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(54) **SURGICAL INSTRUMENTS**

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(57) **ABSTRACT**

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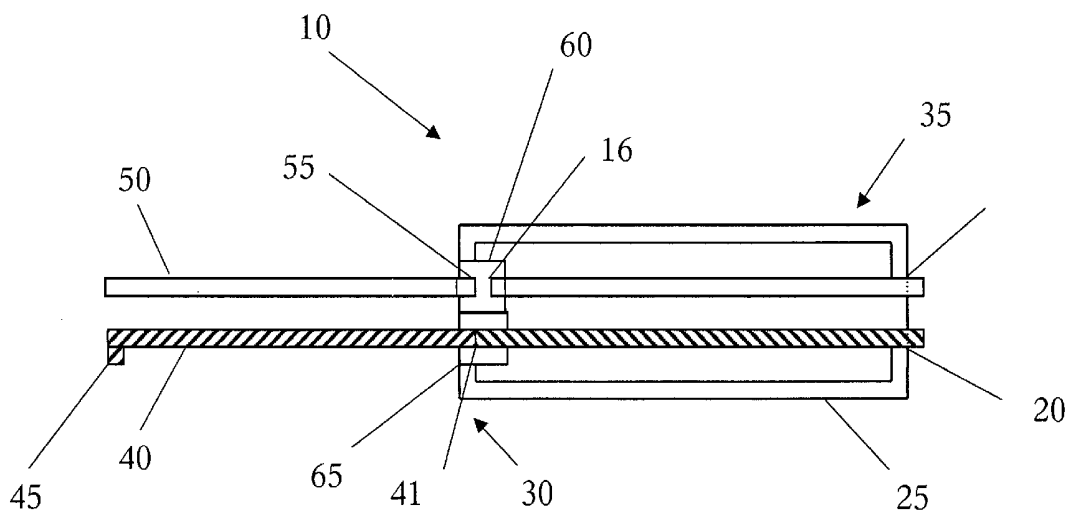
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The invention provides a surgical dissection instrument comprising an electrode suitable for use in electrosurgery and a nozzle for use in generating a pressure jet of liquid wherein the electrode has a proximal end for connection to an electrosurgery generator and an electrode tip at the distal end and wherein the nozzle has a proximal end for connection to a source of pressurised liquid and a distal end at which the pressure jet is generated; and a method of using the instrument.



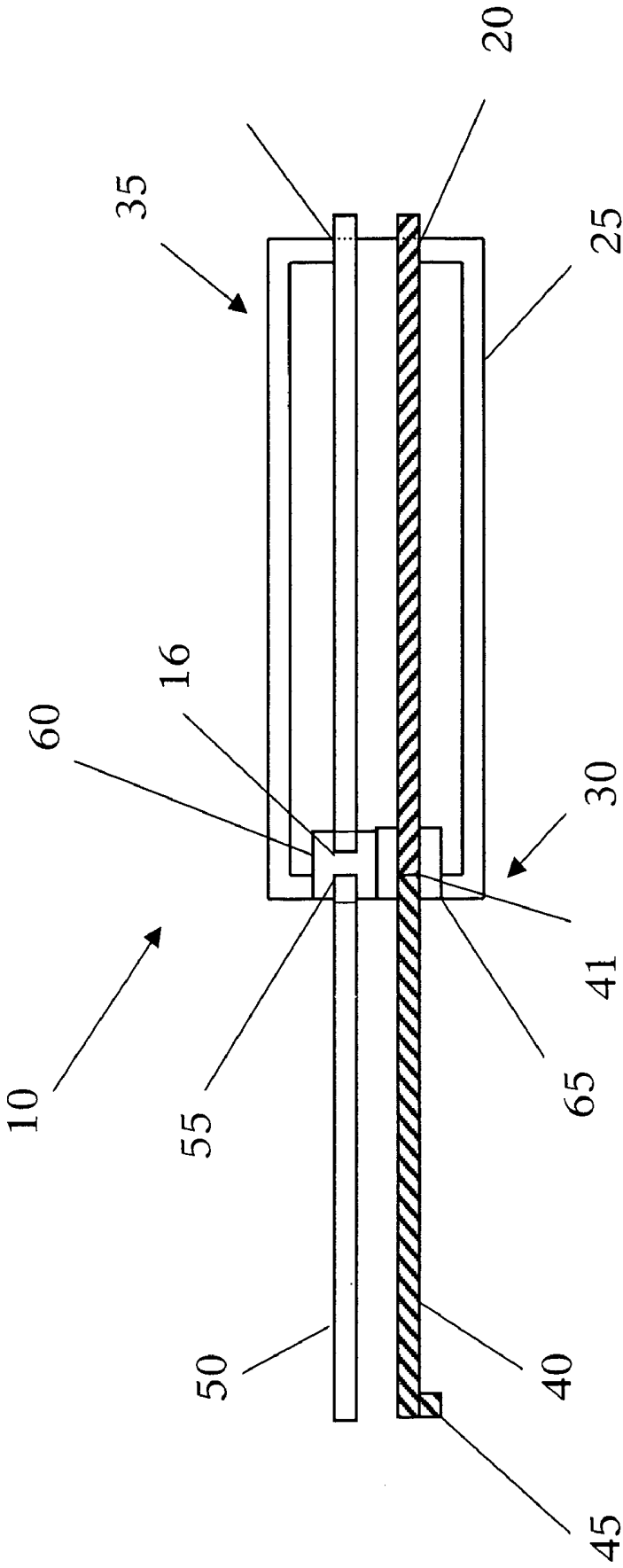


FIGURE 1

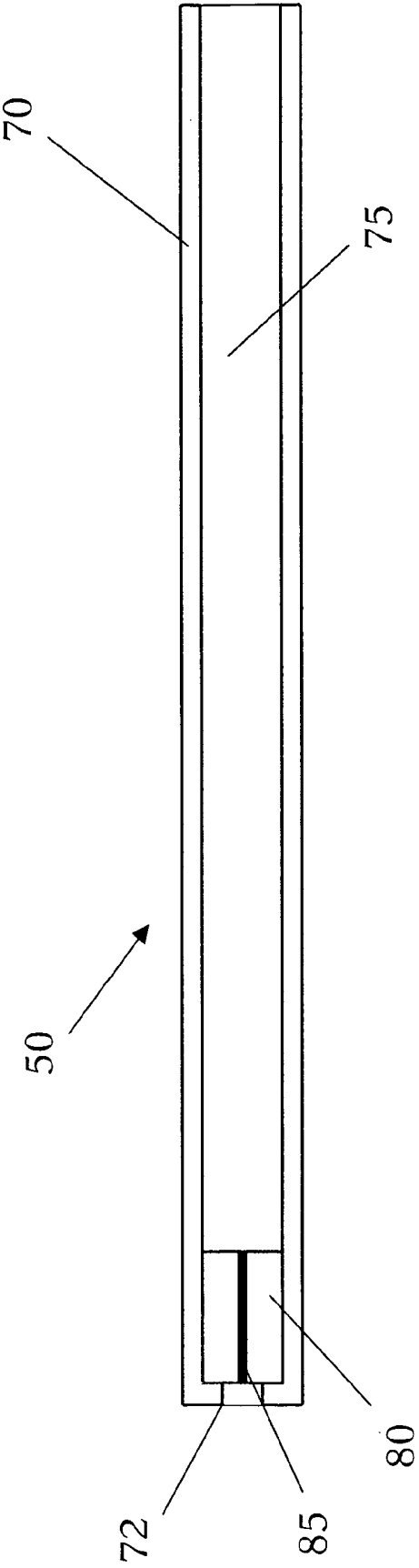


FIGURE 2

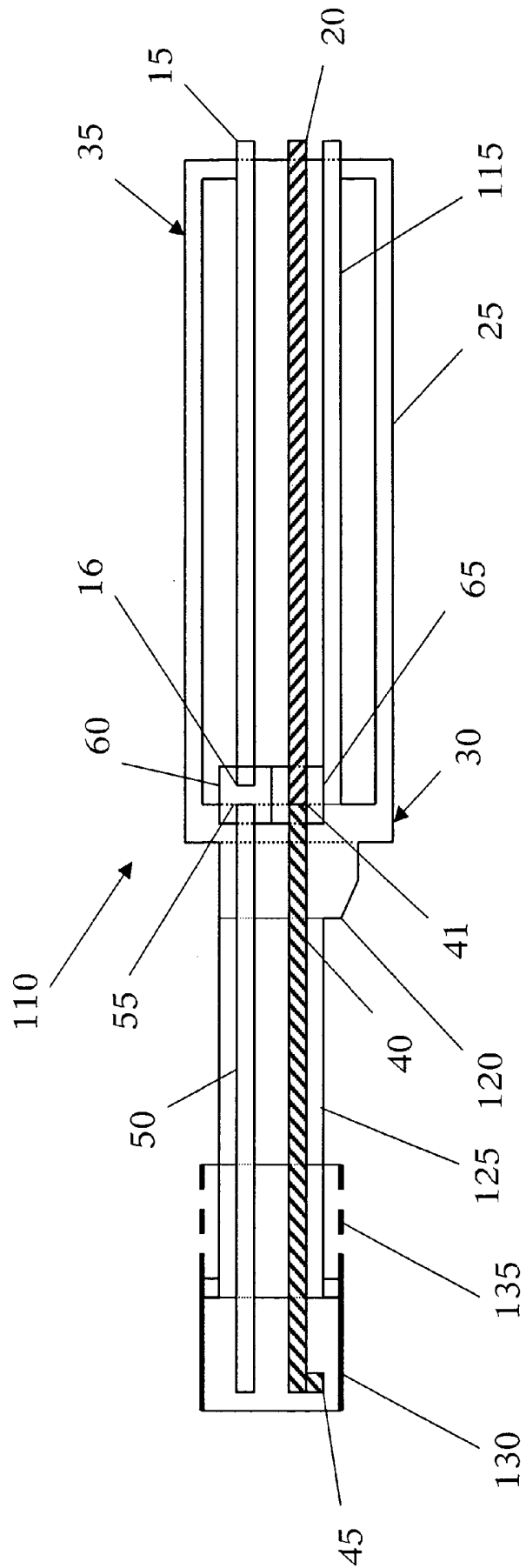


FIGURE 3

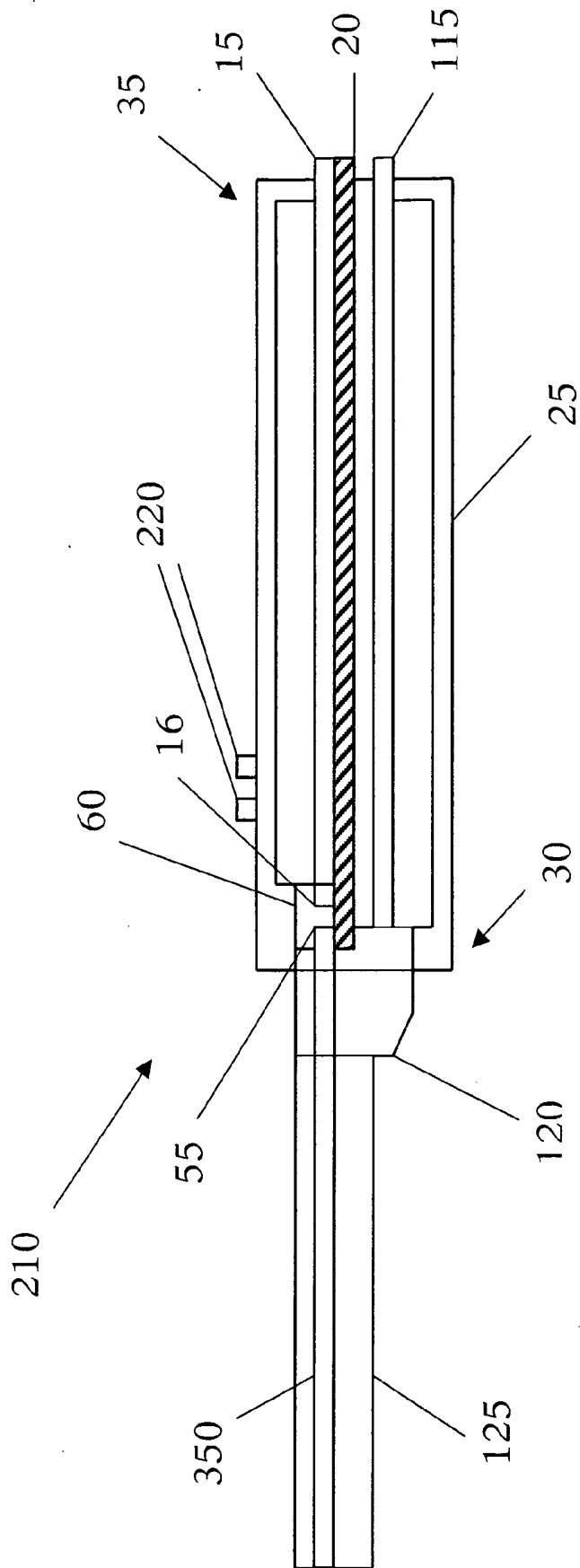


FIGURE 4

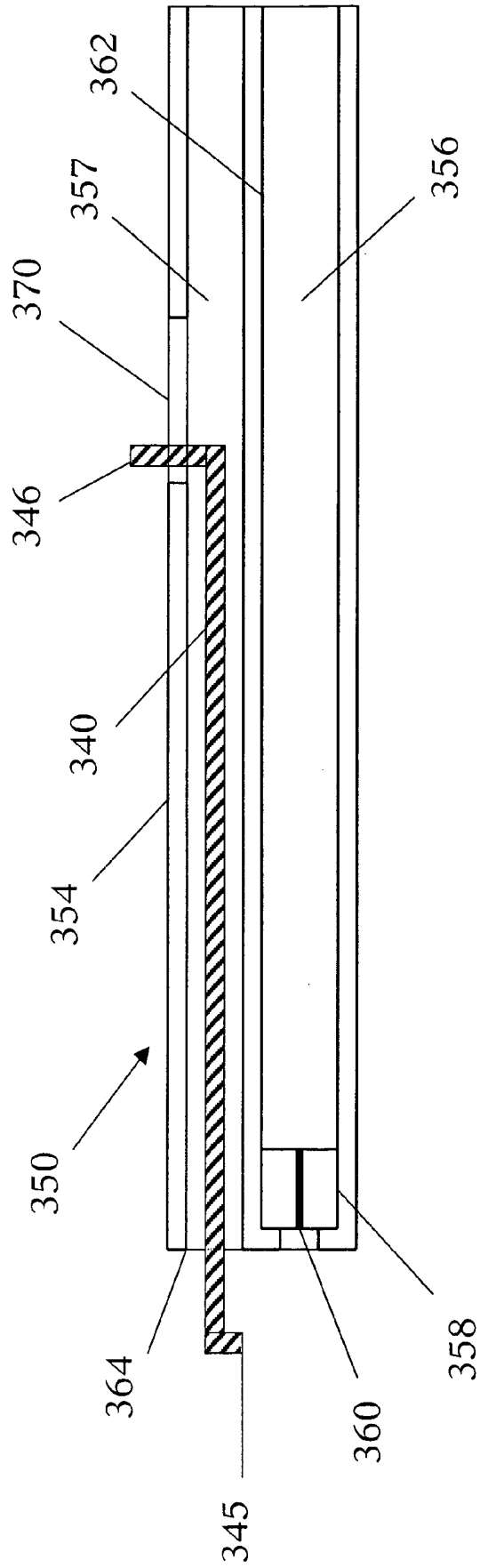


FIGURE 5

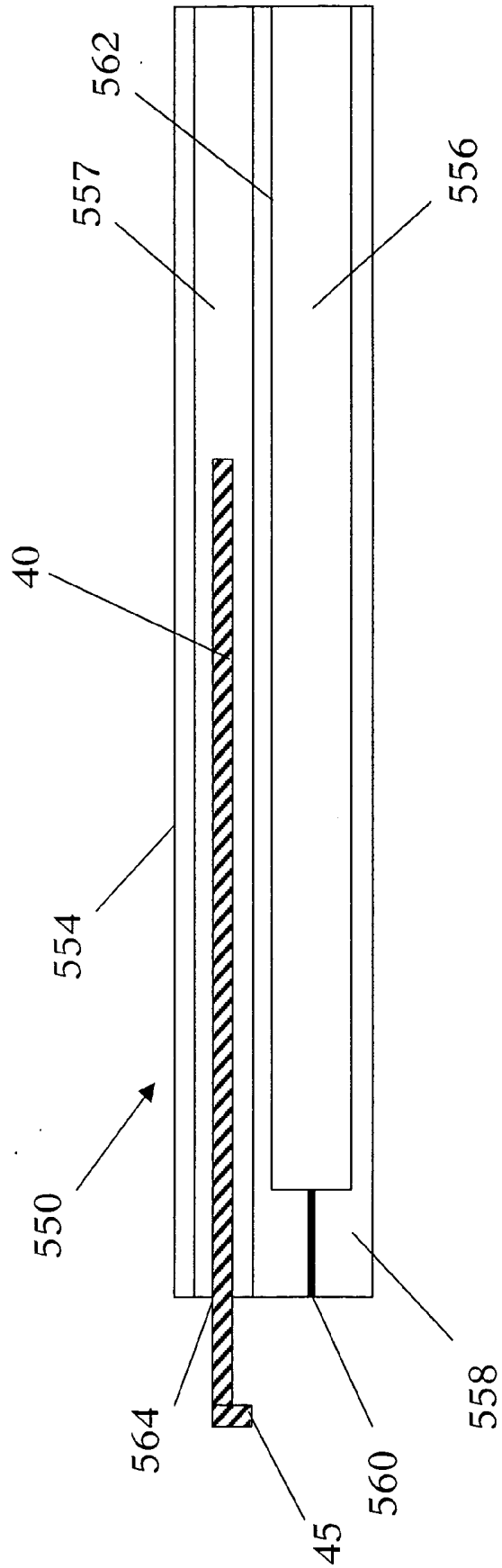


FIGURE 6

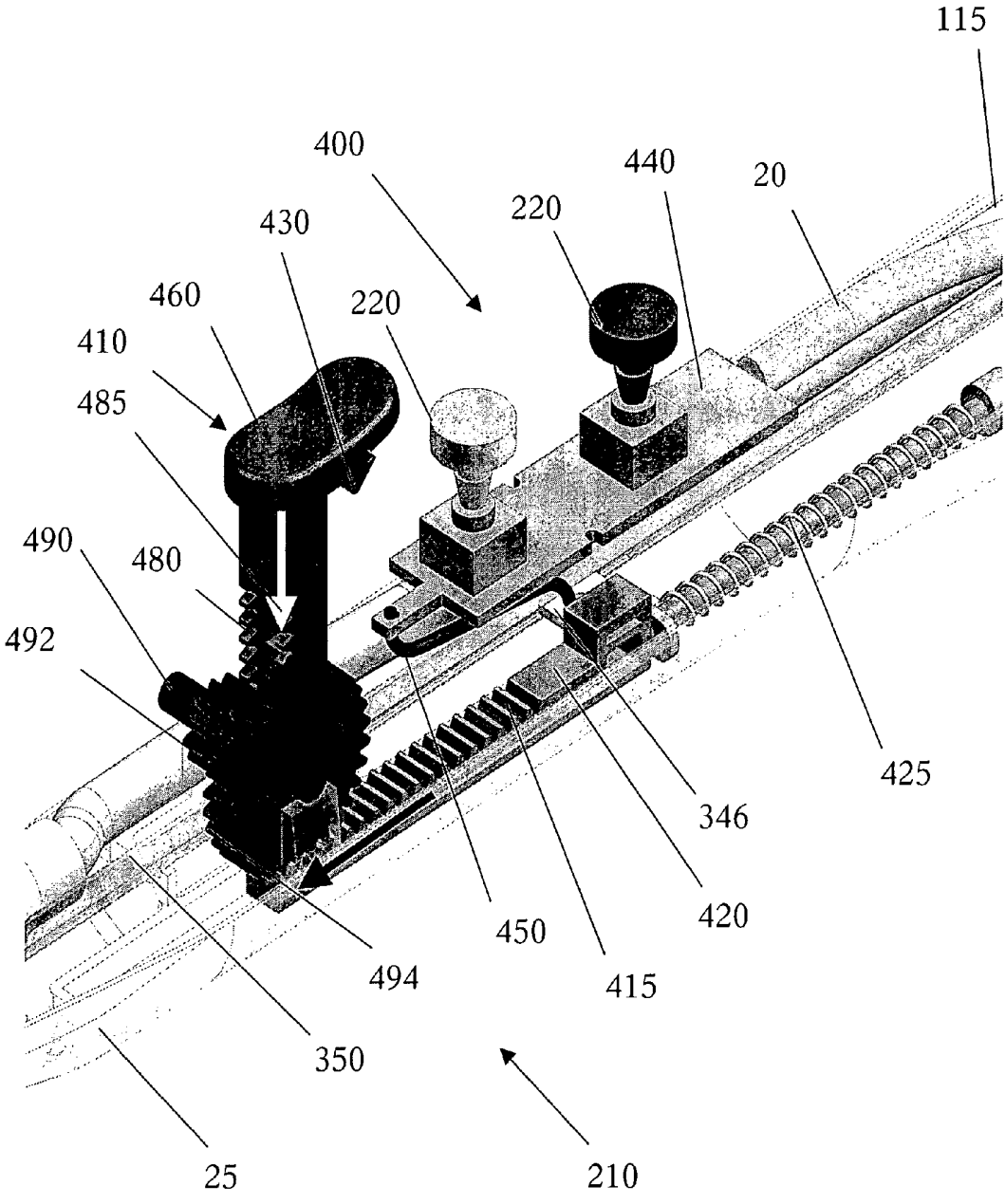


FIGURE 7

FIGURE 8

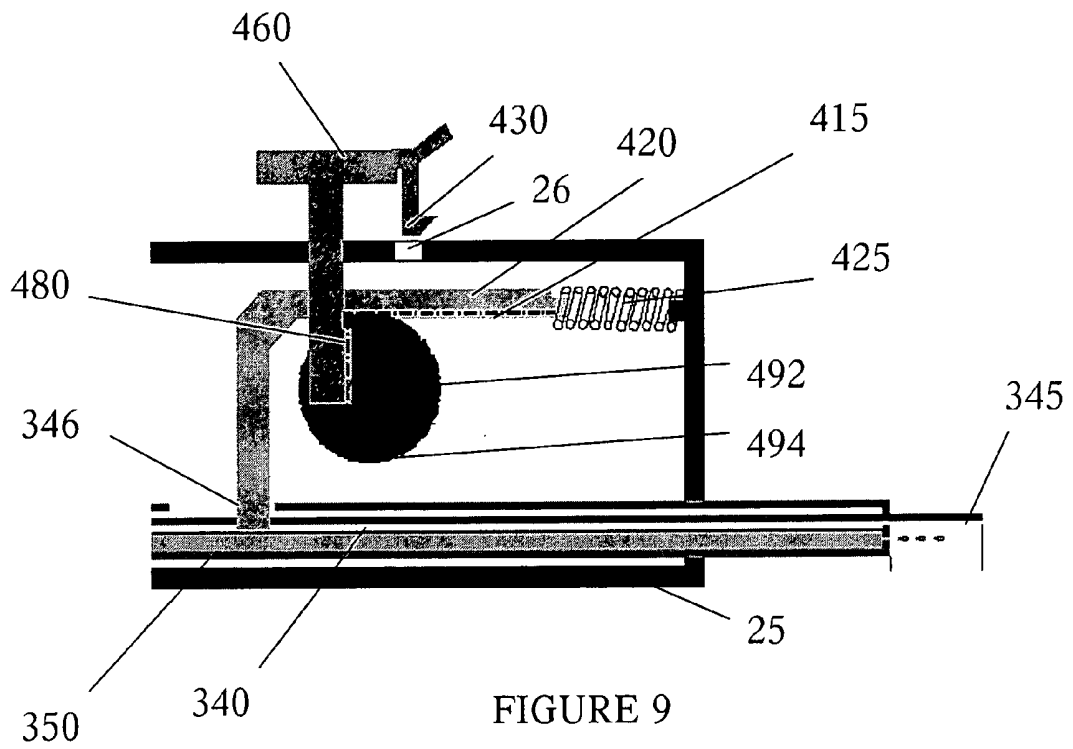
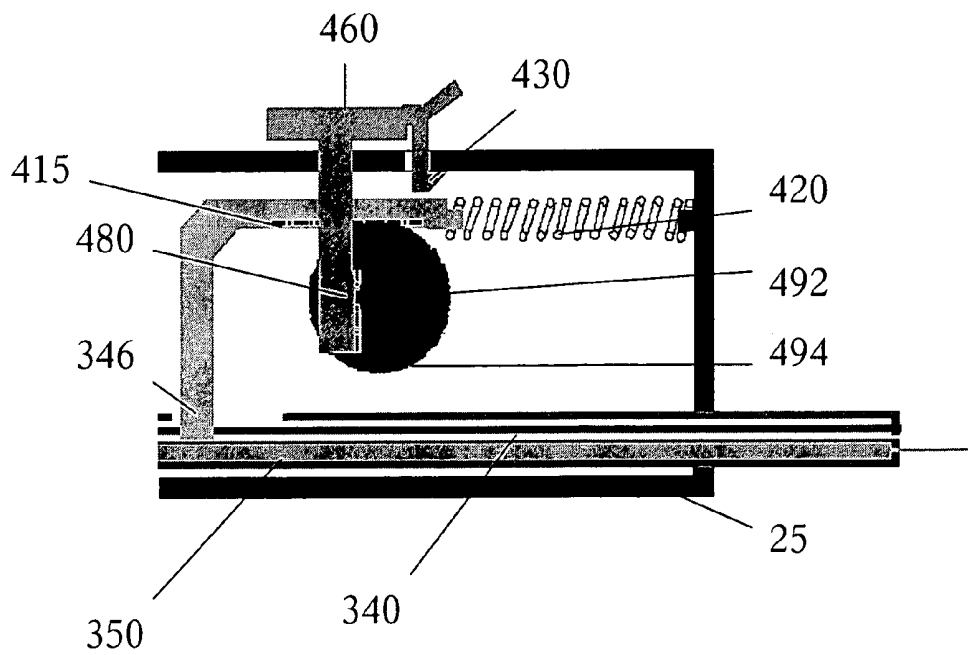


FIGURE 9



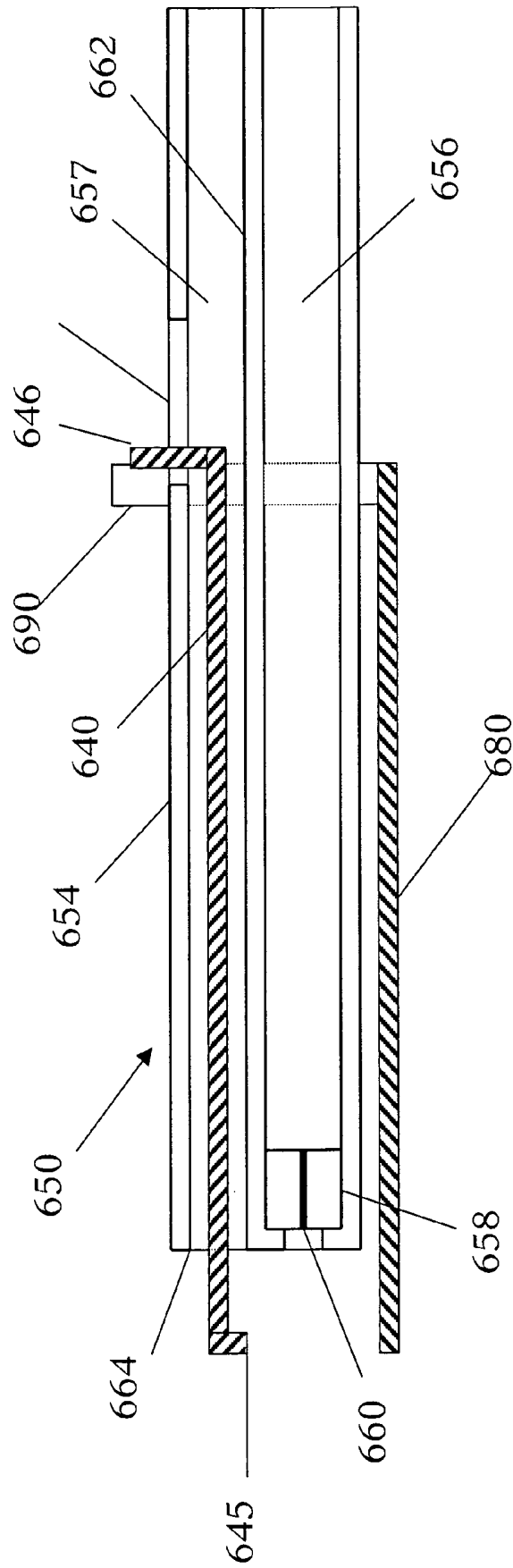


FIGURE 10

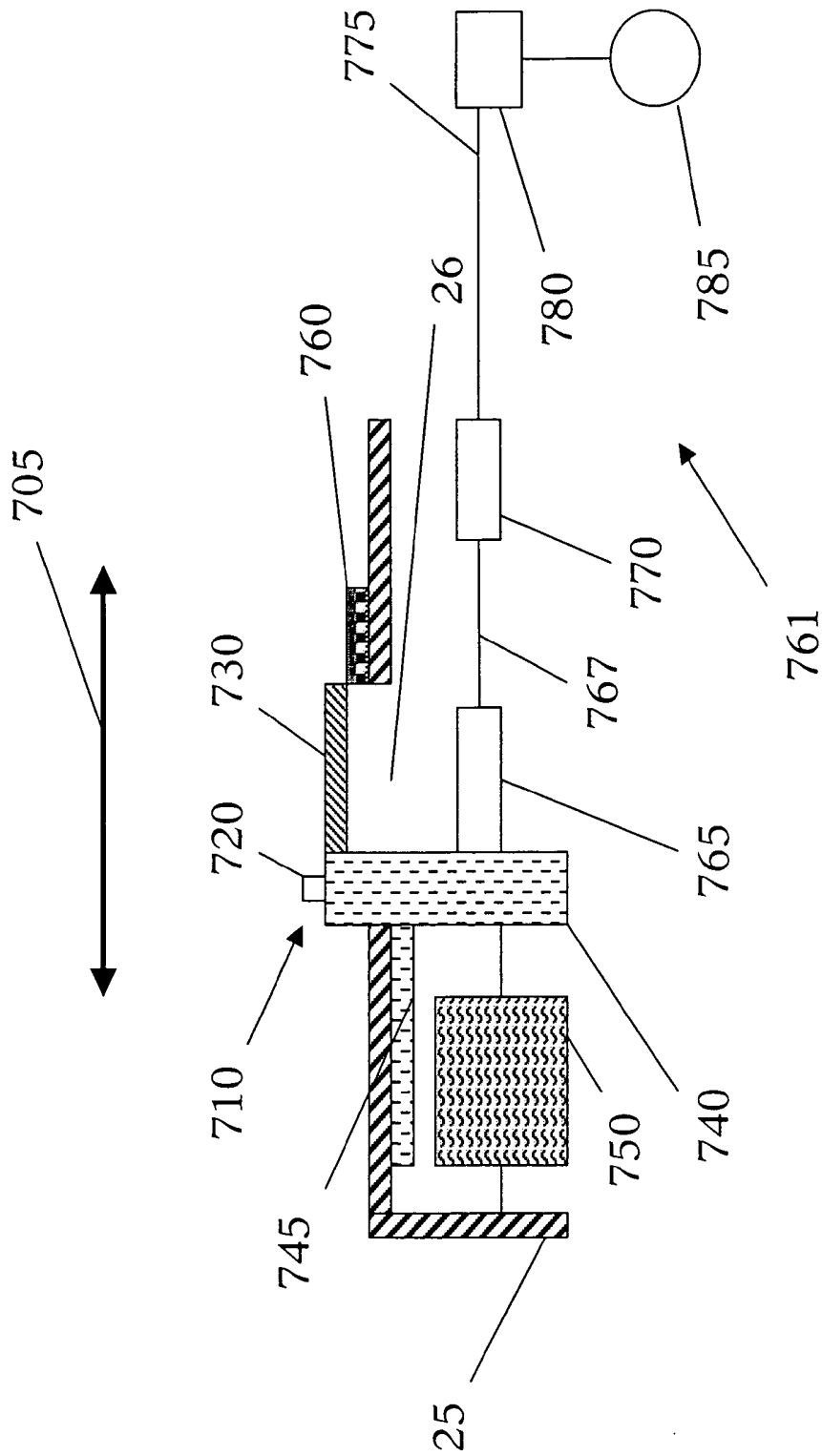


FIGURE 11A

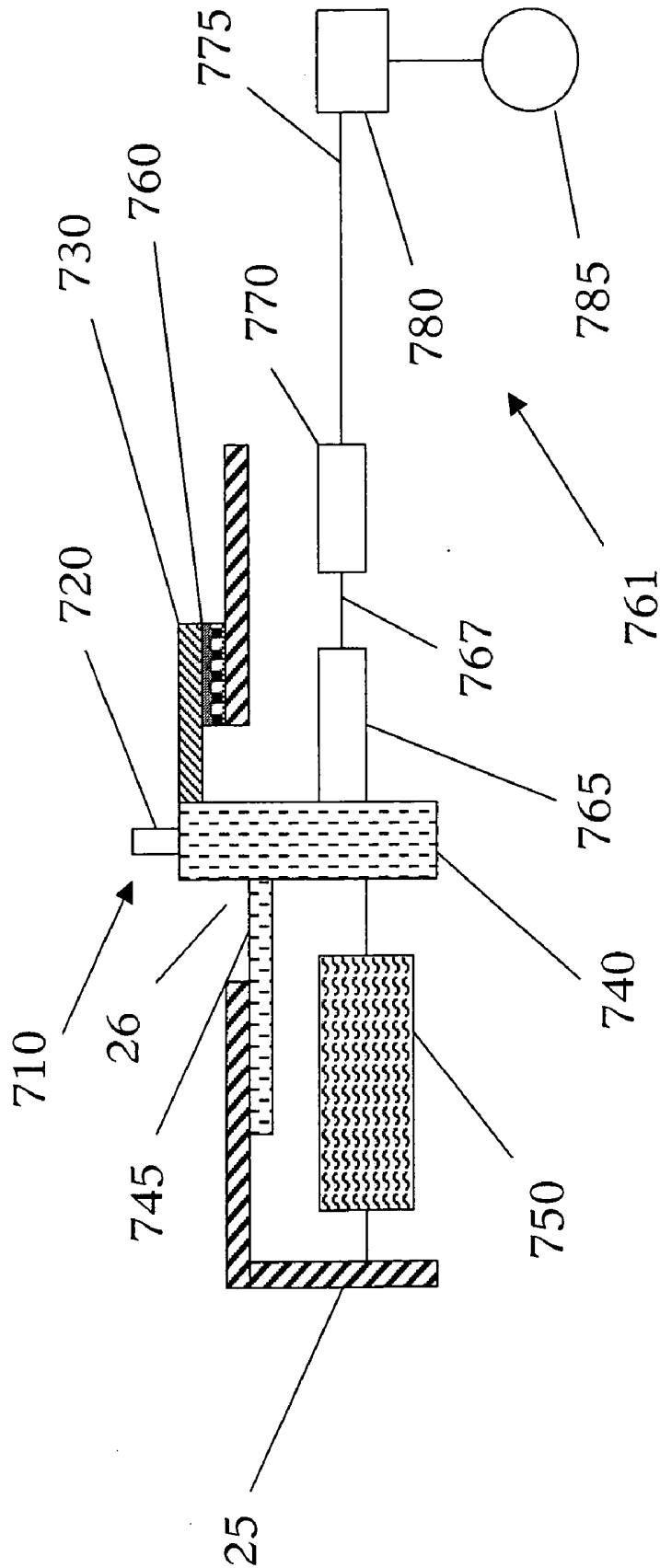


FIGURE 11B

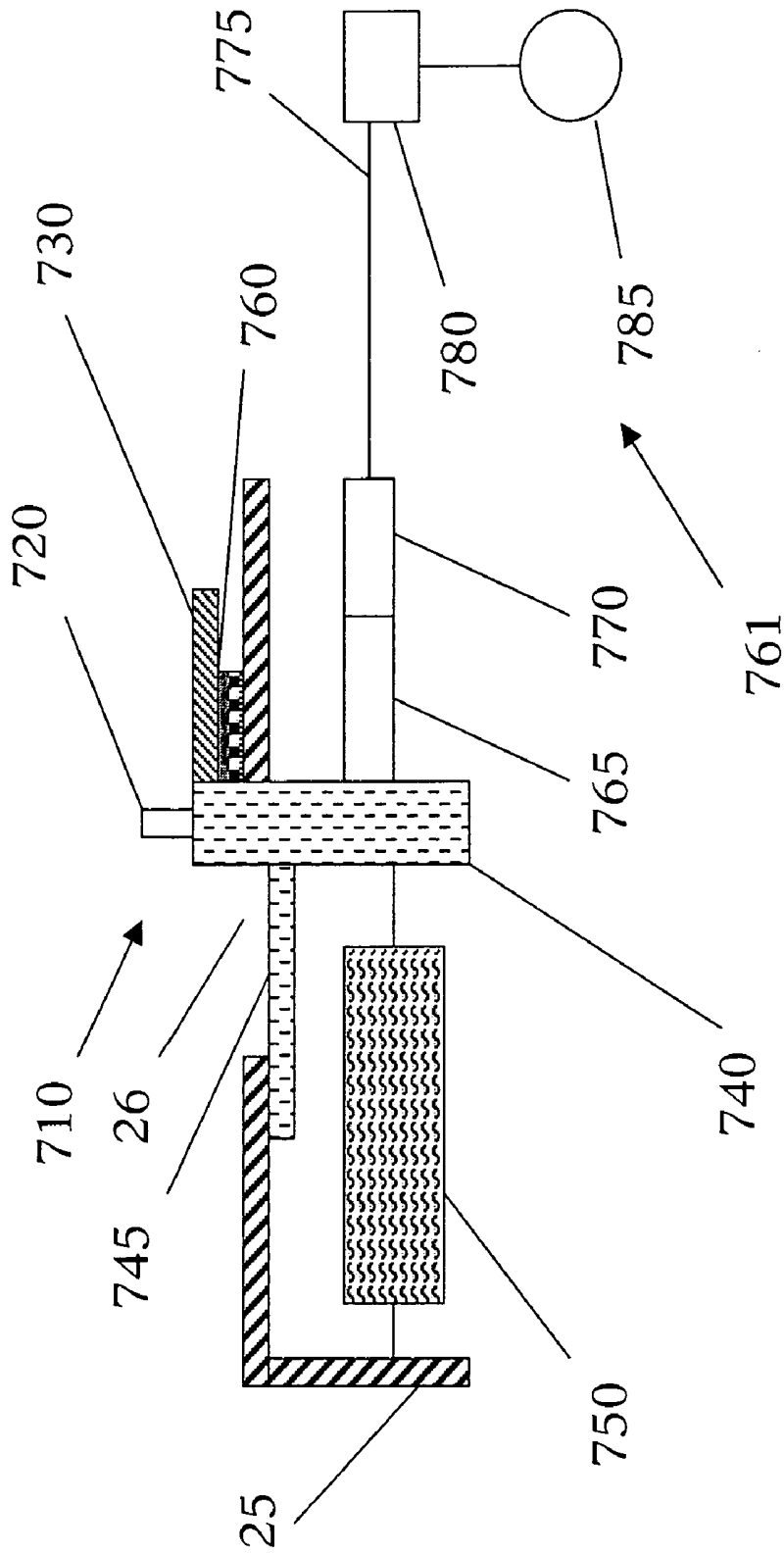


FIGURE 11C

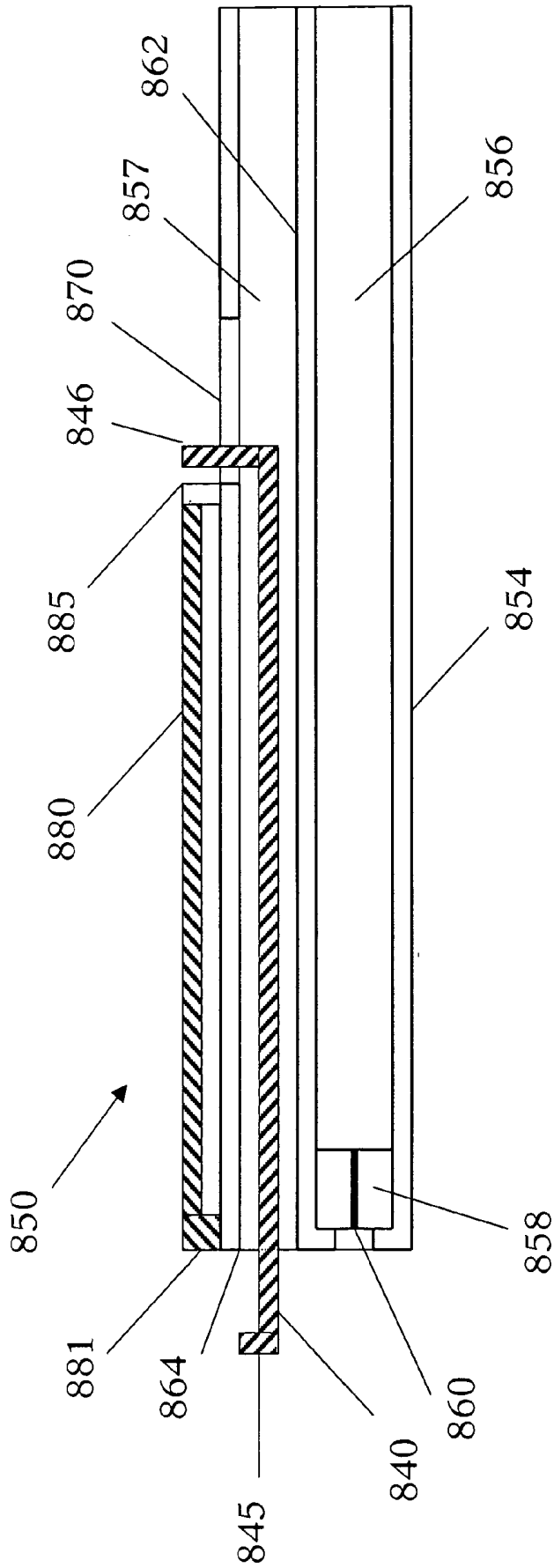


FIGURE 12

## SURGICAL INSTRUMENTS

[0001] The present invention relates to a combined electrosurgery and water-jet hand piece.

[0002] During surgery, a surgeon carries out three principal procedures or interventions: dissection, cutting and coagulation. These three procedures are generally used for about 80% of the duration of a typical surgical intervention. Most of the time, a surgeon uses the dissection procedure with the rest of the time split between cutting and coagulation.

[0003] According to traditional practice, a surgeon will use a water-jet hand piece, a CUSA (a Cavitron ultrasonic surgical aspirator) or scissors and grips for dissection. For cutting, a surgeon will use scissors or an electrosurgery unit. For coagulation, a surgeon will use thread, staples or an electrosurgery unit.

[0004] New surgical instruments have recently been launched which provide combined functionality. For example Johnson & Johnson have a Harmonic Scalpel (registered trade mark) which is an ultrasonic cutting and coagulation device; Valleylab sell their Ligasure (registered trademark) system which is a combined grip and vessel sealing generator; and TissueLink market their FB (registered trade mark) floating ball system which provides coagulation with a fluid delivery system. Thus these new devices, although claiming to have combined functionality, in fact are able to perform only two of the above-noted surgical procedures that may be required during surgery.

[0005] A problem therefore remains with the currently available multi-function surgical instruments in that they fail to provide a surgeon with a single instrument that is capable of performing at least all three of the above-noted typical surgical procedures.

[0006] According to the invention there is provided a surgical instrument adapted to be used to perform at a given time any one of a plurality of surgical procedures which instrument comprises an electrode suitable for use in electrosurgery and a nozzle for generating a pressure jet of liquid wherein the electrode has a proximal end for connection to an electrosurgery generator and an electrode tip at the distal end and wherein the nozzle has a proximal end for connection to a source of pressurised fluid and a distal end at which the pressure jet is output and wherein the electrode and the nozzle are selectively actuatable to perform respective functions to effect different surgical procedures.

[0007] The advantages of the instrument according to the invention include that it provides a single instrument which can be used in the three interventions identified above which are dissection, cutting and coagulation. This is because the pressure jet of fluid generated by the nozzle can be used in a dissection intervention and the electrode can be used in a cutting or coagulation intervention. The fluid used in the invention is preferably a liquid, more preferably water, especially an aqueous saline solution.

[0008] It should be understood that the term "electrode" is intended to cover any electrically conducting implement which is suitable for conducting high frequency electricity. The electrode is generally formed from a material which is physiologically acceptable, for example stainless steel. For example, the electrode could be in the form of a conven-

tional surgical instrument such as forceps. The electrode tip is optionally in the form of a bar, blade, hook or a different form commonly used in the art.

[0009] The nozzle and electrode of the instrument according to the invention are preferably separate. The advantage of such an arrangement is that the nozzle and electrode may be moved in relation to each other. The nozzle is preferably insulated from the pressure jet in the instrument according to the invention. This is useful as a safeguard to protect the patient.

[0010] The instrument according to the invention preferably has an electrode which is moveable relative to the instrument such that the electrode tip can be extended from the instrument in use or retracted to protect the electrode tip. Preferably the instrument has a mechanism which can be operated to extend the electrode tip from the instrument which is generally referred to herein as a switch mechanism. The electrode is preferably moveable mechanically or magnetically. The electrode or switch may be arranged so that the electrode is biased to a retracted position. Alternatively, the switch may be biased to an extended position and provided with a mechanism to lock it in a retracted position. The switch preferably has a first position wherein the electrode is caused to extend from the instrument and a second position where the electrode is caused to be retracted in the instrument. The switch preferably has a third position wherein the electrode is caused to be retracted and wherein in use the source of pressurised liquid is caused to operate such that the nozzle generates a pressure jet of liquid.

[0011] The switch preferably has a pressure jet switch mechanism which is operated when the switch is moved to the third position. The pressure jet switch mechanism is optionally an electrical contact switch mechanism or a pneumatic discontinuity switch mechanism. The pneumatic discontinuity switch mechanism has a tube which is connected, in use, to a source of vacuum or of pressurised gas via a sensor which detects flow rate, pressure or vacuum discontinuity. When pressure jet switch mechanism preferably is a pneumatic discontinuity switch mechanism, it is operated as follows: when the switch is moved to the third position to operate the pressure jet switch mechanism, the switch preferably blocks the tube so as to generate a pressure or vacuum discontinuity which is detected by the sensor. The sensor then causes the source of pressurised liquid to operate. The pneumatic discontinuity switch mechanism is preferably substantially as described in U.S. Pat. No. 6,508,823, the contents of which are incorporated herein by reference, especially as described with reference to FIGS. 7 and 8 of the drawings of that patent.

[0012] The electrode is preferably supported by a tube and can be moved within the tube.

[0013] The instrument according to the invention preferably comprises a tube having a first lumen which forms the nozzle and a second lumen which supports the electrode wherein the electrode is moveable within the second lumen. Each lumen is preferably in the form of an axial chamber in the tube. The tube optionally has one or more additional lumens which could be used for providing suction at a location where the instrument is used or for delivering a medicament to the location.

[0014] Alternatively, where the electrode is not moveable itself, the tip of the electrode may preferably be protected by

a cover or shroud which is moveable relative to the electrode so that the electrode tip can be protected when it is not in use.

[0015] The instrument according to the invention preferably has a nozzle which comprises a hollow tube having an axial lumen wherein the lumen has a restriction at the distal end in which an orifice is formed. The orifice in the restriction preferably has an axial length (which is the length of the restriction) and a diameter and wherein ratio of the axial length of the orifice to its diameter is from 1:1 to 5:1. The nozzle preferably has an additional lumen which is preferably arranged such that the axes of the two lumen are substantially parallel.

[0016] The instrument preferably has a control panel for controlling the characteristics of the electrical supply to the electrode, e.g. the current frequency, polarity, voltage etc. The control panel preferably has one or more buttons by which the supply may be controlled. For example the control panel may have two buttons, one of which, when operated, causes the supply to provide continuous high frequency electricity suitable for use in a cutting procedure and the other of which, when operated, causes the supply to provide pulsed high frequency electricity suitable for use in a coagulation procedure. The control panel is preferably concealed when the electrode is not in use. Preferably the control panel is concealed by the switching mechanism used to extend the electrode tip.

[0017] According to the invention there is also provided a method of performing surgery on a patient in need of such treatment which method comprises the steps of

[0018] providing a surgical dissection instrument as defined in any one of the preceding claims; and, either

[0019] actuating the instrument to provide electrical power to the electrode and performing a cutting or coagulation intervention; or

[0020] actuating the instrument to provide a pressure jet of liquid and performing a dissection intervention.

[0021] The nozzle used in the invention is preferably formed from an insulating plastics material which is preferably a plastics material having mechanical strength, purity, chemical resistance, ease of processing (including mouldability) and sterilization resistance. The plastic material is more preferably a thermoplastic polymeric material, especially a thermoplastic polycondensate. Examples of suitable plastic materials include a polyimide, polycarbonate, polyetheretherketone, polyaryletherketone, polyphenylene oxide, polysulfone and/or a polyphenylene sulphide. Most preferably the plastic material is a polyaryletherketone resin.

[0022] The invention will now be illustrated, by way of example, with reference to the Figures of the accompanying drawings in which:

[0023] FIG. 1 shows a schematic cross-sectional view of a surgical dissection instrument according to a first embodiment of the invention;

[0024] FIG. 2 shows a schematic cross-sectional view of a first nozzle for use in the surgical dissection instrument according to the first or second embodiment;

[0025] FIG. 3 shows a schematic cross-sectional view of a surgical dissection instrument according to a second embodiment of the invention;

[0026] FIG. 4 shows a schematic cross-sectional view of a surgical dissection instrument according to a third embodiment of the invention;

[0027] FIG. 5 shows a schematic cross-sectional view of a second nozzle for use in the surgical dissection instrument according to the third embodiment;

[0028] FIG. 6 shows a schematic cross-sectional view of a third nozzle for use in the surgical dissection instrument according to the third embodiment;

[0029] FIG. 7 is a cut-out perspective view of a first embodiment of a switch mechanism for use in the surgical dissection instrument of the third embodiment of the invention;

[0030] FIG. 8 is a schematic cross-sectional view of a second embodiment of a switch mechanism for use in the surgical dissection instrument of the third embodiment of the invention which shows the mechanism in a first position;

[0031] FIG. 9 is a schematic cross-sectional view of the second embodiment of a switch mechanism for use in the surgical dissection instrument of the third embodiment of the invention which shows the mechanism in a second position;

[0032] FIG. 10 is a schematic cross-sectional view of a fourth nozzle for use in the surgical dissection instrument according to the third embodiment;

[0033] FIG. 11A is a schematic cross-sectional view of a third embodiment of a switch mechanism for use in the surgical dissection instrument of the third embodiment of the invention which shows the mechanism in a first position;

[0034] FIG. 11B is a schematic cross-sectional view of the third embodiment of a switch mechanism for use in the surgical dissection instrument of the third embodiment of the invention which shows the mechanism in a second position;

[0035] FIG. 11C is a schematic cross-sectional view of the second embodiment of a switch mechanism for use in the surgical dissection instrument of the third embodiment of the invention which shows the mechanism in a third position; and

[0036] FIG. 12 is a schematic cross-sectional view of a fifth nozzle for use in the surgical dissection instrument according to the third embodiment.

[0037] With reference to FIG. 1, a first embodiment of a surgical dissection instrument according to the invention comprises a handpiece 10, a first flexible tube 15 for connection, in use, to a source (not shown) for supplying a high-pressure physiological salt solution and a flexible wire 20 for connection, in use, to an output of an electrosurgery generator (not shown). The first flexible tube 15 is typically reinforced by a reinforcement made of braided synthetic wires, so as to be able to withstand the high pressure of the liquid, which may reach 70 bar.

[0038] The control means (not shown) for the source (not shown) for supplying a high-pressure physiological salt solution and for the electrosurgery generator (not shown) is arranged so as not to supply the high-pressure physiological salt solution at the same time as electrical power from the electrosurgery generator. The control means (not shown)

may optionally be provided on handpiece **10** or separately. The source for supplying a high-pressure physiological salt solution is optionally arranged to supply a flow of droplets of physiological salt solution when the electrosurgery generator is operating. In order that the source for supplying a high-pressure physiological salt solution can operate in this way, the source is optionally a bi-functional generator as described in U.S. Pat. No. 6,083,189, the contents of which are incorporated herein by reference. The electrosurgery generator is optionally a TD830 electrosurgery unit manufactured by Eschmann Equipment. This electrosurgery unit is suitable for use with the invention because it can function in a mono- or di-polar mode. The control means may be a control panel **440** described with reference to FIG. 7 which control means may be provided on handpiece **10** or separately as a handheld control means or foot operated control means.

[0039] The handpiece **10** is of a disposable type, made entirely from injection-moulded thermoplastic synthetic material. It primarily comprises an ergonomic body **25** of generally elongated shape, with a substantially circular cross-section, this body extending from a distal end **30** to a proximal end **35**, both ends **30,35** being substantially located on the same axis. The proximal end **35** incorporates an opening through which the tube **15** and wire **20** enter the body **25**.

[0040] The ergonomic body **25** is made up of two substantially identical moulded half shells. The two half shells are hollow on the inside to allow the tube **15** and wire **20** to pass inside the body of the handpiece **10** from the proximal end **35** to the distal end **30** along a substantially straight path.

[0041] An elongate nozzle **50** is securely fitted to the first tube **15**. The distal end **16** of first tube **15** and the proximal end **55** of the nozzle **50** are respectively securely fitted to a respective side of an annular collar **60** of plastic material, for example by push fitting the respective ends **16,55** of the tube **15** and the nozzle **50** into respective annular ends of the collar **60** and then bonding the assembly with adhesive or by thermal bonding.

[0042] An elongate electrode **40** formed from conductive material is securely connected to wire **20** by annular collar **65**. The distal end of wire **20** is soldered or otherwise electrically connected to the proximal end **41** of the electrode **40** and then the connection is reinforced by collar **65**. Electrode **40** has a tip **45** at its distal end.

[0043] The nozzle **50** is shown in more detail in FIG. 2. It comprises a cylindrical tube **70** defining an axially directed central bore or lumen **75** extending therealong. The tube **70** is formed from metal such as stainless steel. Tube **70** has at its distal end a restriction **80** which has an orifice **85**. The restriction **80** is formed from metal. As an alternative, a semi-precious material such as sapphire or a plastics material could be used. The nozzle **50** is formed by inserting the restriction **80** into tube **70** and then closing the end **72** of tube **70** to seal in the restriction **80**.

[0044] The orifice **85** is an axially directed central orifice which extends through the restriction **80**. The restriction **80** typically has an axial length of from 0.1, preferably from 0.3 mm to 2 mm, preferably to 1 mm, more preferably to 0.5 mm typically approximately 0.8 mm or about 0.4 mm, with the orifice **85** having the same axial length. Thus the orifice is an

elongated orifice. The diameter of the bore **75**, and therefore the diameter of the proximal face of the restriction **80** subjected to liquid pressure in the bore **75** and the internal diameter of the tube **50**, is typically from 1.5 to 2.5 mm, more typically approximately 1.7 mm. The internal diameter of the orifice **85** is typically from 0.05 to 0.4 mm, more typically approximately 0.2 mm (e.g. about 0.22 mm). The ratio of the axial length to the internal diameter is from 1:1, preferably from 1.2:1, more preferably from 1.3:1 to 5:1, preferably to 4.5:1, more preferably to 4:1. Preferably the ratio is about 1.5:1 or about 3.7:1. This structure of the restriction **80** is sufficient to withstand typical liquid pressures in the nozzle **50** of up to 70 bar without failure or deformation of the restriction **80**.

[0045] The external diameter of the tube **70** is typically from 2 to 4 mm, more typically approximately 2.3 mm, thereby giving a typical wall thickness of from 0.5 to 2 mm, more typically approximately 0.6 mm.

[0046] As an alternative, nozzle **50** may be formed from a plastics material. A suitable plastics material for use in the construction of tube **70** and/or restriction **80** is typically composed of a thermoplastic polymeric material, especially a thermoplastic polycondensate such as a polyimide, polycarbonate, polyetheretherketone, polyaryletherketone, polyphenylene oxide, polysulfone and/or polyphenylene sulphide. Most preferably it is composed of a polyaryletherketone resin, which exhibits mechanical strength, purity, chemical resistance, ease of processing and sterilization resistance. Nozzle **50** may be a nozzle substantially as described with reference to FIG. 3 of co-pending patent application no. PCT/GB2005/000553; the contents of this document are incorporated herein by reference.

[0047] As an alternative to the first embodiment illustrated in FIG. 1, the handpiece **10** may comprise an elongate return electrode in addition to the electrode **40** such that the handpiece may act as a bi-polar electrosurgery unit. The return electrode may be provided parallel to the electrode **40** at a sufficient distance for it to act in this manner.

[0048] The handpiece **110** of the second embodiment of a hand-operated surgical dissection instrument of the present invention is illustrated in FIG. 3. Like features of the two embodiments are identified by like identification numerals. Handpiece **110** is of similar construction to handpiece **10**, having an ergonomic body **25** made up of two substantially identical moulded half shells.

[0049] Handpiece **110** has a manifold **120** which is bonded in a fluid-tight manner to the distal end **30** of the ergonomic body **25**. The manifold **120** defines an internal chamber which is in fluid communication with a second flexible tube **115** which, in use, is connected to a source of suction. An aspirator tube **125** of plastic material is fitted to the manifold **120**, by being push fitted into the manifold **70**. The aspirator tube **82** is cylindrical and surrounds the nozzle **50** and the electrode **40**. The distal end of the aspirator tube **125** is located a small distance, about 2 to 4 mm or less, proximally of the distal end of the nozzle **50** and of the electrode tip **45**. Therefore the distal end of the nozzle **50** and the electrode tip **45** protrude from the distal end of the aspirator tube **125**. The distal end of the nozzle **50** and the electrode tip **45** are protected by a shroud **130**. Shroud **130** is movable from a distal position where it protects the distal end of the nozzle **50** and the electrode tip **45** to a proximal position shown at

**135** where the distal end of the nozzle **50** and the electrode tip **45** are exposed such that the electrode tip **45** is available for use.

[**0050**] The distal end of the aspirator tube **125** is provided with at least one vent hole (not shown) extending through the wall thickness thereof. In the illustrated embodiment there are two diametrically opposed circular vent holes (not shown), each of a diameter of about 1 to 1.5 mm. The at least one vent hole is provided to obviate the aspirator tube **125** from inadvertently attaching itself to the patient's body under the negative pressure applied to the aspirator tube **125**.

[**0051**] The aspirator tube **125** is typically composed of polyvinylchloride and typically has a wall thickness of from 0.25 to 1.0 mm so as to be flexible, with typically the inner diameter being from 3.5 to 5 mm and the outer diameter being from 4 to 6 mm. The aspirator tube **125** is preferably transparent so that a user can readily check that it has not become inadvertently blocked in use.

[**0052**] The control means (not shown) for the source for supplying a high-pressure physiological salt solution and for the electrosurgery generator is arranged so as not to supply the high-pressure physiological salt solution at the same time as electrical current from the electrosurgery generator. The control means (not shown) may optionally be provided on handpiece **110** or separately.

[**0053**] As an alternative to the second embodiment illustrated in FIG. 3, the handpiece **110** may comprise an elongate return electrode in addition to the electrode **40** such that the handpiece may act as a bi-polar electrosurgery unit. The return electrode may be provided within aspirator tube **125** parallel to the electrode **40** at a sufficient distance for it to act in this manner.

[**0054**] As a further alternative, the aspirator tube **125** is constructed from a physiologically acceptable rigid material such as metal so that the handpiece can be used in laparoscopic surgery. The aspirator tube **125** may optionally be provided with a physiologically acceptable coating, e.g. a phospholipid.

[**0055**] The handpiece **210** of the third embodiment of a hand-operated surgical dissection instrument of the present invention is illustrated in FIGS. 4 and 7. Like features of the three embodiments are identified by like identification numerals. Handpiece **210** is of similar construction to handpiece **10**, having an ergonomic body **25** made up of two substantially identical moulded half shells.

[**0056**] The handpiece **210** has a first flexible tube **15**, a flexible wire **20** and a second flexible tube **115**. The electrosurgical action of the electrode is controlled by buttons **220** on the handpiece **210**.

[**0057**] Handpiece **210** comprises a nozzle **350** formed from a plastics material as defined above in relation to nozzle **50**. Nozzle **350** is shown in detail in FIG. 5. Nozzle **350** is provided in the form of a cylindrical tube **354** having two substantially parallel lumen or bores **356,357** separated by a web **362**. Lumen **357** terminates at the distal end of the nozzle **350** with an orifice **364**. Lumen **357** contains an electrode **340** having an electrode tip **345**. Part **346** of the electrode **340** protrudes from a longitudinal opening **370** in lumen **357**. The opening **370** is arranged so that part **346** can be moved in a proximal direction such that the electrode **340**

can be withdrawn into lumen **357** through orifice **364**. Nozzle **350** may be a nozzle substantially as described with reference to FIG. 5 of co-pending patent application no. PCT/GB2005/000553.

[**0058**] Lumen **356** terminates at the distal end of the nozzle **350** with a restriction **358** having an axially directed central orifice **360** extending through it. Restriction **358** is formed from metal. As an alternative, a semi-precious material such as sapphire or a plastics material could be used.

[**0059**] Lumen **356** of nozzle **350** is securely fitted to the first tube **13** and part **346** of the electrode **340** is connected to wire **20**. Annular collar **60** is used to secure the connections.

[**0060**] The movement of the electrode **340** in and out of lumen **357** of nozzle **350** is controlled by a switch mechanism **400** which is shown in FIG. 7. Switch mechanism **400** has an electronic control panel **440** that may be in the form of a printed circuit (PC) board onto which switches **220** are connected, for example by being solder-jointed. Switches **220** are for controlling the polarity of the electrical power supplied to the electrode. The control panel **440** has a further nozzle control switch (not shown) for controlling the operation of the source of high pressure physiological salt solution. Control panel **440** has an input from wire **20** and is connected to part **346** of the electrode **340** by wire **450**, both of which are also connected for example by being solder-jointed to the printed circuit board. Control panel **440** further has logic control means (either hard wired logic including for example an Exclusive Or gate or a microprocessor electrically coupled to the printed control board) which prevents nozzle control switch (not shown) from switching on the source of high pressure physiological salt solution (not shown) when the electricity is being supplied to the electrode **345** or when the electrode **345** is extended from the handpiece **210**. Of course, the converse is true in that when pressurised fluid is being output from the nozzle, the electrode **345** is prevented from being actuated or powered on. As an alternative embodiment, control panel **440** may be omitted and replaced with foot operated switch or hand controlled switch to provide the same function.

[**0061**] Switch mechanism **400** has a first actuator indicated generally at **410** which is formed from a high impact plastics material. The first actuator **410** is T-shaped with the vertical part of the first actuator **410** elongated compared to the transverse part. The upper surface of the transverse part of the first actuator **410** is formed as a control surface or button **460**. On the underside of the transverse part of the button **460**, a catch **430** is provided.

[**0062**] The actuator **410** is moveable from a first to a second position. Catch **430** engages with an opening **26** in the housing **25** to lock the actuator **410** in the second position. On the vertical part of the first actuator **410**, a toothed portion **480** is provided.

[**0063**] Switch mechanism **400** has a second actuator **420** which is bonded to part **346** of electrode **340**. The second actuator **420** is also formed from a high impact plastics material and is moveable from a first position wherein the electrode **340** is retracted to a second position where the electrode is extended. The second actuator **420** is connected to a resilient member **425** which is shown in the form of a

coiled spring. Resilient member **425** is bonded to the housing **25**. Resilient member **425** biases the second actuator towards the first position. The second actuator has a toothed portion **415**.

[0064] Switch mechanism **400** has two toothed wheels **492,494** which are mounted on axle **490** which is itself mounted on the housing **25**. First toothed wheel **492** has a smaller diameter than second toothed wheel **494**. First wheel **492** engages with the toothed portion **480** of the first actuator **410**. Second wheel **494** engages with the toothed portion **415** of the second actuator **420**.

[0065] Vertical downward movement **485** of the first actuator **410** causes the toothed portion **480** to engage and move the first toothed wheel **492**. Movement of the first toothed wheel **492** causes the axle **490** to turn second toothed wheel **494**. Second toothed wheel **494** then engages and moves the toothed portion **415** of the second actuator **420**. Thus vertical movement **485** of the first actuator **410** is converted into transverse movement of the second actuator **420** and thus of electrode **340**. This movement continues until catch **430** engages in opening **26** and locks the first actuator **410** and second actuator **420** in their respective second positions such that the electrode is extended.

[0066] Release of the catch **430** from opening **26** causes the electrode **340** to be retracted because resilient member **425** causes the second actuator **420** to return to its first position and in so doing, causes the first actuator **410** to return to its first position as well.

[0067] As an alternative to the mechanism shown in FIG. 7, the movement of the electrode could be controlled by a magnet moveable by means of switch from a first position to a second position and biased to return to a first position. Such a mechanism could be substantially as shown in FIG. 7 but with the mechanism providing linear movement of a magnet. In such an embodiment, nozzle **350** could be replaced by nozzle **550** which is a nozzle according to a third embodiment of the present invention and which is shown in FIG. 6. Nozzle **550** is provided in the form of a cylindrical tube **554** having two substantially parallel lumen or bores **556,557** separated by a web **562**. Lumen **557** terminates at the distal end of the nozzle **550** with an orifice **564**. Lumen **556** terminates at the distal end of the nozzle **550** with an integral restriction **558** having an axially directed central orifice **560** extending through it. The length of the integral restriction **558** and the width of the orifice **560** are substantially the same as the restriction **80** and orifice **85** for the first embodiment of the nozzle according to the invention. Lumen **557** contains an electrode **40** having an electrode tip **45**. Nozzle **550** may be a nozzle substantially as described with reference to FIG. 5 of co-pending patent application no. PCT/GB2005/000553.

[0068] As a further alternative to the switch mechanism shown in FIG. 7, the second embodiment of a switch mechanism shown in FIGS. 8 and 9 could be used. In this embodiment, like features to those of the first embodiment of a switch mechanism shown in FIG. 7 have like reference numerals. The second embodiment of a switch mechanism functions in the same manner as the first embodiment except that in the first position, the electrode **345** is extended and in the second position (where the catch **430** engages with an opening **26** in the housing **25** to lock the actuator **410** in the second position), the electrode **345** is retracted.

[0069] As a further alternative to nozzle **350** in the third embodiment, nozzle **650** shown in FIG. 10 may be used. Nozzle **650** is provided in the form of a cylindrical tube **654** having two substantially parallel lumen or bores **656,657** separated by a web **662**. Lumen **657** terminates at the distal end of the nozzle **650** with an orifice **664**. Lumen **656**, used for generating a pressure jet of fluid, terminates at the distal end of the nozzle **650** with an integral restriction **658** having an axially directed central orifice **660** extending through it. The length of the integral restriction **658** and the width of the orifice **660** are substantially the same as the restriction **80** and orifice **85** for the first embodiment of the nozzle according to the invention. Lumen **657** contains an electrode **640** having an electrode tip **645**. Part **646** of the electrode **640** protrudes from a longitudinal opening **670** in lumen **657**. The opening **670** is arranged so that part **646** can be moved in a proximal direction such that the electrode **640** can be withdrawn into lumen **657** through orifice **664**. Nozzle **650** may be a nozzle substantially as described with reference to FIG. 5 of co-pending patent application no. PCT/GB2005/000553. Nozzle **650** has a return electrode **680** mounted on its external surface such that the instrument which comprises nozzle **650** can be used in bi-polar surgery. So that the return electrode **680** and the electrode **640** can be extended at the same time, they are connected by member **690** which is formed from an insulating plastics material. In particular, part **646** of electrode **640** is connected to member **690**. Member **690** is adapted to be connected to the switch mechanism (not shown).

[0070] As a further alternative to nozzle **350** in the third embodiment, nozzle **850** shown in FIG. 12 may be used. Nozzle **850** is provided in the form of a cylindrical tube **854** having two substantially parallel lumen or bores **856,857** separated by a web **862**. Lumen **857** terminates at the distal end of the nozzle **850** with an orifice **864**. Lumen **856**, used for generating a pressure jet of fluid, terminates at the distal end of the nozzle **850** with an integral restriction **858** having an axially directed central orifice **860** extending through it. The length of the integral restriction **858** and the width of the orifice **860** are substantially the same as the restriction **80** and orifice **85** for the first embodiment of the nozzle according to the invention. Lumen **857** contains an electrode **840** having an electrode tip **845**. Part **846** of the electrode **840** protrudes from a longitudinal opening **870** in lumen **857**. The opening **870** is arranged so that part **846** can be moved in a proximal direction such that the electrode **840** can be withdrawn into lumen **857** through orifice **864**. Nozzle **850** may be a nozzle substantially as described with reference to FIG. 5 of co-pending patent application no. PCT/GB2005/000553. Nozzle **850** has a return electrode **880** mounted on its external surface such that the instrument which comprises nozzle **850** can be used in bi-polar surgery. Return electrode **880** is mounted on insulating housing **885** and is fixed in position. Return electrode **880** presents a return electrode surface **881** which is flush with the distal end of the nozzle **850**. The return electrode **880** is mounted on the side of the nozzle **850** which is proximate to electrode **840** such that movement of electrode tip **845** relative to return electrode surface **881** allows an operator of an instrument comprising nozzle **850** and having a suitable control mechanism (not shown) for controlling the movement of electrode **840** to grip tissue between electrode tip **845** and return electrode surface **881**. Thus the combination of electrode tip **845** and

return electrode surface **881** act as forceps and may be used in electrosurgical techniques such as fusing tissue.

[0071] A third switch mechanism **710** for use in the third embodiment of the invention is shown in FIGS. **11A**, **11B** and **11C**. This switch mechanism can be used as an alternative to the switch mechanisms illustrated in FIGS. **7-9**. Switch mechanism **710** is moveable in a longitudinal direction shown by arrow **705** between three positions which are a first position where the electrode(s) **40,680** is/are extended from the instrument, illustrated in FIG. **11A**; a second position where the electrode(s) **40,680** is/are retracted into the instrument, illustrated in FIG. **11B**; and, a third position where the electrode(s) **40,680** is/are retracted into the instrument and the switch mechanism causes the operation of the source for supplying a high-pressure physiological salt solution, illustrated in FIG. **11C**.

[0072] Switch mechanism **710** has a body **740** which is connected (not shown) to the electrode **40** or the member **690** such that movement of the switch mechanism **710** moves the electrode(s) **40,680**. The switch mechanism **710** has a blocking member **745** which blocks the opening **26** into the housing **25** when the switch mechanism **710** is in the second and third positions illustrated in FIGS. **11B** and **11C**. To ensure the proper functioning of switch mechanism **710**, housing **25** forms a channel (not shown) through which blocking member **745** slides. Switch mechanism **710** has a cover **730** which blocks the opening **26** in housing **25** when the switch mechanism **710** is in the first or second positions illustrated in FIGS. **11A** and **11B**.

[0073] Switch mechanism **710** is connected to the housing **25** by means of resilient member **750** which is in the form of a spring. Resilient member **750** is arranged so as to bias the switch mechanism to the first position shown in FIG. **11A**.

[0074] Switch mechanism **710** has a spring-loaded button **720** which is moveable between a locked position shown in FIGS. **11B** and **11C** and an open position shown in FIG. **11A**. In the locked position, the resilient member **750** is prevented from moving the switch mechanism to the first position. However, the switch mechanism is still able to move from the second to the third position. Depression of the button **220** in the locked position whilst the switch mechanism is in the second or third position causes the resilient member to move the switch mechanism to the first position.

[0075] The housing **25** has a control panel **760** positioned adjacent the switch mechanism **710**. Control panel **760** is used to control the power supply for the electrode(s) **40,680**. Cover **730** protects the control panel **760** when the switch mechanism **710** is in the second and third positions and the electrode(s) **40,680** are retracted into the instrument. The control panel **760** may be a control panel **440** substantially as described with reference to FIG. **7**. As an alternative embodiment, control panel **760** may be omitted and replaced with foot operated switch or hand controlled switch to provide the same function.

[0076] In its third position, switch mechanism **710** causes the operation of the source for supplying a high-pressure physiological salt solution, illustrated in FIG. **11C** by means of pneumatic discontinuity switch mechanism **761**. To operate pneumatic discontinuity switch mechanism **761**, switch mechanism **710** has a plunger **767** mounted on guide tube

**765** which is itself mounted on body **740**. Pneumatic discontinuity switch mechanism **761** has a tube **770** into which plunger **767** fits. Tube **770** is connected to a vacuum source **785** via sensor **780** by line **775** such that, in operation, there is a flow of air through tube **770**. Vacuum source **785** may be connected to a vacuum system commonly found in operation rooms of hospitals. As an alternative, source **785** may be a source of pressure. Sensor **780** detects flow rate, pressure or vacuum discontinuity in the line **775** and is a detector as shown in FIG. **8** of U.S. Pat. No. **6,508,823** and described at column **8** lines **8** to **32** of that patent. Sensor **780** is connected to the source for supplying a high-pressure physiological salt solution (not shown) and causes the operation of the source for supplying a high-pressure physiological salt solution when it detects a discontinuity.

[0077] In operation, when the switch mechanism **710** is moved to the third position shown in FIG. **11C**, plunger **767** is moved into tube **770** such that guide tube **765** closes tube **770**. The flow of air through tube **770** is then prevented by guide tube **765** sealing tube **770**. This pneumatic discontinuity is then detected by sensor **780** such that the source for supplying a high-pressure physiological salt solution is switched on.

[0078] With the inventive surgical instrument as described above, during surgery, instead of needing multiple devices, a surgeon now only needs to select the operative mode he requires at any given time. For example, when facing the need for a dissecting procedure, the surgeon would switch the instrument to the dissecting mode whereby pressurised fluid is output from the nozzle. On the other hand, when cutting is required, the surgeon could simply switch the unit to its cutting mode whereby power (continuous high frequency electricity) is provided to the electrode to effect cutting. Finally if a coagulation procedure is required, the instrument may be switched to its coagulating mode so that pulsed high frequency electricity is provided to the electrode to enable the surgeon to perform the coagulation procedure.

[0079] The present invention is not restricted to the forms of embodiment described, but can undergo various alterations and be presented in various aspects derived from the forms described in an obvious manner for a person skilled in the art. For instance, instead of being limited to supplying high frequency continuous or pulsed power to the electrode to effect cutting or coagulation, respectively, other forms of power (low frequency voltage for example) may also be provided to the electrode to effect other types of procedures, for example warming, that currently are not being utilised with an electrode device in surgery.

1. A surgical instrument adapted to be used to perform at a given time any one of a plurality of surgical procedures which instrument comprises an electrode suitable for use in electrosurgery and a nozzle for generating a pressure jet of liquid wherein the electrode has a proximal end for connection to an electrosurgery generator and an electrode tip at the distal end and wherein the nozzle has a proximal end for connection to a source of pressurised fluid and a distal end at which the pressure jet is output and wherein the electrode and the nozzle are selectively actuatable to perform respective functions to effect the different surgical procedures.

2. An instrument as defined in claim 1 wherein the electrode is separate from the nozzle.

3. An instrument as defined in claim 1 wherein the electrode is insulated from the pressure jet.

4. An instrument as defined in claim 1 wherein the electrode is moveable relative to the instrument such that the electrode tip is extended from the instrument in use or retracted to protect the electrode tip and wherein the nozzle is not actuatable when the electrode tip is extended from the instrument.

5. An instrument as defined in claim 4 wherein the electrode is moveable mechanically.

6. An instrument as defined in claim 4 wherein the electrode is biased to an extended or a retracted position.

7. An instrument as defined in claim 1 wherein the electrode is supported by a tube and can be moved within the tube from an extended position to a retracted position.

8. An instrument as defined in claim 1 which comprises a tube having a first lumen which forms the nozzle and a second lumen which supports the electrode.

9. An instrument as defined in claim 8 wherein the electrode is moveable within the second lumen.

10. An instrument as defined in claim 1 further comprising a switch mechanism for selectively controlling the respective functions of the electrode and nozzle.

11. An instrument as defined in claim 10 wherein movement of the electrode is controlled by the switch mechanism which has a first position where the electrode is extended and a second position where the electrode is retracted.

12. An instrument as defined in claim 11 wherein the switch has a third position wherein the electrode is retracted and wherein in use the source of pressurised liquid is switched on such that the nozzle generates a pressure jet of liquid.

13. An instrument as defined in claim 1 which has a part which is moveable relative to the electrode so that the electrode tip can be protected when it is not in use.

14. An instrument as defined in claim 1 wherein the nozzle comprises a hollow tube having an axial lumen wherein the lumen has a restriction at the distal end in which an orifice is formed.

15. An instrument as defined in claim 14 wherein the orifice has an axial length and a width and wherein ratio of the axial length of the orifice to its width is from 1:1 to 5:1.

16. An instrument as defined in claim 1 which has a control panel for controlling the electrical supply to the electrode.

17. An instrument as defined in claim 16 wherein the control panel is concealed when the electrode is not in use.

18. An instrument as defined in claim 1 which comprises a return electrode such that it can act as a bi-polar electro-surgery unit.

19. An instrument as defined in claim 18 wherein the electrode tip is moveable in relation to the return electrode, preferably such that the electrode tip and return electrode act in combination as forceps.

20. An instrument as defined in claim 1 which has an aspirator tube which may be connected to a source of suction.

21. An instrument as defined in claim 20 wherein the aspirator tube supports the electrode and nozzle such that the instrument may be used in laparoscopic surgery.

22. An instrument as defined in claim 1 wherein the electrode is selectively actuatable to perform a cutting procedure or a coagulation procedure and the nozzle is selectively actuatable to perform a dissection procedure.

23. A method of performing surgery on a patient in need of such treatment which method comprises the steps of

providing a surgical dissection instrument as defined in any one of the preceding claims; and, either

actuating the instrument to provide electrical power to the electrode and performing a cutting or coagulation intervention; or

actuating the instrument to provide a pressure jet of liquid and performing a dissection intervention.

\* \* \* \* \*

专利名称(译)	手术器械		
公开(公告)号	<a href="#">US20070149968A1</a>	公开(公告)日	2007-06-28
申请号	US11/640328	申请日	2006-12-18
[标]申请(专利权)人(译)	ESCHMANN控股		
申请(专利权)人(译)	ESCHMANN HOLDINGS LIMITED		
当前申请(专利权)人(译)	ESCHMANN HOLDINGS LIMITED		
[标]发明人	GONON BERTRAND		
发明人	GONON, BERTRAND		
IPC分类号	A61B18/14		
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外部链接	<a href="#">Espacenet</a> <a href="#">USPTO</a>		

摘要(译)

本发明提供一种手术切开器械，包括适用于电外科手术的电极和用于产生液体压力射流的喷嘴，其中电极具有用于连接到电外科发生器的近端和位于远端的电极尖端，并且其中喷嘴具有用于连接到加压液体源的近端和产生压力射流的远端;以及使用该仪器的方法。

