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(54) **SURGICAL SYSTEM AND METHOD OF USE**

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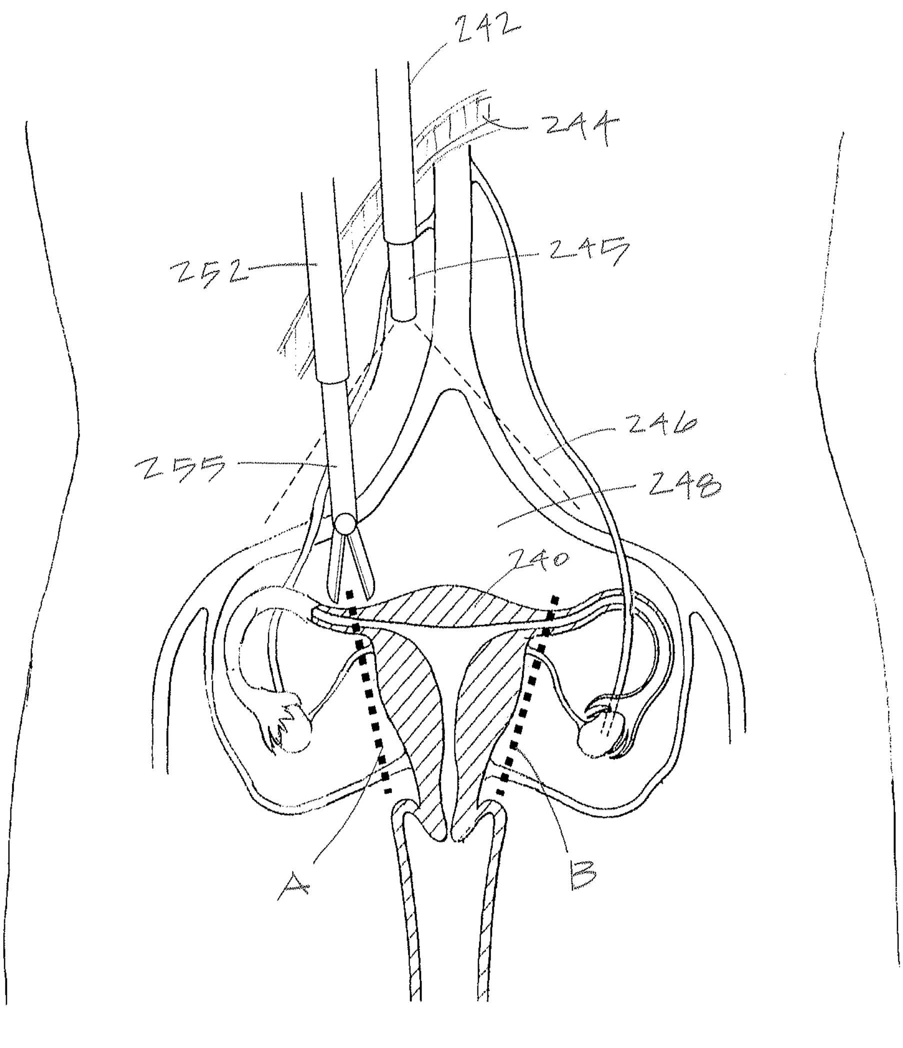
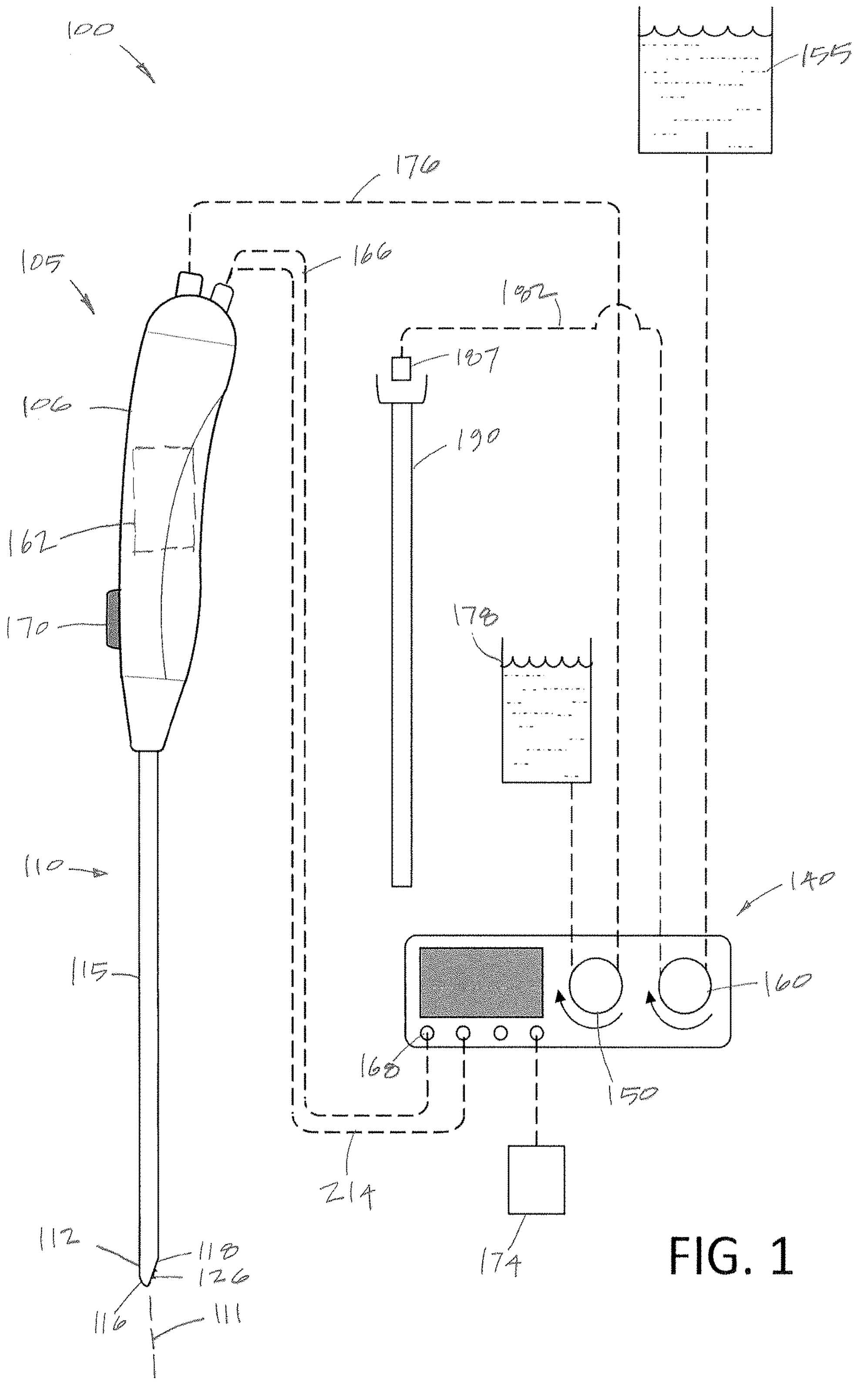
(57) **ABSTRACT**

Systems and devices for resecting and removing tissue or organs from the interior of a patient's body, in a minimally invasive laparoscopic procedure while preventing any dispersion of potentially malignant tissue during the resection process.




100
155
176
105
166
182
187
106
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162
170
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110
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214
174
112
118
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111

FIG. 1

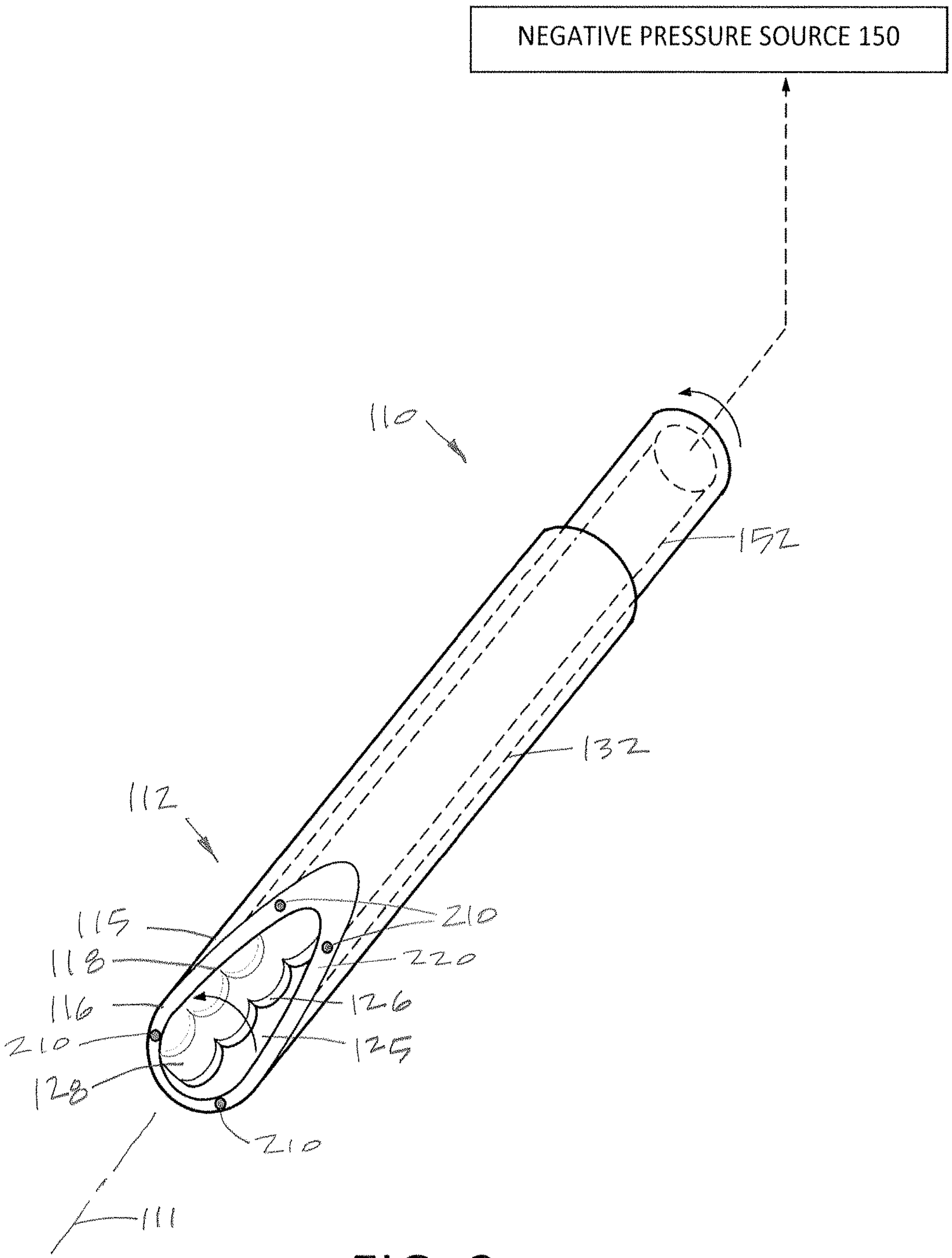
NEGATIVE PRESSURE SOURCE 150
110
152
132
112
115
118
116
210
128
210
220
126
125
210
111

FIG. 2

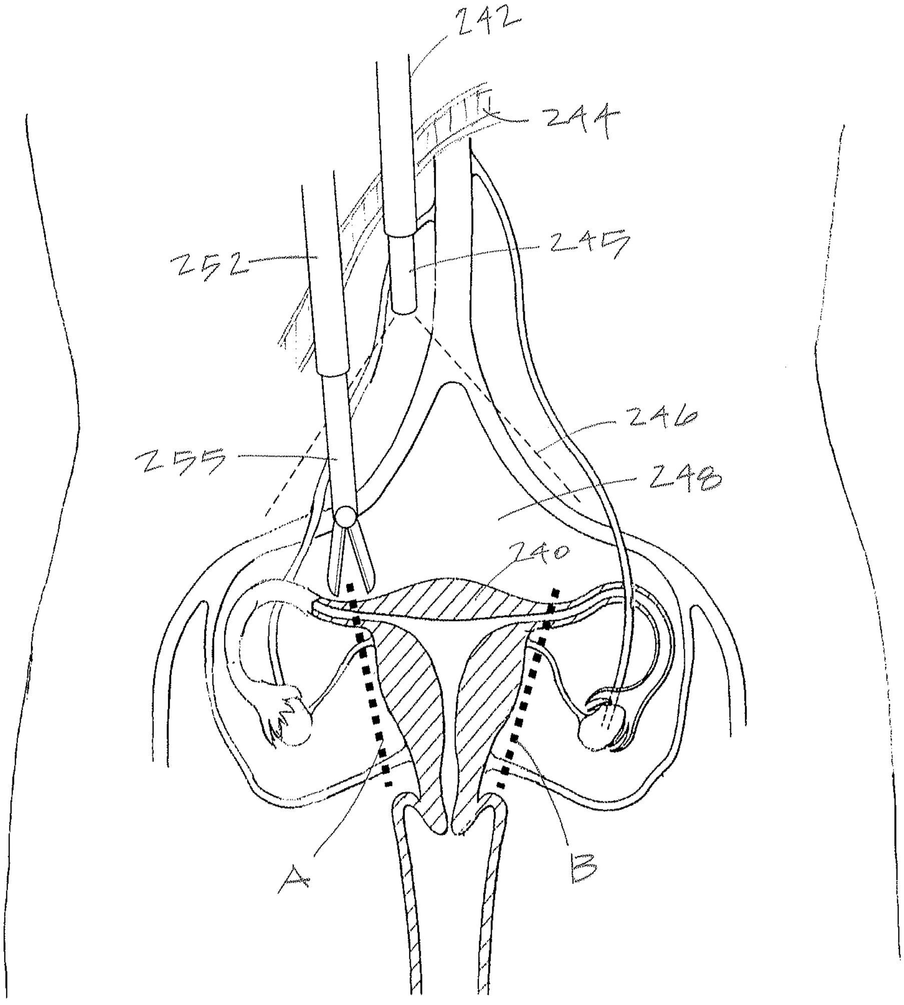

FIG. 3A

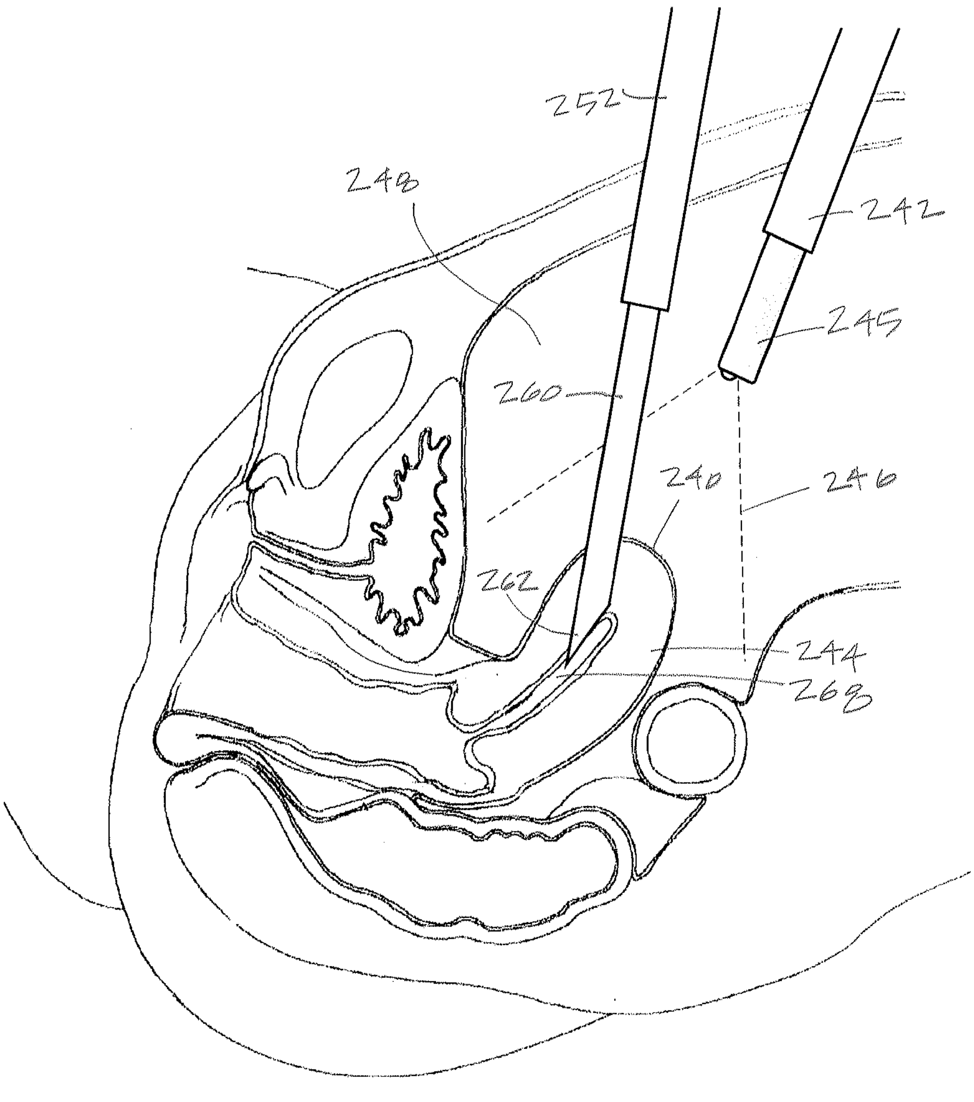

FIG. 3B

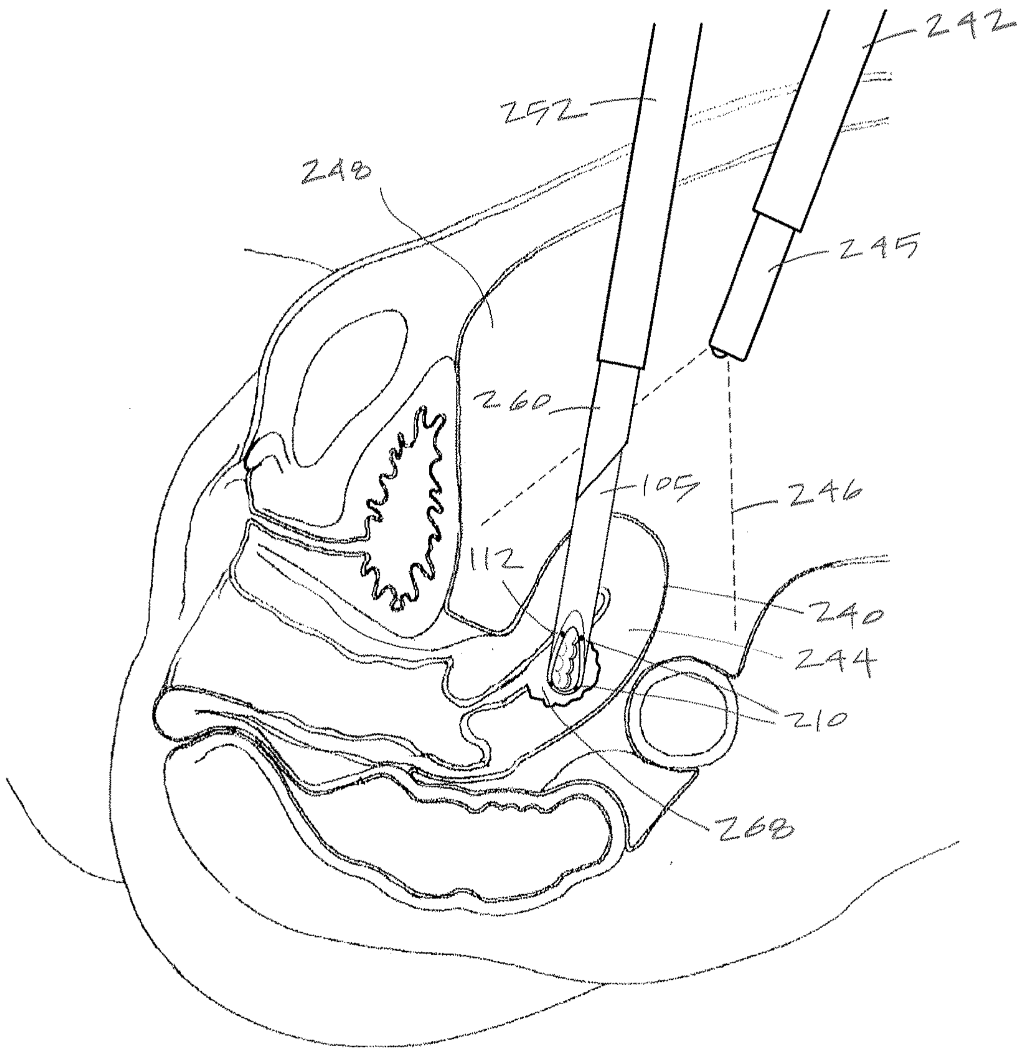

FIG. 3C

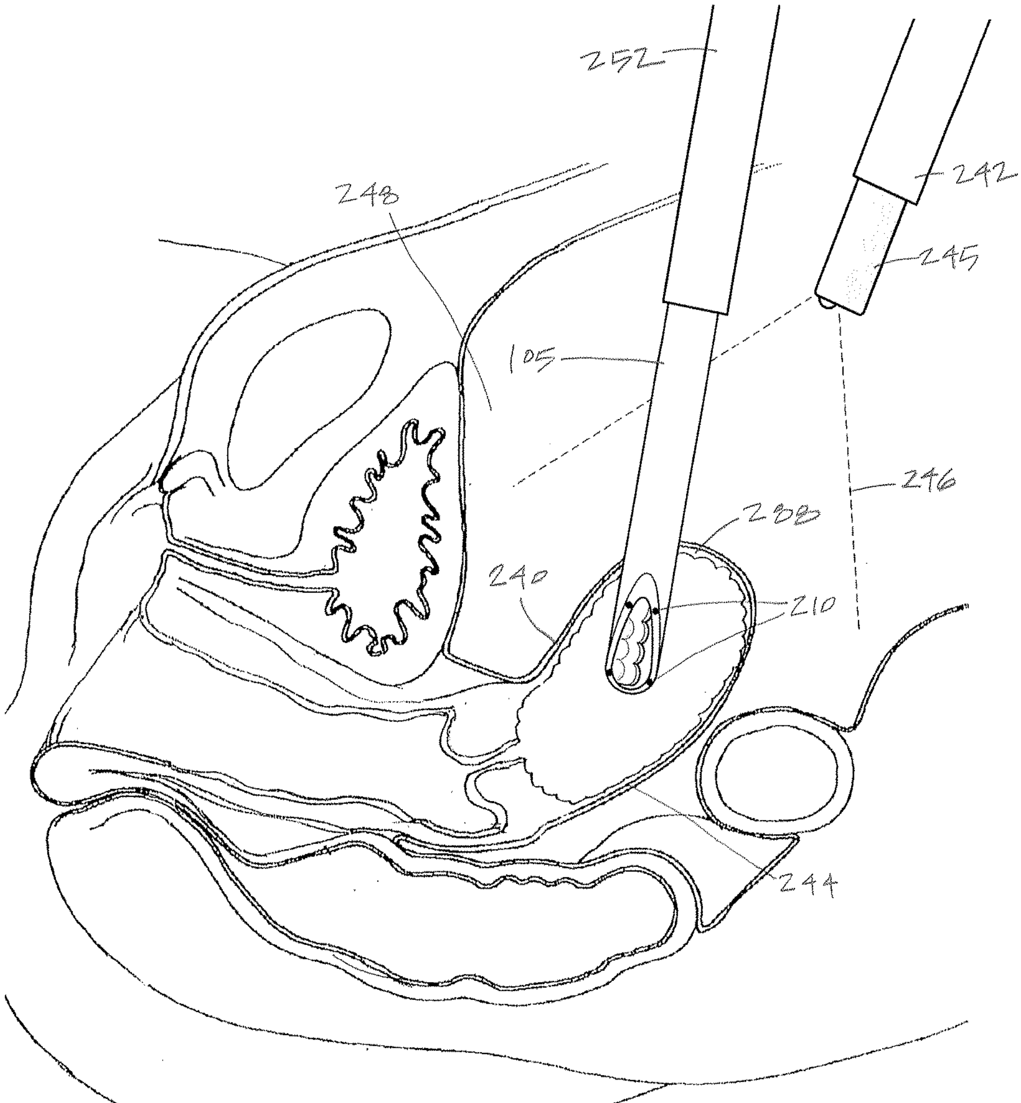

FIG. 3D

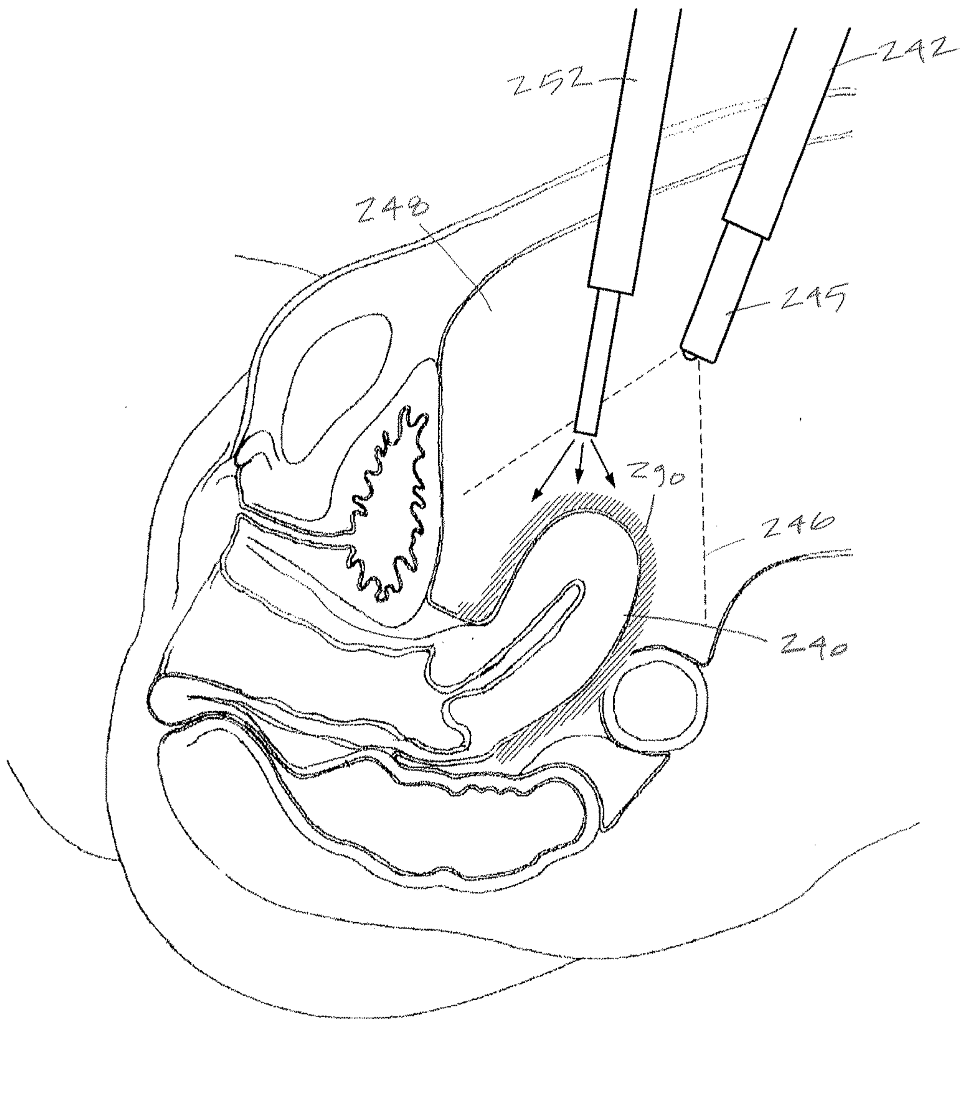

FIG. 4

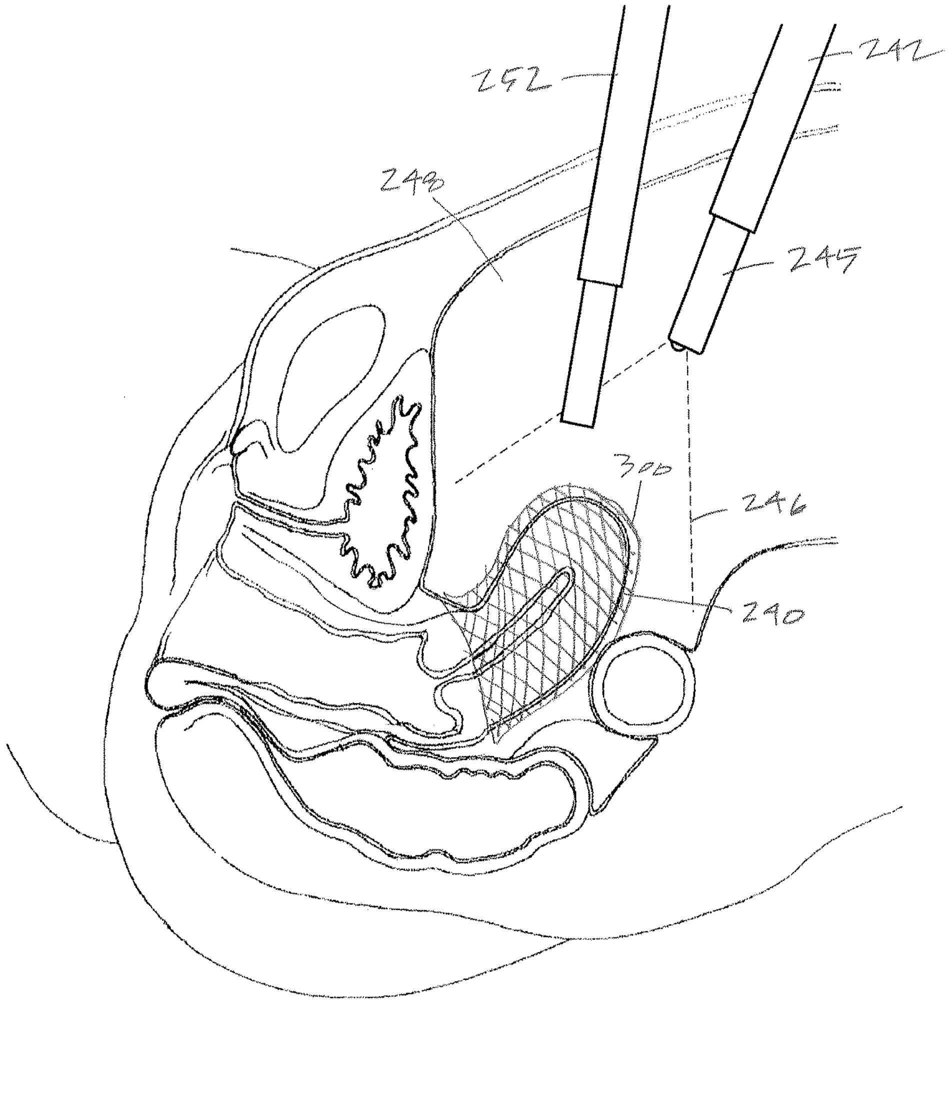

FIG. 5

SURGICAL SYSTEM AND METHOD OF USE

RELATED APPLICATIONS

[0001] This application claims is a non-provisional of U.S. Provisional Patent Application No. 62/189,008, filed on Jul. 6, 2015, the content of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to systems and devices for resecting and removing tissue or organs from the interior of a patient's body, in a minimally invasive laparoscopic procedure while preventing any dispersion of potentially malignant tissue during the resection process.

BACKGROUND

[0003] Several surgical procedures require removing a tissue mass or an organ from the body of a patient in an efficient manner preventing dispersion of potentially malignant tissue during the resection process. One such procedures is a hysterectomy where a woman's uterus is detached and removed from her body. Hysterectomy is typically performed in cases of severe endometriosis, presence of fibroids, cancer, cervical dysplasia, uterine prolapse and more. With the advent of minimally invasive surgery such as laparoscopic surgery large tissue masses such as the uterus are removed through small incisions, decreasing post operative pain and hospitalization time.

[0004] Several types of hysterectomy are performed fully or partially laparoscopically and these include Total Laparoscopic Hysterectomy (TLH) where the uterus and cervix are removed through few small incisions made in the abdomen; Laparoscopic Supracervical Hysterectomy (LSH) where the uterus is removed, but the cervix is left intact. In both cases the uterus is removed through one of the small incisions using an instrument called a morcellator. Another approach is a Total Vaginal Hysterectomy (TVH) where the uterus and/or cervix are removed through the vagina.

[0005] In laparoscopic hysterectomies for example, the uterus is removed using instruments inserted through small tubes into the abdomen, resulting in few small incisions in the abdomen. A laparoscopic approach offers surgeons better visualization of affected structures (e.g. by using an endoscope) than either vaginal or abdominal hysterectomy.

[0006] There remains a need to resecting and/or removing tissue from the interior of an organ while maintaining a surface of the organ to prevent tissue being removed from spreading within the body. Such procedures and devices require an ability for the medical practitioner to be aware of the position of the cutting device relative to the surface of the tissue of the organ while the device is within the organ. This would allow the physician to remove a significant portion of the tissue within the organ and remove the organ from the body. Such devices and systems can be used in any part of the body with a hysterectomy being one example.

SUMMARY

[0007] The present disclosure includes systems and methods for resecting and/or removing tissue from the interior of an organ and monitoring a proximity of the tissue removal device to a surface of the organ to prevent the surface of the organ from being cut or breached by the cutting device. In some variations, the cutting device advances through the outer surface of the organ when inserted into a cavity within the organ. In alternate variations, the device is introduced through an opening of the organ. The devices and methods described herein are explained with respect to performing a hysterectomy. However, the methods, devices and systems can be used in any body location unless otherwise specifically claimed.

[0008] In one example, the prevent disclosure teaches a system for resecting tissue within an interior of an organ. Such a variation can include a probe having a proximal portion and a distal portion; a cutting member configured to remove tissue and located at the distal portion of the probe; at least one sensor located adjacent to the cutting member, the sensor configured to generate a signal comprising an environmental condition adjacent to the cutting member; and a controller configured to receive the signal of the environmental signal and use the signal to determine whether the cutting member is adjacent to an exterior surface of the organ.

[0009] The sensor can comprise a mechanism selected from a group consisting of: a capacitance sensing mechanism, an impedance sensing mechanism, an optical sensing mechanism, and an ultrasound mechanism.

[0010] In one variation of the system, the controller is configured to generate an alert signal upon detecting that the cutting member is adjacent to the exterior surface of the organ. Such an alert signal can comprise an aural alert, a visible alert, a tactile alert, and a combination thereof.

[0011] The probe and cutting mechanism can comprise a mechanical or an electrosurgical based cutting mechanism. In certain variations, the sensor is located adjacent to the cutting mechanism or adjacent to a window or opening in the probe that exposes the cutting member.

[0012] In variations where the cutting mechanism comprises an electrosurgical cutting mechanism, the cutter can comprise an electrode element, a resistively heated element, an inductively heated element, an ultrasound transmission element and a light energy transmission element.

[0013] The controller of the present system can include an algorithm for de-activating the cutting member in response to the signal that the cutting member is within a predetermined proximity to the organ surface. The algorithm can also modulate the speed that the cutting member removes tissue.

[0014] The systems described herein can further comprise a negative pressure source in fluid communication with the probe and cutting mechanism, where the negative pressure source extracts resected tissue through a passageway in the probe. Alternatively, or in combination, the systems can comprise a positive pressure source in fluid communication with the probe.

[0015] The present disclosure also includes methods for resecting tissue. In one such variation, the method can comprise introducing a probe into an interior of an organ, wherein a working end of the probe includes a cutter and sensor mechanism adjacent to the cutter, where the sensor mechanism is configured to detect a surface of the organ; resecting tissue with the cutter generating a signal with the sensor mechanism when the sensor mechanism detects the cutter approaching the organ surface from the interior of the organ; and removing a substantial volume of the organ from within the interior of the organ without the cutter perforating the organ surface from the interior thereby preventing dispersion of potentially malignant tissue.

[0016] The method can further include variations where the sensor mechanism comprises at least one of a capacitance sensing mechanism, an impedance sensing mechanism, an optical sensing mechanism and an ultrasound mechanism. In an additional variation, the sensor mechanism is operatively coupled to a controller to provide signals consisting of at least one of aural, visible or tactile signals.

[0017] The method can also include a controller that employs an algorithm for de-activating the cutter in response to a signal that the cutter is within a pre-determined proximity to the organ surface. The de-activating step can comprise stopping movement of the cutter or stopping energy delivery to the cutter. In additional variations, the controller includes an algorithm for modulating the speed of movement of the cutter in response to a the signal that the cutter is within a pre-determined proximity to the organ surface.

[0018] Variations of the method can also include mobilizing mobilizing the organ with the intact organ surface after the substantial volume is removed and removing the organ from the patient's body.

[0019] In an additional variation, a method of resecting tissue comprises introducing a probe into an interior of an organ, wherein a probe working end includes a first sensor component; disposing a second sensor component at an exterior surface of the organ; and activating the probe to resect tissue wherein the first and second sensor components cooperate to provide at least one signal indicating a proximity of the probe to the exterior surface of the organ. At least one of the sensor components comprises a component selected from the group consisting of a capacitance sensing mechanism, an impedance sensing mechanism, an optical sensing mechanism and an ultrasound mechanism and the other sensor component cooperates to enhance a sensitivity of said signals.

[0020] The sensor component can include a gas, liquid or gel disposed at the exterior of the organ. Alternatively, or in combination the second sensor component comprises a sac disposed at the exterior of the organ.

[0021] In an additional variation, the present disclosure include a method for laparoscopic hysterectomy. For example, the method can include introducing a probe into a uterine cavity, wherein a probe working end includes a sensor mechanism for sensing the proximity of the cutter to an exterior surface of a uterine wall; activating the probe to resect tissue from within the uterine cavity wherein the sensor mechanism provides signals indicating the proximity of the cutter to said exterior surface; and removing a substantial volume of the tissue from within the uterine cavity without perforating the uterine wall thereby preventing dispersion of potentially malignant uterine tissue **29**. The method of claim **28** preceded by the step of sealing and/or ligating blood vessels communicating with the uterus.

[0022] The method can further comprise removing a substantial volume of the tissue within the uterine cavity without perforating the uterine wall from within the cavity such that the uterine wall forms an intact shell. The method can also include transecting the shell of the uterine wall away from the patient's body.

[0023] The methods and/or devices described herein can be performed in a supracervical procedure, a trans-vaginal approach, an endoscopic approach, or in an open surgical approach.

[0024] In an additional variation, a method of resecting at least a portion of an organ can include isolating the tissue mass or organ from its blood supply; introducing a resecting probe into the organ, wherein a probe working end includes a cutter and sensor mechanism for sensing the proximity of the cutter to a surface of the organ; activating the cutter to resect tissue wherein the sensor mechanism provides signals indicating the proximity of the cutter to the organ surface; and removing a substantial volume of the organ without perforating the organ surface thereby preventing dispersion of potentially malignant tissue.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The disclosed variations will next be described in greater detail by reference to exemplary embodiments that are illustrated in the drawings.

[0026] FIG. **1** is a schematic view of a tissue resection device and block diagram of operating components corresponding to the invention for use in a laparoscopic resection procedure.

[0027] FIG. **2** is a perspective view of the working end of a resection device of the type shown in FIG. **1** showing a sensor mechanism carried by the working end.

[0028] FIG. **3**A is a schematic view of the patient's uterus and abdominal region showing initial steps of a laparoscopic hysterectomy procedure with an ultrasound component decoupled from a resection device. The ultrasound component can optionally a plurality of piezoelectric elements carried therein.

[0029] FIG. **3**B is a sagittal view of the patient's uterus and abdominal cavity showing another step comprising introducing a trocar through the uterine wall from the abdominal cavity.

[0030] FIG. **3**C is a sagittal view of a step comprising introducing the resecting device into the interior of the uterus, actuating the device to reset tissue and removing tissue through passageway in the resecting device.

[0031] FIG. **3**D is a sagittal view of a further step comprising introducing utilizing the resecting device to reset and remove a substantial volume of the interior of the uterus while sensor mechanisms indicate and/or control when a cutting member comes into proximity to the wall of the uterus.

[0032] FIG. **4** is a sagittal view of the patient's uterus and abdominal cavity showing the variation in the method wherein a sensor responsive media is applied around the exterior surface of the uterus.

[0033] FIG. **5** is another sagittal view of the patient's uterus and abdominal cavity showing another variation in the method wherein a sensor responsive mesh sac is disposed around the exterior surface of the uterus.

DETAILED DESCRIPTION OF THE INVENTION

[0034] FIGS. **1** and **2** illustrate a tissue resection system **100** that includes a hand-held single-use tissue cutting device or resection device **105**. The device **105** has a handle portion **106** that is coupled to a shaft portion **110** having an outer diameter ranging from about 3 mm to 20 mm. The shaft portion **110** extends along axis **111** and can have a length suitable for introducing directly into a body space or into an organ, for example introducing though a trocar in a laparoscopic procedure or for introducing through a working channel of an endoscope.

[0035] In one variation, a hand-held resecting device **105** as depicted in FIGS. **1** and **2** can be used to perform a laparoscopic hysterectomy procedure as depicted in FIGS. 3A to 3D. Referring to FIGS. **1** and **2**, the resection device **105** is a tubular cutter as is known in the art with a shaft portion **110** and working end **112**. The shaft **110** comprises an assembly of a first or outer sleeve **115** extending along axis **111** to a distal end **116** having a window **118** therein for receiving tissue. A second or inner sleeve **125** with a distal blade edge **126** and distal opening **128** is dimensioned to rotate in bore **132** of outer sleeve **115**. The outer and inner sleeves, **115** and **125**, can be fabricated of thin-wall stainless steel but any other suitable materials can be used. As can be understood from FIGS. **1-2**, rotation of the inner sleeve **125** will cut tissue captured in the window **118** of the outer sleeve. FIG. **2** shows the working end **112** of the assembly of outer sleeve **115** and inner sleeve **125** with the inner sleeve **125** rotating and in a partially window-open position.

[0036] As can be seen in FIG. **1-2**, the resection system **100** can include a controller **140** that is adapted for (i) controlling a motor drive in the resecting device **105** as will be described below; (ii) controlling at least one sensor system carried by the resection device **105** that will be described further below, (iii) controlling a negative pressure source or outflow pump **150** operatively coupled to a tissue extraction channel **152** in the resection device **105**, and (iv) controlling an optional fluid source **155** and inflow pump **160** for distending or flooding a treatment site with a fluid, such as saline.

[0037] Referring FIG. **1**, the controller **140** includes algorithms for driving a motor **162** in the handle **106** of the resecting device **105**. The motor can be a brushless DC motor and controller **140** can be configured to operate the motor at a preset RPM or a user-selected RPM between 100 and 2,000 RPM. FIG. **1** shows an electrical cable **166** extending from connector **168** in the controller **140** to the resecting device handle **106**. The resecting device **105** can be operated by a switch **170** in the handle **106** or a footswitch indicated that **174** coupled to the controller **140**.

[0038] Still referring to FIG. **1**, the controller **140** includes a roller pump **150** that provides a negative pressure source for extracting tissue through the passageway **152** in the resecting device **105**. The roller pump **150** in combination with the flexible tubing **176** is configured to pump fluid and extracted tissue chips through the tubing into the collection reservoir **178**.

[0039] Again referring to FIG. **1**, controller **140** can have a second roller pump **160** adapted to provide fluid flows into a site targeted for resection. A fluid source **155** is coupled to a flexible fluid infusion tubing **182** that is engaged by the roller pump **160** and that further extends to a fitting **187** on cannula **190** which is adapted for access to the treatment site. The cannula **190** can inserted into the site and can be used as an access pathway for the resection device **105** or the cannula can be used for fluid infusion independent of the resection device. In another variation, the fluid infusion tubing **182** can be coupled to the resection device **105** so that fluid flows to the working end **112** and window **118** in a path in the annular space between the outer sleeve **115** and the inner sleeve **125**.

[0040] Now turning to FIG. **2**, the working end **112** of the resecting device **105** is shown in an enlarged perspective view. In one variation shown in FIG. **2**, a sensor system is shown disposed around the cutting window **118** in the working end. This variation shows four capacitance sensors **210** disposed around the window **118** which comprise the distal termination of paired wire leads as is known in the art capacitance sensors. The capacitance sensors **210** are coupled to the controller **140** through cable **214** (FIG. **1**). The sensors **210** can be carried in a thin polymeric coating **220** on the outer sleeve **125**. In this embodiment, there are four capacitance sensors, but there could be from 1 to 20 sensors on the outer sleeve **125**. In another variation, one or more capacitance sensors could be carried on the inner sleeve surface opposing the sharp blade edges. As will be described below, capacitive sensors **210** can provide a signal to the user when the cutting blade **126** (FIG. **2**) approaches the periphery of an organ targeted for resection. While FIG. **2** shows a variation of the resecting device **105** with capacitance sensors **210**, it should be appreciated that other types of sensors can be used to determine the proximity of the cutting blade to an organ periphery, such as optical sensors, impedance sensors, magnetic sensors and the like.

[0041] Now turning to FIGS. **3**A to **3**D, a method corresponding to the invention is described relating to the resection of a uterus in a new form of laparoscopic hysterectomy. FIG. **3**A is a schematic view of the patient's abdominal cavity and a uterus **240** targeted for resection. In a first step of the method, a first sleeve or cannula **242** is introduced through the abdominal wall **244** and an endoscope **245** is inserted through the sleeve to provide a field of view **246** in the abdominal cavity **248**.

[0042] FIG. 3A further shows a second cannula **252** introduced through the abdominal wall **244** after which a cutting-sealing device **255**, such as electrosurgical cutting and sealing device, is introduced through the cannula **252** for use in sealing and transecting blood vessels communicating with the uterus **240**. As is known in the art or performing a laparoscopic hysterectomy, the uterine arteries are sealed and transected, and the broad ligaments, fallopian tubes and fascia are transected along lines A and B to mobilize the uterus **240**. Thereafter, the cutting-sealing device **255** is withdrawn from cannula **252**.

[0043] FIG. 3B depicts a subsequent step of the method wherein a sharp trocar sleeve **260** is introduced through the second cannula **252** by the physician and then, under laparoscopic vision, the distal tip **262** of the trocar sleeve **260** is advanced through the uterine wall **244** into the uterine cavity **268**.

[0044] FIG. 3C shows the next step in the method wherein the resection device **105** is introduced through the cannula **252** and trocar sleeve **260** into the interior of the uterus **240**, and thereafter the trocar sleeve **260** is withdrawn leaving the working end **112** of the resection device **105** within the interior of uterus **240**. In one variation of the method, the fluid source **155** and infusion tubing **182** are coupled to the resection device **105** to provide a fluid flow into the uterine cavity **268** through the annular space between the outer sleeve **115** and the inner sleeve **125** (see FIGS. **1-2**). By this means, the uterine cavity **268** can be distended to some extent, while the controlled fluid inflow assists in the resecting procedure and further assists in the extraction of tissue debris from the site. In another variation (not shown), a cervical seal member can be introduced trans-vaginally to seal the uterine cavity **268**, wherein the cervical seal can be a probe shaft, an inflatable member or other types of seals know in the art. In another variation, the fluid source **155** and infusion tubing **182** can be coupled to a trans-cervical probe and seal (not shown) to provide a fluid flow into the uterine cavity **268**.

[0045] Still referring to FIG. **3**C, the physician then can actuate the resecting device **105** to resect tissue in a blind method while observing the exterior of the uterus **240** with the endoscope **245**. The physician can manipulate the working end **112** of the resecting device **105** to core out the interior of the uterus **240** while leaving the uterine wall **244** completely intact as it cores tissue from within and apart from any access openings. It can now be seen that the purpose of the capacitance sensors **210** is provide signals to indicate the proximity of the cutting blade **126** to the exterior of the uterine wall **244**. As indicated in FIG. **3**D, in one variation, the capacitance sensors **210** can sense a change in tissue capacitance when the window **118** and blade move close to the exterior of the uterine wall **244**. The plurality of capacitive sensors **210** as shown in FIG. **2** allows for sensing proximity to the surface of the uterine wall no matter the orientation of the working end **112**. The resecting procedure can be considered complete when the physician has removed a substantial volume of tissue from the interior of uterus **240** and in effect leaves only a shell **288** of the uterus in place as shown in FIG. **3**D. By this means, it can be understood that no resected tissue, and thus no potentially malignant tissue, has been exposed outside of the interior of uterus **240**. Rather, all tissue has been resected and immediately extracted through passageway **152** in the inner sleeve **125** and then collected in the collection chamber **178** with no possibility of contaminating the abdominal cavity **248**. In one aspect of the method, at least 50%, at least 60%, at least 70%, at least 80% or at least 90% of the mass of the uterus **240** is resected and extracted to leave a reduced-volume shell **288** of the uterus (FIG. **3**D). Following the resection and extraction of the bulk of the uterus **240**, the reduced-volume shell **288** of the uterus can be removed in methods known as in a conventional supracervical or other laparoscopic hysterectomy procedure. Typically, the reduced-volume uterine shell **288** can be removed intact in a trans-vaginal approach.

[0046] During the resection steps described above, the controller **140** can modulate fluid inflows to and from the site by controlling the roller pumps. The flow rates into and out of the uterine cavity **268** can be from 10 mL/min to 1000 mL/min, and also can be modulated depending on a cutting speed selected by the physician.

[0047] In another embodiment in another variation shown in FIG. **4**, a sensor enhancing media may be sprayed, painted flooded or otherwise disposed around the exterior of uterus **240** to enhance the sensitivity of the capacitance sensors **210** or other sensing mechanism. For example, FIG. **4** illustrates a conductive gel **290** that may be sprayed or painted onto the exterior of the mobilized uterus **240** which will increase the resolution of the capacitive sensors **210**. Such a media **290** can be a conductive gel, such as a hypertonic saline gel. A similar conductive gel would enhance the resolution impedance sensors. In another variation, a magnetic sensitive material could be disposed around the uterus **240** which could increase the resolution of a magnetic sensor carried by the working end **112** of the resecting device **105**. In another variation shown in FIG. **5**, a mesh net **300** can be disposed around the uterus **240** for similar purposes. For example, a structure similar to that stretchable nylon stocking with conductive threads could be disposed around the uterus **240** to increase the sensitivity of a capacitance sensor **210**, an impedance sensor or a magnetic sensor.

[0048] In another variation, a source of illumination or light emitters may be disposed in one or more locations around the window **118** of the exterior sleeve **125**. Such illumination or light emitters can added to the device of FIG. **2**, or can be used instead of capacitance sensors **210** or other sensors. The light emitters can be, for example, a distal end of one or more optical fibers, an LED source, or other source of visible illumination. It can be understood that the physician then can see the brightness of the light through the translucent uterine wall and understand the proximity of the cutting blade **126** to the wall surface.

[0049] In one variation, the controller **140** includes algorithms to modulate or terminate operation of the resecting device **105** when the capacitance sensors **126** or other sensor mechanism indicate the proximity of the cutting blade to the exterior of uterine wall **244**. In another variation, the sensor system can provide warning signals to the position of the cutting blade in the form of aural, visual or tactile signals.

[0050] By using the system and method described above, it can be understood that the laparoscopic hysterectomy can be performed without risk of dispersing any potentially malignant tissue in the abdominal cavity **268**. All resected tissue chips are maintained within the interior of the uterus **240** with the uterine wall itself functioning as a containment sac. The system and method can be performed with any type of resecting device, such as a mechanical cutter as shown herein, in which a blade can cut by rotation, reciprocation or both. In other variations, the resecting device may be an RF device, ultrasound device, laser device, microwave device, resistive heat device or the like.

1. A system for resecting tissue within an interior of an organ, the system comprising:
- a probe having a proximal portion and a distal portion;
- a cutting member configured to remove tissue and located at the distal portion of the probe;
- at least one sensor located adjacent to the cutting member, the sensor configured to generate a signal comprising an environmental condition adjacent to the cutting member;
- a controller configured to receive the signal of the environmental signal and use the signal to determine whether the cutting member is adjacent to an exterior surface of the organ.

2. The system of claim **1**, where the sensor comprises a mechanism selected from a group consisting of: a capacitance sensing mechanism, an impedance sensing mechanism, an optical sensing mechanism, and an ultrasound mechanism.

3. The system of claim **1**, where the controller is configured to generate an alert signal upon detecting that the cutting member is adjacent to the exterior surface of the organ.

4. The system of claim **3**, where the alert signal is selected from a group consisting of an aural alert, a visible alert, a tactile alert, and a combination thereof.

5. The system of claim **1** where the cutting member comprises a moveable blade edge.

6. The system of claim **5**, where the moveable blade edge is located within the probe and exposed at a cutting window.

7. The system of claim **1**, where the cutting member comprises an energy transmission element.

8. The system of claim **7**, where the energy transmission element comprises at least one of an electrode element, a resistively heated element, an inductively heated element, an ultrasound transmission element and a light energy transmission element.

9. The system of claim **1**, where the controller is configured to includes an algorithm for de-activating the cutting member in response to the signal that the cutting member is within a pre-determined proximity to the organ surface.

10. The system of claim **1**, where the controller includes an algorithm for modulating the speed that the cutting member removes tissue.

11. The system of claim **1**, further comprising a negative pressure source in fluid communication with the probe and cutting mechanism, where the negative pressure source extracts resected tissue through a passageway in the probe.

12. The system of claim **1**, further comprising a positive pressure source in fluid communication with the probe.

13. A system for resecting tissue within an interior of an organ, the system comprising:

a probe having a proximal portion and a distal portion;

a cutting member configured to remove tissue and located at the distal portion of the probe; and

at least one illumination source located adjacent to the cutting member, the illumination source configured to provide an illumination visible through an outer surface of the organ when placed within the organ.

14. The system of claim **13** where the illumination source comprises an end of at least one optical fiber, an LED source, and an incandescent source of light.

15. A method of resecting tissue, comprising:

introducing a probe into an interior of an organ, wherein a working end of the probe includes a cutter and sensor mechanism adjacent to the cutter, where the sensor mechanism is configured to detect a surface of the organ;

resecting tissue with the cutter

generating a signal with the sensor mechanism when the sensor mechanism detects the cutter approaching the organ surface from the interior of the organ; and

removing a substantial volume of the organ from within the interior of the organ without the cutter perforating the organ surface from the interior thereby preventing dispersion of potentially malignant tissue.

16. The method of claim **15** wherein the sensor mechanism comprises at least one of a capacitance sensing mechanism, an impedance sensing mechanism, an optical sensing mechanism and an ultrasound mechanism.

17. The method of claim **15** wherein the cutter includes a moveable blade edge configured for resecting tissue.

18. The method of claim **15** wherein the cutter includes an energy transmission element configured for resecting tissue.

19. The method of claim **18** wherein the energy transmission element comprises at least one of an electrode element, a resistively heated element, an inductively heated element, an ultrasound transmission element and a light energy transmission element.

20. The method of claim **15** wherein the sensor mechanism is operatively coupled to a controller to provide signals consisting of at least one of aural, visible or tactile signals.

21. The method of claim **20** wherein the controller includes an algorithm for de-activating the cutter in response to a signal that the cutter is within a pre-determined proximity to the organ surface.

22. The method of claim **21** wherein the de-activating step comprises a east one of stopping movement of the cutter or stopping energy delivery to the cutter.

23. The method of claim **20** wherein the controller includes an algorithm for modulating the speed of movement of the cutter in response to the signal that the cutter is within a pre-determined proximity to the organ surface.

24. The method of claim **20** wherein the controller includes an algorithm for modulating energy delivery to the cutter in response to the signal that the cutter is within a pre-determined proximity to the organ surface.

25. The method of claim **15** further comprising mobilizing the organ with the intact organ surface after the substantial volume is removed and removing the organ from the patient's body.

26. The method of claim **15** wherein the probe working end has a windowed outer sleeve and the cutter is moveable relative to the window by at least one of rotation and reciprocation.

27. The method of claim **15** further comprising the step utilizing a negative pressure source to extract resected tissue from the working end through a passageway in the probe.

28. The method of claim **15** further comprising the step utilizing a positive pressure source to extract resected tissue from the working end through a passageway in the probe.

29. The method of claim **15** further comprising the step of introducing a distention fluid into the interior of the organ.

30. A method of resecting tissue, comprising:

introducing a probe into an interior of an organ, wherein a probe working end includes a first sensor component;

disposing a second sensor component at an exterior surface of the organ; and

activating the probe to resect tissue wherein the first and second sensor components cooperate to provide at least one signal indicating a proximity of the probe to the exterior surface of the organ.

31-47. (canceled)

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摘要(译)

用于在微创腹腔镜手术中从患者身体内部切除和移除组织或器官的系统和装置，同时在切除过程中防止潜在恶性组织的任何分散。