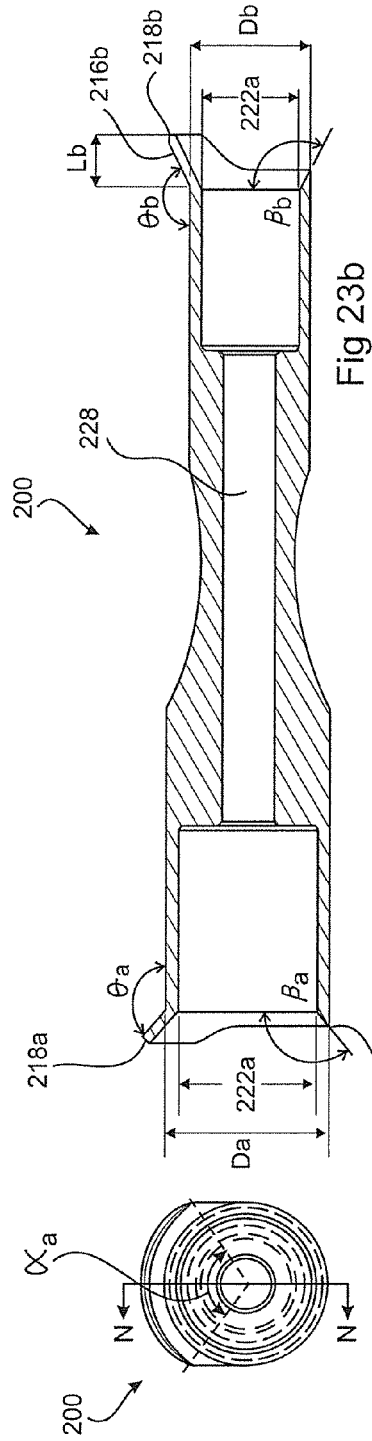


Fig 23b

Fig 23c

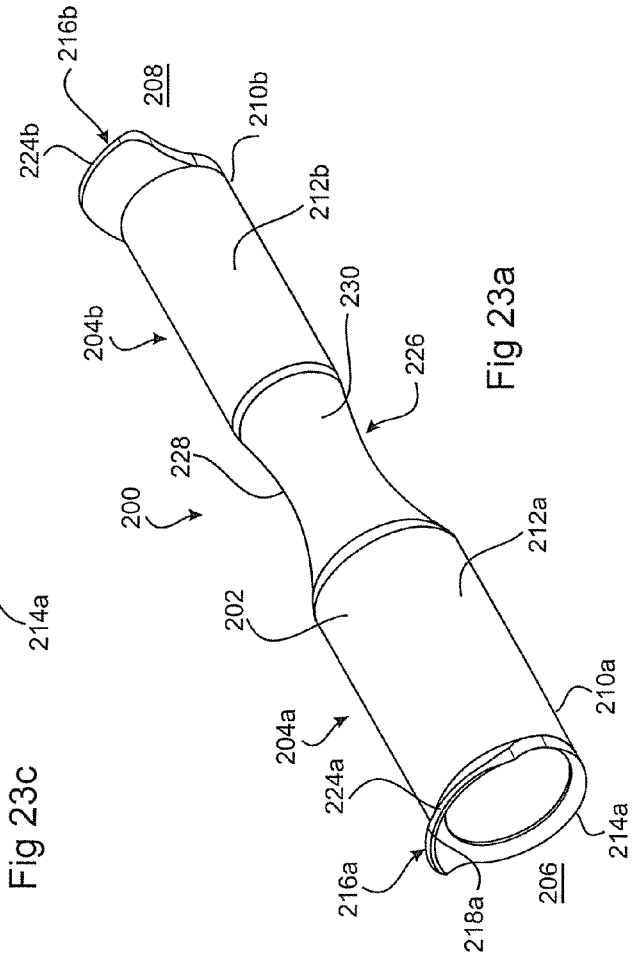


Fig 23a

Fig 23c

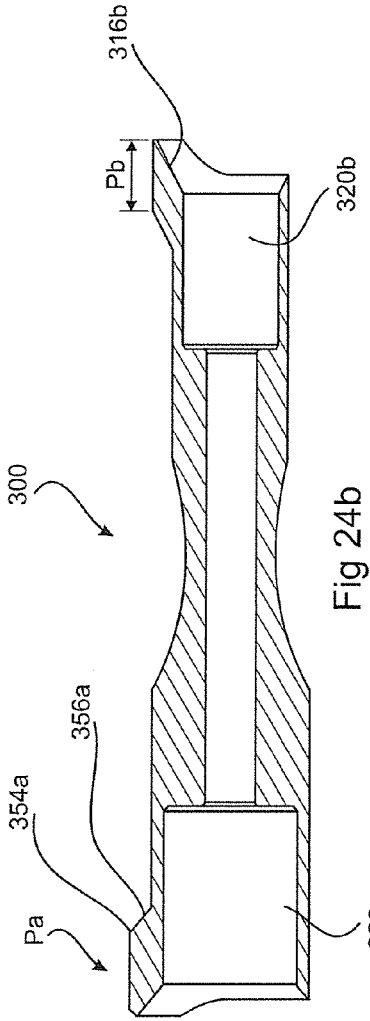


Fig 24b

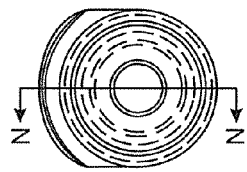


Fig 24c

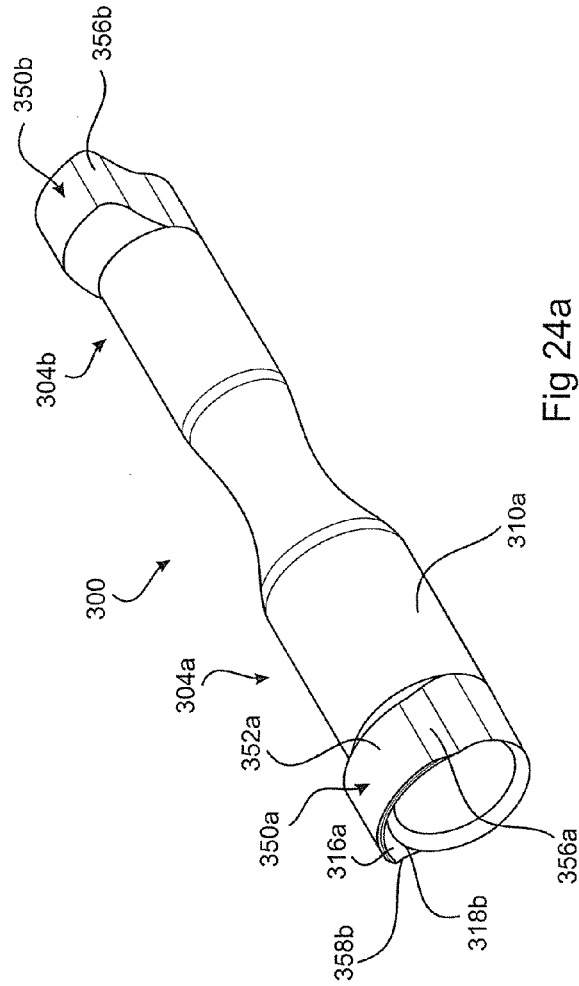


Fig 24a

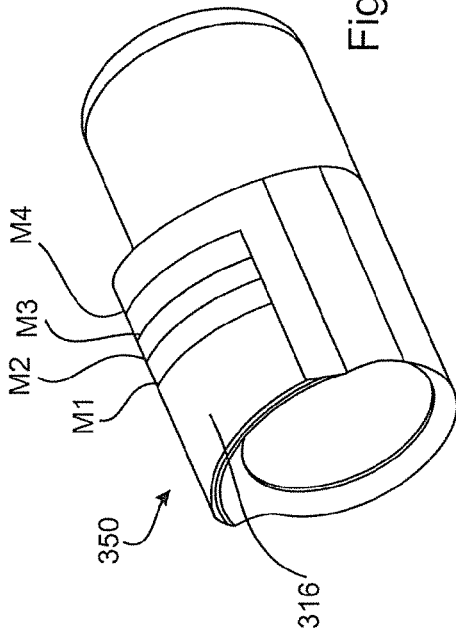


Fig 24d

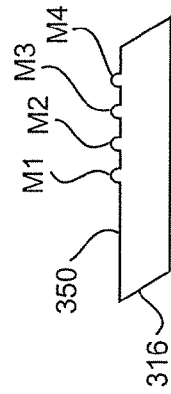


Fig 24e

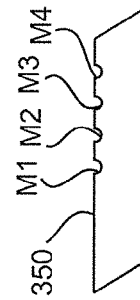


Fig 24f

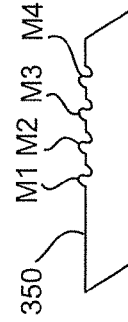


Fig 24g

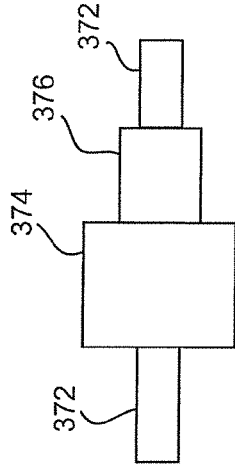


Fig 25

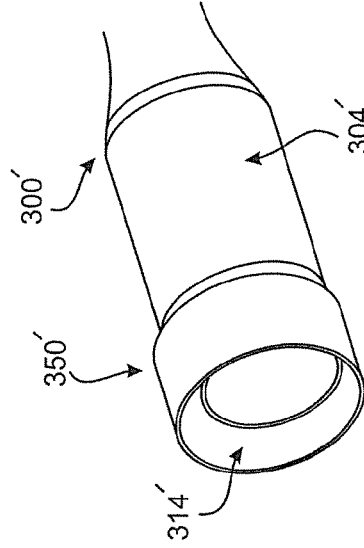


Fig 26

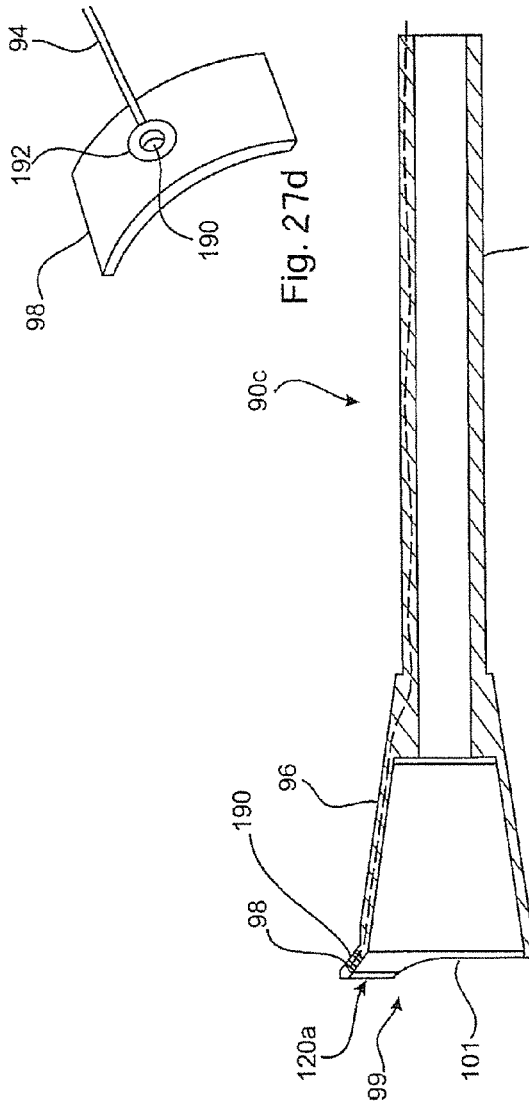


Fig. 27a

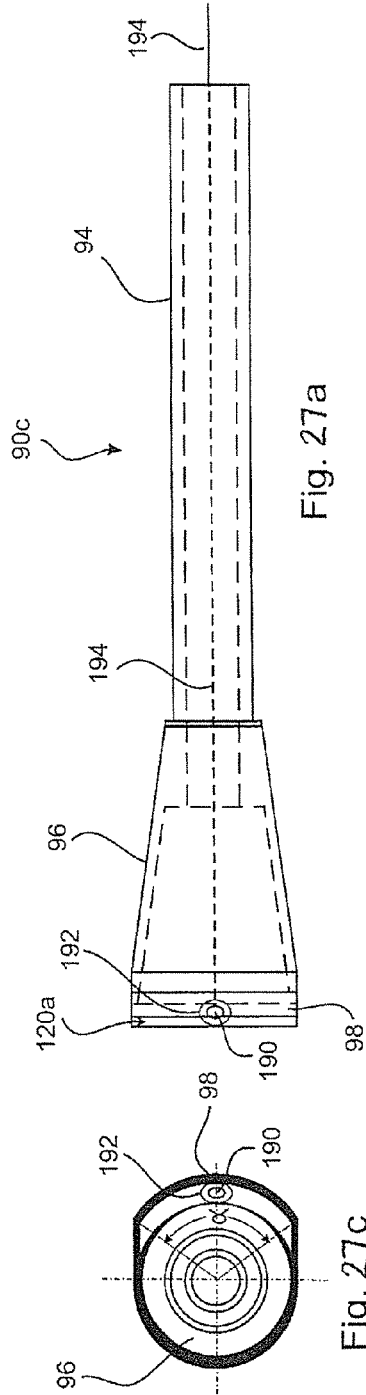


Fig. 27b

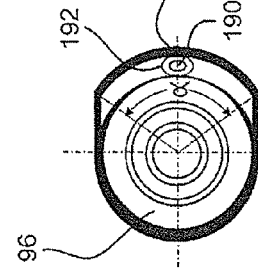


Fig. 27c

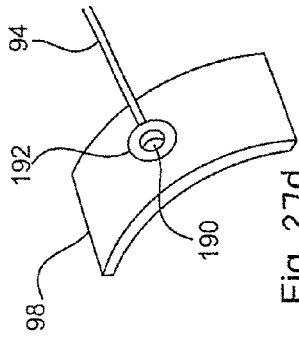


Fig. 27d

## GENERAL UTERINE MANIPULATOR AND SYSTEM

### CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. patent application Ser. No. 13/625,255 filed on Sep. 24, 2012, the contents of which application are herein incorporated by reference in their entirety.

### FIELD OF THE INVENTION

[0002] The present invention relates to a general uterine manipulator and system which may be used in general surgery, gynaecological or non-surgical procedures.

### BACKGROUND OF THE INVENTION

[0003] The present inventor has invented numerous medical instruments which are currently in use in surgical and non-surgical procedures. One such instrument is described in International publication no. WO 2008/074054 which is used in various procedures including total laparoscopic hysterectomy. The instrument described in this publication comprises a tube provided with an integral funnel at one end and through which a uterine cannula can be inserted. Both the tube and the cannula are provided with longitudinal slots or cut outs that aid in visualising the rotational position of a distal end of the instrument when inserted into the vagina and also aid in gripping of the instrument.

[0004] The success and efficacy of the above described and other instruments developed by the present inventor together with the need for improved and more versatile instruments have lead to the present invention.

### SUMMARY OF THE INVENTION

[0005] According to one aspect of the present invention there is provided a general uterine manipulator comprising:

[0006] an elongated hollow tube defining an internal passage and having opposite first and second ends;

[0007] a smooth continuous outer surface of constant outer diameter extending between the first and second ends; and

[0008] internal first and second screw threads formed in the elongated hollow tube, the first screw thread being formed at the first end and the second screw thread being formed at the second end.

[0009] The general uterine manipulator may comprise a first fitting having a screw thread arranged to engage the first screw thread, the first fitting also having an axial through hole and configured to receive an inner manipulator shaft.

[0010] In some embodiments the first fitting is configured to apply increasing clamping force on a received inner manipulator when the first fitting a screw further into the first end.

[0011] The general uterine manipulator may comprise a hydrotubation port in fluid communication with the internal passage wherein a fluid injected into or through the hydrotubation port is able to flow into the internal passage.

[0012] In some embodiments the hydrotubation port is formed in the elongated hollow tube at a location near the first end and beyond the first screw thread.

[0013] In some embodiments the hydrotubation port is formed in the first fitting and is in fluid communication with the axial through hole.

[0014] The axial through hole may comprise a first length which opens onto an end of the first fitting distant the screw thread of the first fitting, and a second contiguous length wherein the first length has a first internal diameter and the second length has a second internal diameter which is greater than the first internal diameter; and wherein the hydrotubation port opens onto the second length of the axial through hole.

[0015] The general uterine manipulator may comprise a second fitting having a threaded portion provided with a screw thread configured to engage the second internal thread on the elongated hollow tube and a body portion extending co-linearly from the threaded portion.

[0016] In some embodiments the body portion comprises a tubular member which is open at one end distal the threaded portion and is closed at an end near to the threaded portion to form a cavity.

[0017] In some embodiments the tubular member comprises a circumferential wall and at least one internal passage formed in the circumferential wall, the or each internal passage opening onto axially opposite ends of the circumferential wall.

[0018] In some embodiments the body portion comprises a conically shaped portion with decreasing outer diameter in a taper direction being away from the threaded portion and wherein the conically shaped portion is provided with an external coarse screw thread.

[0019] In some embodiments the second fitting is provided with an axial through hole.

[0020] The general uterine manipulator may comprise an inner manipulator shaft, the shaft capable of being received in the axial through hole of the first fitting and the axial through hole of the second fitting and extending through the internal passage.

[0021] In some embodiments a crest of the coarse screw thread is provided with a flattened surface wherein a line on the flattened surface is inclined relative to a central axis of the coarse screw thread in the taper direction.

[0022] In some embodiments the coarse screw thread is a ball screw thread.

[0023] In some embodiments the general uterine manipulator comprising a forceps holder supported on the elongated hollow tube and configured to be releasably lockable in a plurality of positions along the elongated hollow tube.

[0024] In some embodiments the forceps holder comprises a first component seated on the elongated hollow tube and provided with a detent for gripping a finger hole of the forceps.

[0025] In some embodiments the forceps holder comprises a locking nut engagable with the first component and arranged to releasably lock the first component in a fixed position along the elongated hollow tube when rotated in a first direction, and to release the second component to allow sliding motion along the elongated hollow tube when rotated in an opposite direction.

[0026] In a second aspect there is provided general uterine manipulator comprising:

[0027] an elongated hollow tube defining an internal passage and having opposite first and second ends;

[0028] a smooth continuous outer surface of constant outer diameter extending between the first and second ends;

[0029] internal first and second screw threads formed in the elongated hollow tube, the first screw thread being formed at the first end and the second screw thread being formed at the second end;

[0030] a first fitting having a screw thread arranged to engage the first screw thread, the first fitting also having an axial through hole;

[0031] a second fitting having a threaded portion provided with a screw thread configured to engage the second internal thread on the elongated hollow tube and a body portion extending co-linearly from the threaded portion; and,

[0032] an inner manipulator shaft arranged to extend through the axial through hole, the internal passage and the second fitting, the inner manipulator shaft having one end which is bent and protrudes from the second fitting.

[0033] In one embodiment the general uterine manipulator comprises a resistance mechanism enabling the axial and rotational position of the inner manipulator shaft to substantially held in the absence of adjustment by a user of the manipulator.

[0034] In one embodiment the resistance mechanism comprises clamp shells incorporated in the first fitting.

[0035] In one embodiment the resistance mechanism comprises a bend in a portion of the inner manipulator shaft within the internal passage the bend being to an extent that the inner manipulator shaft bears against an inside surface of the tube.

[0036] In one embodiment the general uterine manipulator comprises a hydrotubation port formed in the first fitting and in fluid communication with the axial through hole wherein a fluid injected into or through the hydrotubation port is able to flow into the internal passage. In this embodiment the axial through hole comprises a first length which opens onto an end of the first fitting distant the screw thread of the first fitting, and a second contiguous length wherein the first length has a first internal diameter and the second length has a second internal diameter which is greater than the first internal diameter; and the hydrotubation port opens onto the second length of the axial through hole.

[0037] In one embodiment the second fitting comprises a threaded portion provided with a screw thread configured to engage the second internal thread on the elongated hollow tube and a body portion extending co-linearly from the threaded portion, the body portion having a frusto-conical shape with decreasing outer diameter in a direction away from the threaded portion and on which is provided an external coarse screw thread.

[0038] In one embodiment the general uterine manipulator comprises a forceps holder supported on the elongated hollow tube and configured to be releasably lockable in a plurality of positions along the elongated hollow tube.

[0039] In one embodiment the forceps holder comprises a first component seated on the elongated hollow tube and provided with a detent for gripping a handle of the forceps.

[0040] In one embodiment the forceps holder comprises a locking nut engagable with the first component and arranged to releasably lock the first component in a fixed position along the elongated hollow tube when rotated in a first direction, and to release the second component to allow sliding motion along the elongated hollow tube when rotated in an opposite direction.

[0041] In one embodiment the general uterine manipulator comprises a cervical funnel mounted on the tube.

[0042] In a third aspect there is provided a general uterine manipulator system comprising:

[0043] an elongated hollow tube defining an internal passage and having opposite first and second ends;

[0044] a smooth continuous outer surface of constant outer diameter extending between the first and second ends;

[0045] internal first and second screw threads formed in the elongated hollow tube, the first screw thread being formed at the first end and the second screw thread being formed at the second end;

[0046] at least one first fitting the or each first fitting having a screw thread arranged to engage the first screw thread, the first fitting also having an axial through hole;

[0047] at least one second fitting the or each second fitting having a threaded portion provided with a screw thread configured to engage the second internal thread on the elongated hollow tube and a body portion extending co-linearly from the threaded portion;

[0048] wherein the at least one first fitting comprises one or both of: (a) a clamping first fitting configured to apply increasing clamping force on a received inner manipulator when the first fitting a screw further into the first end; and (b) a hydrotubation first fitting which has a hydrotubation port in fluid communication with the internal passage wherein a fluid injected into or through the hydrotubation port is able to flow into the internal passage; and wherein

[0049] the at least one second fitting comprises one or both of: (c) a cervical second fitting in which its body portion is of a frusto-conical shape with decreasing outer diameter in a direction away from the threaded portion and is provided with an external coarse screw thread; and (d) a tubular second fitting in which its body portion comprises a tubular member which is open at one end distal the threaded portion of the second fitting and is closed at an end near to the threaded portion of the second fitting to form a cavity.

[0050] In one embodiment the tubular member of the tubular second fitting comprises a circumferential wall and at least one internal passage formed in the circumferential wall, the or each internal passage opening onto axially opposite ends of the circumferential wall.

[0051] In one embodiment the general uterine manipulator system comprises an inner manipulator shaft arranged to extend through the axial through hole, the internal passage and the second fitting when the second fitting is the cervical second fitting, the inner manipulator shaft having one end which is bent and protrudes from the cervical.

[0052] In one embodiment the general uterine manipulator system a resistance mechanism enabling the axial and rotational position of the inner manipulator shaft to substantially held in the absence of adjustment by a user.

[0053] In one embodiment the general uterine manipulator system a forceps holder supported on the elongated hollow tube and configured to be releasably lockable in a plurality of positions along the elongated hollow tube.

[0054] In a fourth aspect there is provided a medical instrument configured to facilitate a gynaecological procedure comprising:

[0055] a body provided with opposite first and second end portions, the first end portion having a first opening and the second end portion having a second opening;

[0056] a throughway extending between the first and second openings, the throughway arranged to enable the body to

be supported on a shaft to facilitate insertion of one of the first and second end portions into a body cavity.

**[0057]** In one embodiment the first and second end portions are different in one or more of their shape, size and configuration.

**[0058]** In one embodiment the first end portion is of a tubular configuration and has a first outer diameter.

**[0059]** In one embodiment the second end portion is of a tubular configuration and has a second outer diameter that is different to the first outer diameter.

**[0060]** In one embodiment the second end portion is of a frusto conical configuration.

**[0061]** In one embodiment the first end portion is of a frusto conical configuration and has a first outer diameter.

**[0062]** In one embodiment the second end portion is of a frusta conical configuration and has a second outer diameter that is different to the first outer diameter.

**[0063]** In one embodiment the or each end portion of frusto conical configuration is provided with a lip that extends radially outward from an outer surface of the second end portion and for an arc of less than 360°.

**[0064]** In one embodiment one or both of the first and second end portions is provided with an illumination device arranged to enable the emission of light from the respective end portion.

**[0065]** In one embodiment the device comprises an illumination device arranged to enable the emission of light from the lip.

**[0066]** In one embodiment the general uterine manipulator system comprises an illumination device arranged to enable the emission of light from an end of the tubular portion.

**[0067]** In one embodiment the general uterine manipulator system comprises an illumination device arranged to enable the emission of light from an end of the cervical funnel.

**[0068]** In one embodiment the general uterine manipulator system comprises an illumination device arranged to enable the emission of light from an end of the tubular second fitting.

**[0069]** In one embodiment the general uterine manipulator system comprises a motor arranged to engage and rotate the cervical funnel.

**[0070]** In one embodiment the general uterine manipulator system comprises a foot operated switch associated with the motor and switchable between a first position wherein the motor rotates in a clockwise direction and a second position wherein the motor rotates in an anti-clockwise direction.

**[0071]** In one embodiment the cervical funnel has conical portion and a through hole formed in or near a large diameter end the conical portion.

**[0072]** In one embodiment the large diameter end of the conical portion has an outwardly flared lip that extend for a part of the circumference of the conical portion and wherein the hole is formed in the lip.

**[0073]** In one embodiment the general uterine manipulator system comprises an illumination device arranged to illuminate the through hole.

**[0074]** In a fifth aspect there is provided a cervical funnel comprising a conical portion and a through hole formed in or near a large diameter end the conical portion.

**[0075]** In one embodiment the funnel comprises the large diameter end of the conical portion has an outwardly flared lip that extend for a part of the circumference of the conical portion and wherein the hole is formed in the lip.

**[0076]** In one embodiment the funnel comprises an illumination device arranged to illuminate the through hole.

**[0077]** In one embodiment the illumination device comprises an annular light guide surrounding the through hole.

**[0078]** In a sixth aspect there is provided a cervical funnel comprising a conical portion and a tube extending coaxially form a small diameter end of the conical portion, wherein an outer surface of the tube is profiled to mechanically engage a motor to facilitate rotation of the cervical funnel.

**[0079]** In one embodiment the outer surface of the tube is provided with gear teeth arranged to enable mechanical engagement with the motor.

**[0080]** In one embodiment the funnel comprises a through hole formed in or near a large diameter end the conical portion.

**[0081]** In one embodiment the large diameter end of the conical portion has an outwardly flared lip that extend for a part of the circumference of the conical portion and wherein the hole is formed in the lip.

**[0082]** In a seventh aspect there is provided a double ended medical instrument arranged for insertion into a body cavity comprising:

**[0083]** a body having a first probe at first end, a second probe at a second opposite end;

**[0084]** the first probe having a cylindrical portion with an first outer circumferential surface of a first diameter, a first circumferential edge distant the first end and a first lip projecting outwardly from the first outer circumferential surface beyond the first circumferential edge and extending for at least a part of a circumference of the first circumferential edge;

**[0085]** the second probe having a cylindrical portion with a second outer circumferential surface of a second outer diameter, a second circumferential edge distant the first probe and a second lip projecting outwardly from the second outer circumferential surface beyond the second circumferential edge and extending for at least a part of a circumference of the second circumferential edge;

**[0086]** wherein the first outer diameter and the second outer diameter are different from each other.

**[0087]** In one embodiment the first and second lips have respective mid-points that are located in axial alignment.

**[0088]** In one embodiment the part of the circumference of the first and second circumferential edges about which the first and second lips respectively extend are the same.

**[0089]** In one embodiment the first probe is provided with a first cavity extending axially from the first circumferential edge toward the second probe and having a first inner diameter.

**[0090]** In one embodiment the second probe is formed with a second cavity extending axially from the second circumferential edge toward the first probe and having a second inner diameter wherein the second inner diameter is different to the first inner diameter.

**[0091]** In one embodiment the first probe is provided with a first platform of constant first outer diameter extending over the first cylindrical portion from a circumferential edge of the first lip toward the second probe.

**[0092]** In one embodiment the first platform is co-extensive in a circumferential aspect with the first lip.

**[0093]** In one embodiment a side of the first platform rearward of the first lip slopes from the first outer diameter to first outer circumferential surface in a direction toward the second probe.

**[0094]** In one embodiment circumferentially opposite sides the first platform transition smoothly from first outer diameter the first outer circumferential surface.

**[0095]** In one embodiment the second probe is provided with a second platform of constant second outer diameter extending over the second cylindrical portion from a circumferential edge of the second lip toward the first probe.

**[0096]** In one embodiment the second platform is co-extensive in a circumferential aspect with the second lip.

**[0097]** In one embodiment a side of the second platform rearward of the second lip slopes from the second outer diameter in a direction toward the first probe.

**[0098]** In one embodiment circumferentially opposite sides the second platform transition smoothly from second outer diameter the second outer circumferential surface.

**[0099]** In one embodiment the platform has a circumferential surface of constant diameter extending coaxially with the first outer circumferential surface.

**[0100]** In one embodiment the double ended medical instrument comprises an intermediate portion that transitions smoothly between the first and second probes.

**[0101]** In one embodiment the intermediate portion has a central region of an outer diameter less than each of the first diameter and the second outer diameter.

**[0102]** In one embodiment the double ended medical instrument comprises an intermediate portion that transitions smoothly between the first and second probes wherein the intermediate portion is formed with an internal bore the bore extending in an axial direction between the first and second cavities and having an inner diameter smaller than each of the first and second inner diameters.

**[0103]** In one embodiment the first lip and second lip extend for the full circumference of first circumferential edge and the second circumferential edge respectively; the first probe being provided with a first platform of constant first outer diameter extending wholly about the first cylindrical portion from a circumferential edge of the first lip toward the second probe; and the second probe being provided with a second platform of constant second outer diameter extending wholly about the second cylindrical portion from a circumferential edge of the second lip toward the first probe.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0104]** FIG. 1a is a representation of one embodiment of a general uterine manipulator in accordance with the present invention;

**[0105]** FIG. 1b is a disassembled view of the general uterine manipulator depicted in FIG. 1a;

**[0106]** FIG. 2 is a longitudinal section view of the tube incorporated in the general uterine manipulator shown in FIGS. 1a and 1b;

**[0107]** FIG. 3 is an isometric view of a tail screw incorporated in the general uterine manipulator shown in FIGS. 1a and 1b;

**[0108]** FIG. 4 is a side view of the tail screw shown in FIG. 3;

**[0109]** FIG. 5 is an end view of the tail screw shown in FIG. 3;

**[0110]** FIG. 6 is an isometric view of a second form of tail screw that may be incorporated in the general uterine manipulator shown in FIGS. 1a and 1b;

**[0111]** FIG. 7 is a side view of the tail screw shown in FIG. 6;

**[0112]** FIG. 8 is an end view of the tail screw shown in FIG. 6;

**[0113]** FIG. 9a is a side view of a second fitting incorporated in the general uterine manipulator shown in FIGS. 1a and 1b;

**[0114]** FIG. 9b is a longitudinal section view of the second fitting shown in FIG. 9a;

**[0115]** FIG. 9c is an isometric representation of the second fitting;

**[0116]** FIG. 10a is a side view of a second form of setting fitting that may be incorporated in the general uterine manipulator depicted in FIGS. 1a and 1b;

**[0117]** FIG. 10b is an end view of the second fitting shown in FIG. 9a;

**[0118]** FIG. 10c is an isometric view from one end of the second fitting;

**[0119]** FIG. 10d is a isometric view from an opposite angle of the second fitting;

**[0120]** FIG. 11 is an isometric view of a forceps holder incorporated in the uterine manipulator;

**[0121]** FIG. 12 is an isometric view of an embodiment of the general uterine manipulator and associated system with additional fittings to enable performance of a total laparoscopic hysterectomy; and,

**[0122]** FIG. 13a is a side view of a cervical funnel incorporated in an embodiment of the general uterine manipulator shown in FIGS. 1a and 1b;

**[0123]** FIG. 13b is a longitudinal section view of the cervical funnel;

**[0124]** FIG. 13c is an end view of the cervical funnel shown in FIGS. 13a and 13b;

**[0125]** FIG. 14a is an isometric representation of a vaginal plug incorporated in an embodiment of the general uterine manipulator shown in FIGS. 1a and 1b;

**[0126]** FIG. 14b is a section view of the vaginal plug shown in FIG. 14a;

**[0127]** FIG. 15 is a side view of a manipulator handle which may be incorporated in an embodiment of the general uterine manipulator;

**[0128]** FIG. 16a is a side view of a further form of second fitting that may be incorporated in the general uterine manipulator depicted in FIGS. 1a and 1b;

**[0129]** FIG. 16b is an end view of the second fitting shown in FIG. 16a;

**[0130]** FIG. 16c is an isometric view from a first angle of the second fitting shown in FIG. 16a;

**[0131]** FIG. 16d is a isometric view from a second angle of the second fitting shown in FIG. 16a;

**[0132]** FIG. 16e is a schematic representation of an illumination device incorporated in the second fitting shown in FIG. 16a;

**[0133]** FIG. 17a is a side view of a cervical funnel with an illumination device incorporated in a further embodiment of the general uterine manipulator;

**[0134]** FIG. 17b is a longitudinal section view of the cervical funnel shown in FIG. 17a;

**[0135]** FIG. 17c is an end view of the cervical funnel shown in FIGS. 17a and 17b;

**[0136]** FIG. 17d is a schematic representation of the illumination device incorporated in the cervical funnel shown in FIGS. 17a and 17b;



[0137] FIG. 18 is an isometric view of the general uterine manipulator shown in FIG. 12 but modified with the inclusion of a drive to enable powered rotation of an associated cervical funnel;

[0138] FIG. 19 is view of cross section A-A of the manipulator shown in FIG. 18;

[0139] FIG. 20 is a schematic representation of a medical instrument that can be incorporated in or used with an embodiment of the general uterine manipulator;

[0140] FIG. 21 is a schematic representation of an alternate medical instrument that can be incorporated in or used with an embodiment of the general uterine manipulator;

[0141] FIG. 22 is a schematic representation of a further form of medical instrument that can be incorporated in or used with an embodiment of the general uterine manipulator;

[0142] FIG. 23a is an isometric view of a double ended medical instrument that can be incorporated in or used with an embodiment of a general uterine manipulator;

[0143] FIG. 23b is a longitudinal section view of the instrument shown in FIG. 23a;

[0144] FIG. 23c is an end view of the instrument shown in FIG. 23a;

[0145] FIG. 24a is an isometric view of a further double ended medical instrument that can be incorporated in or used with an embodiment of a general uterine manipulator;

[0146] FIG. 24b is a longitudinal section view of the instrument shown in FIG. 24a;

[0147] FIG. 24c is an end view of the instrument shown in FIG. 24a;

[0148] FIG. 24d is an enlarged view of an extended probe that can be incorporated in the instrument shown in FIG. 24a;

[0149] FIG. 24e depicts a cross section of a platform of the probe shown in FIG. 24a with markings in the form of ridges;

[0150] FIG. 24f depicts a cross section of a platform of the probe shown in FIG. 24a with markings in the form of grooves;

[0151] FIG. 24g depicts a cross section of a platform of the probe shown in FIG. 24a with markings in the form of sets of adjacent grooves and ridges;

[0152] FIG. 25 illustrates a plug that can be used with the instruments depicted in FIGS. 20-24g;

[0153] FIG. 26 illustrates one end of a modified form of the double ended medical instrument shown in FIG. 24a having a full circumference platform;

[0154] FIG. 27a is a side view of a further embodiment cervical funnel with an illumination device that may be used with the general uterine manipulator;

[0155] FIG. 27b is a longitudinal section view of the cervical funnel shown in FIG. 27a;

[0156] FIG. 27c is an end view of the cervical funnel shown in FIGS. 27a and 27b; and

[0157] FIG. 27d is a schematic representation of a lip portion of the cervical funnel shown in FIGS. 27a and 27b.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0158] Embodiments of the general uterine manipulator and associated system provide a multipurpose manipulator that may be used for a variety of procedures by interchanging particular fittings of the manipulator. With particular reference to FIGS. 1a to 2, each embodiment of the general uterine manipulator 10 (hereinafter referred to in general as “manipulator 10”) is based on or incorporates an elongated hollow tube 12 defining an internal passage 14. Tube 12 has opposite

first and second ends 16 and 18 and a smooth continuous outer surface 20 of constant outer diameter. A first internal screw thread 11 is formed at the first end 16 and a second internal screw thread 12 is formed at the second end 18.

[0159] The versatility of the manipulator 10 and associated system arises from the ability to connect with a number of different fittings depending on the specific application at hand. FIGS. 1a and 1b illustrate a first fitting in the form of tail screw 22 and a second fitting in the form of a cervical screw 24. An inner manipulator rod 26 is also illustrated in FIGS. 1a and 1b which extends through the first fitting 22, tube 12, and second fitting 24.

[0160] One form of the first fitting 22 is shown in greater detail in FIGS. 3 to 5. In this embodiment the first fitting 22 comprises a threaded portion 28; an integral body portion 30; and, an internal axial hole 32. Threaded portion 28 is configured to engage screw thread T1 and is provided with a transverse slot 34 terminating prior to the body portion 30. Slot 34 in effect divides the threaded portion 28 into opposed clamp shells 36a and 36b (hereinafter referred to in general as “clamp shells 36”). Body portion 30 is in the general form of a cylinder with two flats 38a and 38b on opposed sides that assist in gripping of the fitting 22. Axial hole 32 is of constant diameter for the length of the fitting 22 except for a counter sink 40 at a distal end of fitting 22.

[0161] Threaded portion 28 is slightly flared outwardly so as it is screwed into screw thread T1 at end 16, the clamp shells 36 move toward each other. When an inner manipulator rod 26 is used in the manipulator 10 this results in a clamping action on the rod providing resistance to movement of the rod 26 so as to hold it at a desired rotational and translational position. Unscrewing of the portion 28 releases or reduces this resistance to enable adjustment of the position and orientation of the rod 26. Thus the first fitting can be considered in this embodiment as incorporating or comprising a resistance mechanism which substantially maintains the position of the rod 26 until moved or adjusted by a surgeon or other user.

[0162] FIGS. 6 to 8 depict an alternate form of the first fitting denoted as 22'. Features of the fitting 22' which are of the same or similar configuration or function as those of fitting 22 are denoted with the same reference numbers but with the addition of the prime (') symbol. Fitting 22' comprises a threaded portion 28', body 30', an inner axial hole 32' with counter sink 40' at a distal end, and opposed flats 38'a and 38'b formed on body portion 30'. Fitting 22' differs from fitting 22 by the omission of slot 34, the inclusion of a hydrotubation port 42, and a re-configuring of the axial hole 32'. With particular reference to FIG. 7 it can be seen that the axial hole 32' has a first length 44 and a contiguous second length 46. The first length 44 extends from the threaded portion 28' for a majority of the axial length of fitting 22. The second length 46 extends between and joins the counter sink 40' to the first length 44. The inner diameter of the first length 44 is greater than the inner diameter of second length 46'. Further, the inner diameter of second length 46 is dimensioned to be slightly greater than an outer diameter of the inner manipulator rod 26 forming a close fit but enabling the rod 26 to pass through the axial hole 32'.

[0163] Hydrotubation port 42 is formed in the body 30' at a location where it communicates with the first length 44. The thread on threaded portion 28' is arranged to engage with the thread T1 at end 16. In the event that for example the manipulator 10 is being used in a gynaecological application and it is

desired to inject a liquid such as a dye to assist in the visualization of tissue the dye may be injected through the hydrotubation port 42. The dye then flows through the internal passage 14 and from an opposite end of second fitting 24 attached to end 18. In this regard in the event that manipulator rod 26 is in use, a clearance exists between second fitting 24 and an outer surface of rod 26 to allow the flow of dye or other fluid. Further, the close fitting between the rod 26 and second length 46 of axial hole 32' substantially prevents any back leakage of the dye. Alternately and/or in addition if desired, a rubber grommet seal (not shown) may be provided in the second length 46 to further minimize back leakage of dye or other liquid injected through the hydrotubation port 42.

[0164] As the fitting 22' does not have the clamping shells 36 of fitting 22 it is unable to clamp inner manipulation rod 26. However in embodiments of the manipulator 10, the inner manipulator rod 26 can be bent to varying degrees intermediate of its length so that the rod 26 bears against an inside surface of tube 12 to provide resistance to both axial and rotational motion when fitting 22' is used. This still allows the rod 26 to substantially maintain its position until moved or adjusted manipulated by a surgeon or other user. Thus the intermediate bend in the rod 26 can be equated with or considered to be another or alternate form of resistance mechanism which substantially maintains the position of the rod 26 until moved or adjusted by a surgeon or other user.

[0165] The second fitting 24 of FIGS. 1a and 1b is shown in greater detail in FIGS. 9a, 9b and 9c. The fitting 24 comprises a threaded portion 48 configured to engage thread T2, and an integral body portion 50. Body portion 50 is of a frusto-conical shape with a decreasing outer diameter in a taper direction D being away from threaded portion 48. A coarse screw thread 52 is formed about the conically shaped body portion 50. The crest of thread 52 has a flattened surface orientated so that a line 53 on the surface of the crest is inclined parallel with a central axis 55 of second portion 24. An axial through hole 57 is also formed through second portion 24. This allows for the passage of the inner manipulator rod 26 and/or other instruments as well as fluids including saline, dye, and air. In this embodiment of the manipulator 10, second fitting 24 is a cervical screw which is configured to screw into the cervix forming an attachment point as well as a seal.

[0166] However, alternate forms of second fittings may be incorporated in the manipulator 10. FIGS. 10a-10d illustrate an alternate second fitting 24a. Fitting 24a is in the form of a hollow probe having a threaded portion 48a and a body portion 50a. Threaded portion 48a has a thread configured to engage with thread T2. Body portion 50a is in the form of a tubular member which is open at its distal end 56 and is closed at an end 58 near threaded portion 48a to define or otherwise form a cavity 60. Distal end 56 is formed with a chamfer or bevel 62 to assist in insertion of the fitting 24a into a body cavity such as a vagina or rectum. Fitting 24a may be used for example during a hysterectomy to maintain pneumoperitoneum after removal of the uterus. The cavity 60 also allows for collection of pelvic tissue and specimens from the abdominal and pelvic cavities. A lumen (i.e. through hole) 64 may be formed axially through a circumferential wall 66 of the body 50a. In one embodiment the lumen 64 may have an internal diameter of approximately 6 mm to enable the receipt of a 4 mm telescope to enable illumination and visualization of tissue in cavities. For example this may be used in pelvic

floor operations where the vagina and rectum septum need to be dissected out. This reduces the possibility of a recto-vaginal fistula occurring.

[0167] It is envisaged that the fitting 24a may be made in a variety of different sizes and in particular different diameters. For example 40 mm outer diameter, 30 mm outer diameter, and 20 mm outer diameter.

[0168] FIG. 11 illustrates one form of a forceps holder 70 that may be incorporated in an embodiment of manipulator 10. The forceps holder 70 is configured to seat on the elongated hollow tube 12 and releasably lock at a desired location along the tube 12. Forceps holder 70 comprises a first component 72 that is able to slide over and along tube 12 and is provided with detents 74 for gripping a handle of the forceps. Two detents 74 are shown on opposite sides of a central boss 76. However in other configurations alternate numbers of detent 74 may be provided. The boss 76 is provided with a screw thread 78 extending from a cross piece 80 which contains the detent 74. Extending axially from the thread portion 78 is a split collar 82. The forceps holder 70 also includes a locking nut 84 that is able to screw onto the threaded portion 78 over the split collar 82 and act to clamp the collar 82 onto an outer surface of the tube 12 thereby releasably locking the holder 70 at an outside location along the tube 12. In one example, the forceps holder 70 may be used to hold vassellum forceps which in turn holds the manipulator 10 to the cervix making the manipulator self retaining.

[0169] With reference to FIGS. 12-14b, the manipulator 10 may also support a cervical funnel 90 and a plug 92. The cervical funnel 90 is formed as a unitary device comprising a tube 94 of constant inner and outer diameter and an integral conical portion 96 which increases in outer diameter in a direction away from first end 16 of tube 12. The conical portion is provided with a lip 98 that extends about a part of the circumference of conical portion 96 and is flared in a radial outward direction.

[0170] Plug 92 sits on the outside of funnel 90 and when used in gynaecological procedures forms a plug in the vagina. With reference to FIG. 12, it can be seen that the forceps holder 70 may also act as a positioning device for the funnel 90.

[0171] FIGS. 13a and 13b depict in greater detail the cervical funnel 90 incorporated in the manipulator 10 shown in FIG. 12. The lip 98 is flared outwardly by an angle  $\theta$  of approximately  $130^\circ$  but may lay in the range of  $130^\circ$ - $160^\circ$ . In this embodiment the outermost edge of the lip 98 extends for an arc  $\alpha$  of approximately  $115^\circ$  about the conical portion 96 but may lay in the range of about  $100^\circ$ - $130^\circ$ . An inside diameter of the tube 94 is arranged to be slightly greater than the outer diameter of the tube 12 to enable the cervical funnel 90 to be rotatably and linearly moveable with respect to the tube 12.

[0172] FIGS. 14a and 14b depict in greater detail the vaginal plug 92 shown previously in FIG. 12. The plug 92 has a main body 100 formed of a constant outer diameter and a contiguous distal end portion 102 of progressively reducing outer diameter tapering to the distal end 104 of the plug 92. When the plug 92 is used with the manipulator 10, it is orientated so that the distal end portion 102 is directed toward the second fitting 24. An interior surface 106 of the plug 92 has a first portion 108 of constant inner diameter, and a contiguous second portion 110 of progressively increasing outer diameter. More particularly, the surface of the portion 110 is arranged to seat an exterior surface of the conical

portion 96 of cervical funnel 90. Thus the increase in inner diameter of the surface of portion 110 is substantially the same as the angle of increasing diameter of the outer surface of conical portion 96.

[0173] FIG. 15 depicts an optional handle 120 incorporated in embodiments of the manipulator 10. The handle 120 comprises a grip 122 and a contiguous extension 124. The extension 124 is provided with a through hole 126 and a screw thread 128. The screw thread 128 extends from approximately the location of the hole 126 to an end 130 of the handle 120. The through hole 126 is dimensioned to enable the tube 12 to pass there through either with a slight interference fit or a small clearance. Thus the handle 120 extends perpendicular to the tube 12. The screw thread 130 is configured to enable coupling with a nut such as a second locking nut 84. The locking nut when tightened on screw thread 128 can then act to clamp the handle 120 to the tube 12. The handle 120 can be applied to any portion of the tube 12 between the end fittings 22 and 24 which is not otherwise covered by other components such as the cervical funnel 90.

[0174] From the above description it will be recognized that dependant on the application at hand the manipulator may take many different forms owing the interchangeability of first and second fittings and the ability to use additional components such as the rod 26, the forceps holder 70, cervical funnel 90 and the plug 92. It is envisaged that a general uterine manipulator system or kit may be provided to surgeons and doctors composed of all or at least a selection of the first and second fitting; together with other components such as the rod 26, forceps holder 70, cervical funnel 90 and the plug 92. In this way the surgeon or doctor will always have at hand various components to enable the performance of many different procedures.

[0175] FIGS. 16a-16d illustrate a further form of a second fitting 24b which primarily differs from the second fitting 24a by the inclusion of an illumination device 140. Features of the fitting 24b that have the same structure or function as the fitting 24a are designated with the same reference numbers. In this embodiment the illumination device 140 is in the form of a ring 142 fitted to or otherwise supported at the distal end 56 of fitting 24b. The illumination device 140 enables light to be emitted from the distal end 56. In one form the ring 140 is a ring of material embedded with one or more light emitting diodes (LEDs) 124. In this embodiment ring 142 may be made from a transparent acrylic resin. Power to the LEDs 144 is provided via a cable 146 that extends through the lumen 64. In the embodiment the lumen 64 may nevertheless be configured to also receive a telescope to enable visualization of the body cavity into which the fitting 24b is inserted. In a variation of the illumination device 140, the ring 142 itself comprises a light guide that receives light from an optical fiber that passes through the lumen 64. Light transmitted through the optical fiber enters and travels about the ring 142 thus enabling the emission of light from the distal end 56.

[0176] FIGS. 17a-17c depict a cervical funnel 90a which differs from the cervical funnel 90 by the provision of a light emitting device 140a enabling the emission of light from distal end 99 and more particularly from the 98 of the funnel 90a. The funnel 90a has essentially the same physical structure as a funnel 90 and accordingly includes a first conical portion 96 and integrally formed tube 94. The lip 98 extends partly about an opening 101 formed at the distal end 99. The illumination device 140a comprises an arcuate transparent body 142a which may for example be made from of a trans-

parent acrylic resin. Coupled to the body 142a is an optical fiber 146 which is arranged to transmit light from a source to the body 142a. The body 142a has a configuration enabling it to be attached to the lip 98 in a manner so as to form a substantially continuous surface of the lip 98. The optical fiber 146 extends can through a channel or hole 148 formed in the funnel 90a. In one embodiment, a channel or groove can be cut in the exterior surface of the body 90a in which the optical fibre 146 is laid. Thereafter the groove can be filled with a resinous material and smoothed, effectively encapsulating the fiber 146 in the funnel 90a. A coupling 148 at the end of the optical fiber 146 enables coupling with a light source or another optical fiber which carries light from the light source. In a variation to the illumination device 140a, the body 142a may have embedded therein one or more LEDs which when provided with electric current either: emit light directly from the body 142a; or alternatively transmit light into the body 122a from which it is emitted. In the event that the body 122a carries one or more LEDs, then the optical fiber 126 is replaced with a wire or cable to provide electrical power to the LEDs.

[0177] FIG. 18 illustrates a manipulator 10 similar to that shown in FIG. 12 but with a modified cervical funnel 90b and a motor 150 arranged to rotate the cervical funnel 90b on, and relative to, the tube 12. The motor 150 is held within a housing 152 which is supported on a bracket 154. The bracket 154 is a squared U shaped configuration with opposed arms. The motor 150 is attached to one of the arms and a clamp 155 attached to the other arm. The clamp 155 can be operated to selectively grip and release the tube 12. When the clamp 155 is tightened it grips the tube 12 preventing axial or rotational motion of the tube 12.

[0178] The cervical funnel 90b is provided with a wave like outer surface profile on its tube 94 as depicted most clearly in FIG. 19. Successive troughs 156 and peaks 158 of the wave like profile act as rounded gear teeth about the periphery of tube 94b. These engage with a complementary shaped annular gear 160 driven by the motor 150. When the motor 150 is energized it rotates the gear wheel 160 and, due to its engagement with the outer surface of the tube 94b, causes the funnel 90b to rotate about and on the tube 12. Due to the manner of engagement of the motor 150 with the outer surface of the tube 94, the funnel 90b can be slid linearly along the tube 12 while maintaining engagement with the motor 150. The bracket 154 is attached to an arm 162 that in turn can be clamped on to a stable support such as an operating table. A foot controlled switch 164 communicates with the motor 150 via a cord 166. A surgeon is able to operate the motor 150 by the foot operated switch 164. The motor may be in the forms of a bi-directional stepper motor and the switch arranged to control the direction of rotation. The illuminating device 120a depicted in FIGS. 17a-17c may also be incorporated with the funnel 90b.

[0179] FIGS. 20a-20c illustrate variations of a medical instrument that may be used with the manipulator 10. In FIG. 20 the medical instrument 170 comprises in effect the second fitting 24a or 24b formed back to back and integrally with the cervical funnel 90 or 90a. The second fittings 24a, 24b differs slightly from those previously described in that they do not comprise a thread portion 48 but rather have a through hole at their proximal end 172 that communicates with the tube 94. Instrument 170 may be considered as comprising a body 174 provided with opposite first and second end portions 176 and 178. First end portion 176 has a first opening 180 and the

second end portion **178** has a second opening **182**. A through-way **184**, constitute by the tube **94** extends between the first and second openings **180** and **182** and is arranged to enable the body **174** to be supported on a shaft such as the tube **12**. With reference to FIG. **1a**, if the end of the manipulator **10** provided with the cervical screw **24** is taken as the leading end, then the instrument **170** can be supported on the tube **12** with either of the first and second end portions **176**, **178** at the leading end of the manipulator **10**. Whichever of the end portions **176** or **178** is at the leading end will be inserted into the body cavity during a medical procedure.

[**0180**] In the embodiment in FIG. **20**, it can be readily seen that the end portions **176** and **178** differ in one or more of their shape, size and configuration. In particular in FIG. **20**, the end portions **176** and **178** differ in at least their shape and configuration. End portion **176** has an outer diameter **D1** measured in a plane of the opening **180** while the end portion **178** has an outer diameter **D2** measured in a plane containing opening **162**. In this embodiment **D1** may equal **D2** or alternatively **D1** and **D2** may be different.

[**0181**] FIG. **21** illustrates an alternate form of medical instrument denoted as **170a** comprising an opposite first and second end portions **176a** and **178a** respectively joined by an integral tube **94**. Each of the portions **176a** and **178a** is of the general configuration of the portion **178** described in FIG. **20** but with different outer diameters **D1** and **D2**. In particular in this embodiment **D1** is less than **D2**. Instrument **170a** would be used in substantially the same manner as the second fitting **24a** or **24b**. However having the two end portions of different diameters **D1** and **D2** allows a medical specialist to simply use the end of instrument **170a** which is dimensioned for the best suit the body cavity into which it is to be inserted.

[**0182**] FIG. **22** illustrates a form of the medical instrument **170b** in which the first and second end portions **176b** and **178b** are both of the same general frusto conical configuration as the first end portion **176** in FIG. **20**. The difference between the end portion **176b** and **178b** being their respective outer diameters **D1** and **D2**. In this specific embodiment **D1** is greater than **D2**. When the instrument **170b** is used with the manipulator **10** a medical specialist orientates the instrument **170b** with the end portion **176b** or **178b** at the leading end determined on the basis of the best match of outer diameter **D1** or **D2** to the vagina in to which it is to be inserted.

[**0183**] The instruments **170-170b** may be considered to be double ended instrument as each of the end portions **176-176b** and **178-178b** is configured to be inserted in a vagina or rectum. FIGS. **23a-23c** illustrate a further form of double ended instrument **200** for insertion into a body cavity. Double ended instrument **200** comprises a body **202** having a first probe **204a** and a second probe **204b** (referred to in general as "probe(s) **204**") at one end **206** and an opposite end **208** respectively of the body **200**. The same reference numbers will be used to denote the same features of each probe. Reference number that includes the suffix "a" relate to the features of probe **204a**; reference the number that includes the suffix "b" relate to the features of probe **204b**; and reference numbers with no suffix "a" or "b" refer the feature in general pertaining to either probe **204a** or **204b**.

[**0184**] The first probe **204a** has a cylindrical portion **210a** of a first circumferential surface **212a** having an outer diameter **Da**. Probe **204a** is also provided with a first circumferential edge **214a** at the first end **206** and a first lip **216a** projecting outwardly from the outer circumferential surface **212a** and beyond the first circumferential edge **214a**. The first

lip **216a** extends for a part of the circumference of the edge **214a**. The lip **216a** may extend for between 100-130° of the circumference. This is akin to the angle  $\alpha$  and the angular extent of the lip **98** shown in FIG. **13c**.

[**0185**] The second probe **204b** has the same general configuration as the probe **204a** but with several differences including in dimensions of various aspects. The probe **204b** has a cylindrical portion **210b** with an outer circumferential surface **212b** having an outer diameter **Db**. At the end **208** the probe **204b** is formed with a second circumferential edge **214b** and a second lip **216b**. The second lip **216b** projects outwardly from the outer circumferential surface **212b** and beyond the second circumferential edge **214b**.

[**0186**] In this embodiment the diameters **Da** and **Db** are different from each other. In particular **Da** is  $>Db$ . In one example the diameter **Da** is about 40 mm while the diameter **Db** is about 30 mm. A further difference in the dimensions and configuration of the probes **204a** and **204b** is that the lip **216b** projects at a greater angle  $\theta$  with respect to its corresponding adjacent second outer circumferential surface **212b**. As a result the lip **216b** is inclined at a shallower angle to a central longitudinal axis of the instrument **200** than lip **216a**. In a general sense, each of the lips **216** projects at an angle  $\theta$  relative to its adjacent circumferential surface **212** where  $\theta$  is in the range of 130°-160°. This is akin to the angle  $\theta$  of the lip **98** shown in FIG. **13b**. However in this specific embodiment the angle of projection of the lip **216a** is about 140° whereas the angle  $\theta_b$  for the lip **216b** is about 154°.

[**0187**] A further difference between the probes **204** is the axial difference by which each of the lips **216** project in the axial direction. The lip **216a** which is inclined at a steeper angle than the lip **216b** projects in an axial direction from a location immediately adjacent the outer circumferential surface **212a** by a length **La**. The length **La** is different to and shorter than the length **Lb** of axial extent of the lip **216b**. In one specific example, the distance **La** may be in the order of 9 mm where the distance **Lb** may be in the order of 13 mm.

[**0188**] Probe **214a** is provided with an internal cavity **220a** of circular cross section and having an inner diameter **222a**. The outer circumferential edge **214a** is formed by tapering or flaring the material of the probe **204a** at the end **206**. The angle of the taper is shown as angle  $\beta$  in FIG. **23b** and may lie in a range of 110°-140°. However in this specific embodiment flaring angle  $\beta$  is 130°.

[**0189**] The internal configuration of the probe **204b** is generally the same as that of probe **204a** but with different dimensions. Specifically, the probe **204b** has an internal cavity **220b** with an internal diameter **222b** which is not the same as and more particularly smaller than the internal diameter **222a**. In one example the diameter **222a** is about 35 mm and the diameter **222b** is about 35 mm. The probe **204a** at the end **208** is also tapered to reduce in thickness at an angle  $13b$  which is different to and in this embodiment less than the angle  $\beta_b$ . In one example, the angle  $\beta_b$  may be 116°.

[**0190**] The probe **200** is formed so that the lips **216** have respective circumferential mid points **224a** and **224b** that are in axial alignment. Thus when one probe **204** is inserted into a body cavity with the other probe outside of the cavity, a surgeon is able to easily visualize the position of the lip on the inserted probe by simple reference to the position of the lip of the non-inserted probe. The arcuate extend of the lips **216**, i.e. the angles  $\alpha_a$  and  $\alpha_b$  can be arranged to be either the same or different. However in this specific embodiment the angle  $\alpha_a > \alpha_b$ .

[0191] The double ended probe **200** is also formed with an intermediate portion **226** that smoothly transitions between the probes **204a** and **204b**. The probe **226** has a central region **228** which is necked and has an outer diameter less than each of the diameters  $D_a$  and  $D_b$ . Thus, the outer circumferential surface **230** of the intermediate portion **226** has a concave profile. In one example the overall length of the probe **200** is about 230 mm with each probe **204** having a length of 85 mm and the intermediate portion having a length of 60 mm.

[0192] As shown most clearly in FIG. **23b**, the intermediate portion **226** is formed with an internal bore **228** that extends in an axial direction between and providing fluid communication with the first and second cavities **220a** and **220b**. The bore **228** enables the double ended instrument **200** to be supported on the manipulator **10** and in particular the hollow tube **12** in the same manner as the funnel **90** and the medical instruments **170**, **170a** and **170b**.

[0193] In a general sense, the double ended medical instrument **200** comprises a combination of the instrument **170a** shown in FIG. **21** but with the addition of the funnel lips **98** and a reshaping and smoothing of the tube **98** and respective adjacent back ends of the portions **176a** and **178a**.

[0194] FIGS. **24a-24c** depict a further embodiment of a double ended medical instrument. In this embodiment the double ended medical instrument is denoted by the reference number **300**. The medical instrument **300** is a modified form of the medical instrument **200**. All features of the medical instrument **300** that are the same as those of the medical instrument **200** are denoted with a reference number incremented by 100. For example, the probes of the medical instrument **300** are denoted by the numbers **304a** and **304b**, the lips are denoted by the reference numbers **316a** and **316b** and the intermediate portion is denoted by the reference number **326**. Also as with the numbering convention for the instrument **200**, reference number that includes the suffix "a" relate to the features of probe **304a**; reference the number that includes the suffix "b" relate to the features of probe **304b**; and reference numbers with no suffix "a" or "b" refer the feature in general pertaining to either probe **304a** or **304b**.

[0195] The double ended medical instrument **300** differs from the double ended medical instrument **200** solely by the provision of a platform **350a** on the probe **304a**; and a platform **350b** on the probe **304b**. Platform **350a** has a constant first outer diameter extending over the cylindrical portion **310a**. More particularly, the platform **350a** has an outer circumferential surface **352a** that is concentric with the outer circumferential surface **310a** but of a greater radius. The platform **350a** extends rearwardly from the outer circumferential edge **318a** of the corresponding lip **314a**. Also in this example the circumferential extent of the platform **350a** is the same as that of the underlying lip **316a**. The platform **350a** extends in an axial direction toward the second probe **304b**. Thereafter, the platform smoothly transitions from its rearward edge **354a** to the circumferential surface **310a**. This transition forms a ramp **356a** between the outer circumferential surfaces **352a** and **310a**. Opposite sides **356a** and **358a** of the platform **350a** transition smoothly to the outer circumferential surface **318a**. Indeed rounded surfaces can be provided between the outer circumferential surfaces **352a** and the sides **356a** and **358a**.

[0196] In this embodiment, the length  $P_a$ , that is the axial length of the platform **350a** is in the order of 20 mm. While this distance may be varied and in particular extended the significance of the 20 mm length will be described in greater

detail below. Suffice to say that it is possible to increase this length to say 30 or 40 mm and have tactile markers for example circumferential ridges or circumferential grooves at various set distances or lengths such as 20 mm, 25 mm, 30 mm, 35 mm.

[0197] The platform **350b** is of the same general shape and configuration as the platform **350a**. However the radius of the platform **350b** is different to and in this embodiment smaller than the radius of a platform **350a**. Further, as the lip **314b** is formed with a smaller arc angle  $\alpha_b$ , the circumferential width of the platform **350b** is smaller than that of platform **350a**. However, the axial length  $P_b$  of the platform **350b** in this embodiment is the same as the length  $P_a$ .

[0198] Each of the double ended medical instruments **200** and **300** maybe used in laparoscopic gynecological surgery and in particular, for laparoscopic hysterectomy. The instrument **200** may be considered as a "standard" model and the instrument **300** as an "oncology" model.

[0199] Each of the medical instruments **200** and **300** can be slid over the uterine manipulator and in particular the tube **12** as described herein above in relation to the instruments **170**, **170a** and **170b**. The specific probe which is inserted is simply dependent upon the size of the cavity at hand. An advantage or benefit of the instruments **200** and **300** over say the instrument **170b** shown in FIG. **22** is that as the probe **204** or **304** is of a cylindrical shape rather than in the form of a frusto conical funnel, the outer surface **210** can act as a stopper in say the vaginal cavity to prevent leakage of  $\text{CO}_2$  gas. Thus the probes **204** may be considered as integral functional combination of the instrument **170b** shown in FIG. **22** together with respective plugs **92**. In this way the instrument **200/300** can replace the instrument **170b** and respective stops **92** for each of the portions **176b** and **178b** of the instrument **170b**.

[0200] The lips **216/316** function as previously described to present the vaginal vault tissue for incision. After a hysterectomy is performed and the uterus is delivered through the vagina, usually an appropriate sized probe is inserted to prevent  $\text{CO}_2$  leakage. This function is now performed as mentioned before by the provision of the cylindrical probes **204/304**. A suture needle can be placed in the cavity **220/320** of the inserted probe **204** to be picked up by a laparoscopic needle holder to subsequently suture the vaginal vault.

[0201] The instrument **300** by virtue of the provision of the platforms **350** may be used in oncology procedures relating to cervical cancer. When cervical cancer is detected in the early stages, common procedure is to remove a 20 mm cuff from the vagina to adequately excise cancer tissue. Usually there is no indicator of how much margin is incise apart from the surgeon's subjective perception of adequate cuff removal. The instrument **300** provides a platform **350** of known length for example 20 mm to indicate to the surgeon the line of incision to remove an adequate margin of vaginal cuff. By rotating the lip **314** the vaginal margins are freed from the bladder anteriorly, the uterine vessels laterally and the rectum posteriorly, ensuring that these important structures are clear from the vaginal cuff before the vaginal incisions are made. The principles and functions of the instrument **300** is the same as the standard instrument **200** after the uterus and cervix is removed.

[0202] To the best of the Applicant's knowledge there is no vaginal marker colpotomizer available to accurately measure the vaginal margin of clearance that is required for gynecological oncology cases both in laparoscopy and open incision or laparotomy surgery. If too much vaginal tissue is removed

the shortened vagina will make intercourse uncomfortable. Conversely, inadequate margins will result in cancer recurrences. Current practice is to gauge the depth of vaginal margin by estimation, and every surgeon has their own estimation method. Embodiments of the instrument 300 provide an accurate measuring tool for adequate vaginal margin removal to ensure the patient has the best clearance result and the best chance to have a functioning vagina. The platforms 350 provide a hard surface to push away the bladder anteriorly and the rectum posteriorly. The lips 314 ensure adequate ureteric displacement. The vagina is dissected at the edge of the platform 250. This can be performed in a number of different ways including but not limited to:

- (a) a knife cutting along the end of the platform 350;
- (b) cautery or cutting current being applied by a hook electrode or sharp scissors to the edge of the platform 350;
- (c) harmonic scalpel energy to incise the vagina at the edge of the platform 350;
- (d) a recessed trough at an edge of the platform 350 to guide vaginal incisions;
- (e) by providing a hole near an edge of the platform 350 into which an electrode, monopolar or bipolar is inserted. In this event by rotating the instrument 300 the vagina is incised by the energy source being applied.

[0203] FIG. 26 depicts one end only of a further embodiment of a double ended medical instrument 300' which differs from the instrument 300 by virtue of its platforms 350' and the lips 314' that extend for the full circumference of the respective probe 304'. (The opposite end of the instrument 300' is of the same general configuration as shown in FIG. 26 but with the probe 304' at that end being of a different dimension akin to the differences between probes 204a and 204b; or 304a and 304b.) The instrument 300' can be used in laparotomy or open surgery. In these cases, the platform can be directly palpated hence there is no need to rotate the lip 314'/platform 350' to visualize the margin as in laparoscopic surgery. By a direct palpation the vaginal margin is reflected before incisions are made to remove a desired length of vaginal cuff, for example 20 mm.

[0204] As mentioned hereinbefore, the platform of the instrument 300 or 300' used in laparotomy or open surgery can be provided with an axial length P greater than say 20 mm with palpable markings such as circumferential ridges or grooves at set lengths or distances to provide an indication of a precise length of vaginal cuff for incision. This is shown for example in FIGS. 24d-24g where markings M1-M4 are provided on the platform 350 at spacings of 20 mm, 25 mm, 30 mm, and 35 mm from the outer edge of associated lip 316. In FIG. 24e the markings M are ridges, in FIG. 24f the markings M are grooves, and in FIG. 24g the markings M comprise sets of immediately adjacent circumferential grooves and troughs. The double ended medical instrument with the platform and lip that extend wholly about the respective probes 304 may be termed as the laparotomy double ended instrument.

[0205] In the case of sacrocolpopexy where the bladder and rectum are reflected back to facilitate placement of mesh on the vagina, the platforms 350/350' in both the oncology and laparotomy double ended medical instrument provide a solid dissecting base. However in the event of use of the oncology double ended medical instrument 300 rotation may be required in order to place the platform 350 in the appropriate location. Clearly no rotation is required for the laparotomy double ended medical instrument 300'.

[0206] A double ended plug 370 shown in FIG. 25 can be used with the either of the standard, oncology or laparotomy double ended medical instrument. The plug has an axially aligned and opposite cylindrical stems 372 of a diameter that provides a light interference fit with the inner circumferential surface at one end of the bore 228,328 of the intermediate portions. Between the stems 372 is a large diameter cylindrical portion 374 and an intermediate diameter cylindrical portion 376. The portion 374 is dimensioned to form a light interference fit with the cavity 220a, or 320a; and portion 376 is dimensioned to form a light interference fit with the cavity 220b, 320b of the probes 204b or 304b. The plug when fitted into the corresponding end of the medical instrument forms a fluid seal at that end of the seal. Naturally the plug 370 can only be used when the double ended instrument is not supported on the manipulator 10. It is envisaged that the plug 300 would be used to assist in maintaining pneumoperitoneum when the double ended instrument is used without the manipulator 10. In exactly the same way the plug 370 can be used with any one of the instrument s, 170, 170a and 170b shown in FIGS. 20-22.

[0207] FIGS. 27a-27d illustrate a further variations to the cervical funnel 90c. The funnel 90c is of the same general shape and configuration and works in the same way as funnel 90, but differs by the provision of a through hole 190 in the lip 98. The through hole 190 is provided mid way along the arc of the lip 98. Optionally the funnel 98 may also comprise an illumination device 192. In this embodiment the illumination device 192 is in the form of an annular light guide coupled to an optical fiber. The annular light guide 192 surrounds the through hole 190. When the optical fiber is coupled to a light source the light is guided by the fiber 194 to the annular light guide and illuminates the annular light guide 192 providing a ring of light about the hole 190. The annular light guide 192 can be in the form a transparent acrylic resin ring. The optical fiber 194 can be embedded/encapsulated in a groove formed along the cervical funnel 90d.

[0208] The hole 190 is dimensioned to receive the tip of an electrical cautery probe. During say a hysterectomy the probe is inserted into the hole 190. It is believed that the hole 190 will ordinarily be easily visible or locatable by a surgeon. However the provision of the illumination device 192 will assist in visually locating the hole 190. The electrical cautery probe is inserted through the vagina wall (which is being lifted by the lip 98) and into the hole 190. By applying electric current and rotating the funnel 90d a very clean and precise circumcission can be made of the vaginal wall to separate it from the cervix.

[0209] The through hole 190 may also of course be incorporated in every other form of cervical funnel described hereinbefore. As can the annular light guide 192.

[0210] Now that an embodiment of the invention has been described in detail it will be apparent to those skilled in the relevant arts that numerous modifications and variations may be made without departing from the basic inventive concepts. For example, in one embodiment, the hydrotubation port 42 is illustrated and described as being formed on the first fitting 22. However in an alternate embodiment, a hydrotubation port may be formed on the tube 12 at a location near first end 16 but beyond the screw thread T1. In one embodiment, the first and second fittings 22, 24 may be formed from a plastics material so as to be disposable after a single use while the elongated hollow tube 12 may be made from surgical grade stainless steel so as to be reusable. Also as would be readily

apparent to one of ordinary skill further double ended instruments may be constructed using combinations end portions or probes shown in FIGS. 20-26 of the same or different size. For example a double ended instrument could comprise: a probe 204a at one end and a probe 304a at another, where the probes are of the same or different outer diameter; a probe 204a at one end and a probe 304a at another, where the probes are of the same or different outer diameter; an end portion 176a at one end and a probe 204b at the other, where the probes are of the same or different outer diameter; etc. All other combinations of the currently disclosed probes and end portions are possible. All such modifications and variations together with others that would be obvious to persons of ordinary skill in the art are deemed to be within the scope of the present invention the nature of which is to be determined from the above description and the appended claims.

1. A double ended medical instrument arranged for insertion into a body cavity comprising:

a body having a first probe at first end, a second probe at a second opposite end;

the first probe having a cylindrical portion with an first outer circumferential surface of a first diameter, a first circumferential edge distant the first end and a first lip projecting outwardly from the first outer circumferential surface beyond the first circumferential edge and extending for at least a part of a circumference of the first circumferential edge;

the second probe having a cylindrical portion with a second outer circumferential surface of a second outer diameter, a second circumferential edge distant the first probe and a second lip projecting outwardly from the second outer circumferential surface beyond the second circumferential edge and extending for at least a part of a circumference of the second circumferential edge;

wherein the first outer diameter and the second outer diameter are different from each other.

2. The double ended medical instrument according to claim 1 wherein the first and second lips have respective mid-points that are located in axial alignment.

3. The double ended medical instrument according to claim 2 wherein the part of the circumference of the first and second circumferential edges about which the first and second lips respectively extend are the same.

4. The double ended medical instrument according to claim 1 wherein the first probe is provided with a first cavity extending axially from the first circumferential edge toward the second probe and having a first inner diameter.

5. The double ended medical instrument according to claim 5 wherein the second probe is formed with a second cavity extending axially from the second circumferential edge toward the first probe and having a second inner diameter wherein the second inner diameter is different to the first inner diameter.

6. The double ended medical instrument according to claim 1 wherein the first probe is provided with a first platform of constant first outer diameter extending over the first cylindrical portion from a circumferential edge of the first lip toward the second probe.

7. The double ended medical instrument according to claim 6 wherein the first platform is co-extensive in a circumferential aspect with the first lip.

8. The double ended medical instrument according to claim 6 wherein a side of the first platform rearward of the first lip

slopes from the first outer diameter to first outer circumferential surface in a direction toward the second probe.

9. The double ended medical instrument according to claim 6 wherein circumferentially opposite sides the first platform transition smoothly from first outer diameter the first outer circumferential surface.

10. The double ended medical instrument according to claim 6 wherein the second probe is provided with a second platform of constant second outer diameter extending over the second cylindrical portion from a circumferential edge of the second lip toward the first probe.

11. The double ended medical instrument according to claim 10 wherein the second platform is co-extensive in a circumferential aspect with the second lip.

12. The double ended medical instrument according to claim 10 wherein a side of the second platform rearward of the second lip slopes from the second outer diameter in a direction toward the first probe.

13. The double ended medical instrument according to claim 10 wherein circumferentially opposite sides the second platform transition smoothly from second outer diameter the second outer circumferential surface.

14. The double ended medical instrument according to claim 10 wherein the platform has a circumferential surface of constant diameter extending coaxially with the first outer circumferential surface.

15. The double ended medical instrument according to claim 1 comprising an intermediate portion that transitions smoothly between the first and second probes.

16. The double ended medical instrument according to claim 15 wherein the intermediate portion has a central region of an outer diameter less than each of the first diameter and the second outer diameter.

17. The double ended medical instrument according to claim 5 comprising an intermediate portion that transitions smoothly between the first and second probes wherein the intermediate portion is formed with an internal bore the bore extending in an axial direction between the first and second cavities and having an inner diameter smaller than each of the first and second inner diameters.

18. The double ended medical instrument according to claim 1 wherein the first lip and second lip extend for the full circumference of first circumferential edge and the second circumferential edge respectively; the first probe being provided with a first platform of constant first outer diameter extending wholly about the first cylindrical portion from a circumferential edge of the first lip toward the second probe; and the second probe being provided with a second platform of constant second outer diameter extending wholly about the second cylindrical portion from a circumferential edge of the second lip toward the first probe.

19. The double ended medical instrument according to claim 18 comprising an intermediate portion that transitions smoothly between the first and second probes.

20. The double ended medical instrument according to claim 19 wherein the intermediate portion has a central region of an outer diameter less than each of the first diameter and the second outer diameter.

21. The double ended medical instrument according to claim 19 wherein the intermediate portion is formed with an internal bore the bore extending in an axial direction between the first and second cavities and having an inner diameter smaller than each of the first and second inner diameters.