(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 September 2008 (12.09.2008)

PCT

(10) International Publication Number
WO 2008/109014 A2

(51) International Patent Classification:
F25B 45/00 (2006.01)

(21) International Application Number:
PCT/US2008/002759

(22) International Filing Date:
29 February 2008 (29.02.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/904,270 1 March 2007 (01.03.2007) US

(71) Applicant *(for all designated States except US)*: **MEDTEK DEVICES, INC. DBA/ BUFFALO FILTER** [US/US]; 595 Commerce Drive, Buffalo, NY 14228 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **DEAN, Robert, O.** [US/US]; 83 Devonshire Rd., Buffalo, NY 14223 (US). **KAJDAS, Jay, T.** [US/US]; 83 Schimwood Court, Getzville, NY 14068 (US).

(74) Agent: **LOHRMAN, C., Richard**; Simpson & Simpson, PLLC, 5555 Main Street, Williamsville, NY 14221 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL,

[Continued on next page]

(54) Title: WICK AND RELIEF VALVE FOR DISPOSABLE LAPARSCOPIC SMOKE EVACUATION SYSTEM

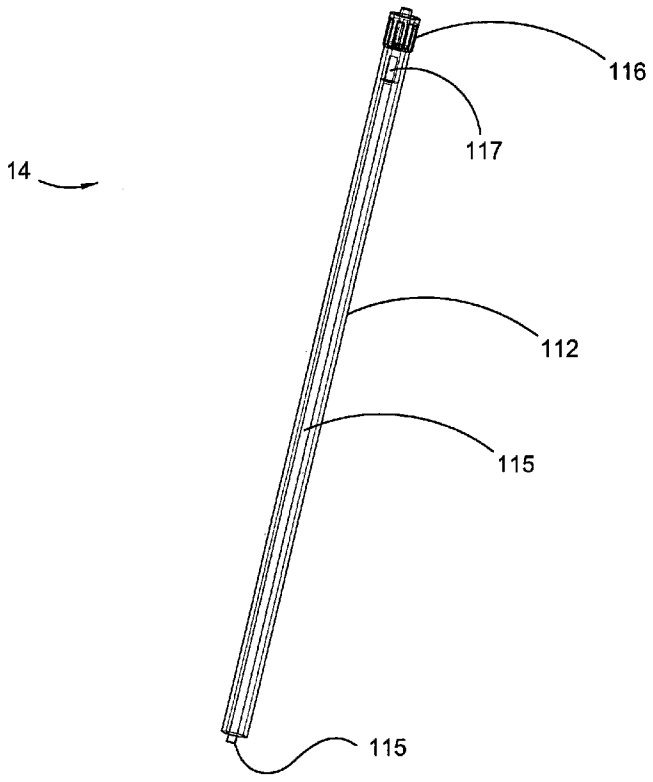

Fig. 3A

(57) Abstract: The present invention relates to an improved smoke evacuation device for use in laparoscopic surgeries. One improvement is a hydrophilic wick positioned within the inlet system of the smoke device for absorbing moisture and trapping surgical waste entering the smoke evacuation device. The second improvement is a multi-outlet valve inserted into the outlet system of the smoke evacuation device to enable quick depressurization of the surgical site.

WO 2008/109014 A2

NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

WICK AND RELIEF VALVE FOR DISPOSABLE LAPARSCOPIC SMOKE EVACUATION SYSTEM

CROSS REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims the priority benefit of U.S. Provisional Patent Application No. 60/904,270, filed March 1, 2007.

FIELD OF THE INVENTION

[0002] The invention relates to surgical procedures and, more specifically, to a device for more efficiently removing surgical waste and vapor smoke-free environment within the surgical field during laparoscopy.

BACKGROUND OF THE INVENTION

[0003] Laparoscopy is a fast growing surgical modality widely used in the treatment of certain prevalent physical ailments. Laparoscopy entails the introduction of an endoscope, light source, and surgical instruments through ports formed in the patient's abdomen. In order to facilitate the procedure, the patient's abdominal cavity is inflated with a suitable gas typically CO_2 to give the surgeon additional working area and minimize obstruction. Generally, laparoscopy avoids the risks of laparotomy, which requires the surgeon to open the abdomen and carry out the required procedure by his or her direct viewing.

[0004] However, when the laparoscopic procedure requires tissue removal by ablation, several channels through the abdominal wall are required. These include a channel for the laparoscopic camera needed for viewing the surgical field, a channel for the laser or electrosurgical instrument used to burn the target tissue, a channel for insufflation (introduction of CO_2 gas into the patient's cavity to expand the patient's cavity) with CO_2 gas, and a means for withdrawal of gas and smoke. Note that insufflation with a suitable gas is required during the laparoscopic procedure so as to provide both increased cavity volume and optimal visual conditions during the surgical procedure. A smoke clearing system is usually employed in order to maintain both the

visual clarity and proper abdominal pressure within the expanded cavity during the procedure.

[0005] A common procedure for positioning the laparoscopic assembly in the patient's abdominal cavity includes first making an incision into the patient's abdominal wall through which a large gauge needle is inserted. A suitable gas, typically CO_2, is then introduced into the patient's abdominal cavity through the needle. The needle is then replaced with a trocar, which is then removed leaving behind a sleeve, or cannula, through which a laparoscope is introduced into the abdominal cavity. In order to perform laser or electrosurgery one or two additional small incisions are made in the abdominal wall over the surgical site and cannula/trocar assemblies positioned accordingly. These cannula/trocar assemblies may be used for the positioning of the insufflation tube as well as any other surgical instruments that may be required for the particular laparoscopic procedure.

[0006] A laparoscopic procedure typically requires a surgeon to employ either electrosurgery or laser surgery within the confined space of the patient's abdominal cavity. This surgery typically involves tissue burning or ablation. This tissue burning leads to the creation of smoke. Surgical smoke within the confines of a patient's abdominal cavity reduces the surgeon's view of the surgical site, increases the patient's hematocrit levels, and causes delays in the surgery while the smoke is cleared from the laparoscopic field. Efficient removal of the smoke is thus a necessity for the surgical team during the laparoscopic procedure.

[0007] Although a laparoscopic evacuation system ("lapevac system") is effective in maintaining cavity inflation pressure, one problem that occurs during its operation is the clogging of the inlet tube and filter by solid waste, water and humidity carried out of the abdominal cavity by the incoming waste stream. Because the cavity is moist and may be heated above normal temperature by some surgical procedures such as cauterization, surgical wastes can be driven off the cavity wall and internal organs in the form of particles, vapor, and liquids from broken cells and tissues. In addition, vapors within the cavity itself can be drawn into the waste stream. Another problem that may occur during laparoscopic surgery is the insufficient removal of waste vapor from the cavity, stratification of water vapor in the cavity as well as other visualization problems.

[0008] Therefore, there is a need in the field for an improved laparoscopic surgical system that is designed to prevent clogging of the inlet and filter by surgical waste and that will reduce or eliminate stratification of smoke and water vapor in the abdominal cavity during laparoscopic surgery

SUMMARY OF THE INVENTION

[0009] The present invention is an improvement of a laparoscopic surgical device that comprises a smoke removal apparatus having a housing, inlet means for defining an inlet pathway for impure gas from a surgical cavity to the housing, wherein the inlet means includes locking means for connecting the surgical cavity to the inlet pathway, filter means for filtering impurities from impure gas to form filtered gas, outlet means for defining an outlet pathway for the filtered gas from the housing to the surgical cavity, and a fan for drawing impure gas from the surgical cavity through the inlet means and through the filter means to form the filtered gas and for driving the filtered gas through the outlet means into the surgical cavity, wherein the outlet means are adapted to a laparoscopic surgical instrument assembly, the improvement comprising a hydrophilic wick inserted into and attached to the locking means of the inlet means.

[0010] In a separate improvement, the improvement to the smoke removal apparatus comprises a multi-outlet valve incorporated into the outlet means.

[0011] In an additional embodiment, the improvement to the smoke removal apparatus comprises both a hydrophilic wick inserted into and attached to the inlet means and a multi-outlet valve incorporated into the outlet means.

[0012] One object of the present invention is to reduce or eliminate blocking of the inlet means by surgical waste.

[0013] A second object of the present invention is reduce or eliminate stratification of surgical smoke and water vapor in the abdominal cavity by supplying a venting valve on the outlet means of the surgical smoke removal device to effect quick removal of smoke and water vapor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The nature and mode of operation of the present invention will now be more fully described in the following detailed description of the invention taken with the accompanying drawing figures, in which:

[0015] Figure 1 is a schematic view of a laparoscopic smoke evacuation system of the prior art depicting the arrangement of the smoke evacuation system during laparoscopic surgery;

[0016] Figure 2 is a top perspective view of a typical disposable laparoscopic smoke evacuation system with the improvements of the present invention;

[0017] Figure 3 is an exploded top perspective view of the disposable laparoscopic smoke evacuation system shown in Figure 2;

[0018] Figure 3A depicts an enlarged view of the wick assembly of the present invention inserted into the inlet tube of the smoke evacuation system;

[0019] Figure 4 is a top perspective view depicting the components of the wick assembly of the present invention in an assembled condition;

[0020] Figure 4A is a top perspective view of a partially disassembled wick assembly;

[0021] Figure 4B is a side view of the assembled wick assembly of the present invention;

[0022] Figure 5 is a side view of the wick component of the wick assembly of the present invention;

[0023] Figure 5A is an end view showing one embodiment of the wick depicted in Figure 4;

[0024] Figure 5B is an isometric view of the wick shown in Figure 4;

[0025] Figure 6A is an isometric view of one embodiment of the two-way valve of the present invention in the divert mode;

[0026] Figure 6B is a top view of the two way outlet valve of the present invention in the divert mode;

[0027] Figure 6C is a side view of the two-way outlet valve from the side facing the outlet port in the divert mode;

[0028] Figure 6D is a cross section of the two-way valve taken along line H-H in Figure 5B in the divert mode;

[0029] Figure 7A is an isometric view of the two-way valve showing the valve barrel in the open (flow through) mode;

[0030] Figure 7B shows a top view of the two-way valve in the open mode;

[0031] Figure 7C is a side view of the two-way valve in the open mode facing the side of the outlet showing the open channel to the valve outlet;

[0032] Figure 7D is a cross section of the two-way valve taken along line I-I in Figure 6B showing the channel configuration when the valve is in the open mode;

[0033] Figure 8A is a top view of a second embodiment of the two-way outlet divert valve in the off mode;

[0034] Figure 8B is a top view of the second embodiment of the two-way outlet valve in the open mode; and,

[0035] Figure 8C is a top view of the second embodiment of the two-way outlet valve in the divert mode.

DETAILED DESCRIPTION OF THE INVENTION

[0036] At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical structural elements of the invention. While the present invention is described with respect to what is presently considered to be the preferred embodiments, it is understood that the invention is not limited to the disclosed embodiment.

[0037] Furthermore, it is understood that this invention is not limited to the particular methodology, materials and modifications described and as such may, of course, vary. It is also understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to limit the scope of the present invention.

[0038] Adverting now to the figures, Figure 1 is a schematic view of a laparoscopic smoke evacuation system of the prior art depicting the arrangement of the smoke evacuation system during laparoscopic surgery. Smoke clearing device **10** includes housing **12**. Housing **12** may be made out of a variety of materials, such as a

metal or a plastic, as long as the material facilitates the device's use and is preferably disposable. The housing **12** preferably has a generally rectangular box shape or it may have a generally cylindrical hollow shape, preferably with rounded corners. The housing **12** contains an inlet port **14** at one end, i.e., on one side and an outlet port **16** at the other end, i.e., on the opposite side. One end of an inlet tube **18** is connected to the inlet port **14**. One end of an outlet tube **20** is connected to the outlet port **16**. This tubing is preferably conventional sterile flexible plastic tubing. It is envisioned that conventional Luer lock structures **22** will be used to connect the tubes **18** and **20** to the housing **12**, but other locking structures could alternatively be used.

[0039] The patient's inner cavity, such as the abdominal cavity, is shown as **24** and the patient's skin is schematically shown as **25** in Figure 1. The patient's tissue which is to be removed is shown as **26**, with the surgical smoke shown and indicated as **26a**, **26b**, and **26c**. Three trocars containing laparoscopic surgical instrument clusters **28**, **30** and **32** extend through the patient's skin **25** into the cavity **24**.

[0040] These groups of instruments are representative of the type of instruments that are typically used in laparoscopic surgery. Each instrument cluster includes a cannula/trocar for introducing the instrument into the patient's cavity and maintaining a seal to the cavity **24** to preclude gas escape from the cavity **24**. Each cannula/trocar has a single channel or passage along its length that allows instruments to be inserted into the body while maintaining the intra-abdominal pressure created by insufflation. Instrument cluster **28** is a single channel instrument cluster which serves to house the laser instrument **34** and direct the laser beam to the operating site. An annular channel **36** around the instrument **34** within the trocar serves as an annular egress passage from near the operating site for gas to be drawn around the laser instrument **34** and out of the patient's cavity to the smoke clearing device **10** of the present invention.

[0041] Figure 2 is a top perspective view of a typical disposable laparoscopic smoke evacuation system **100** ("lapevac **100**"). Such devices are described in U.S. Patent No. 6,544,210 to Trudel, et al. which is hereby incorporated by reference in its entirety. Housing **111** is shown with inlet means, in this case inlet tube **112** and outlet means, in this case outlet tube **120** attached to inlet attachment **112a** and outlet attachment **120a**, respectively. Inserted into the input end of inlet tube **112** is wick assembly **114**.

Attached to the outlet attachment **120a** is the inlet of one embodiment of a multi-outlet relief valve, in this case a two-way bleed or relief valve, t-tap valve **150**. By two-way valve is meant a valve that has at least two outlets that allow material, such as a gas or liquid fluid, that enters the valve to be directed to one of two or more different outlet flow paths. Also seen is y-connector **124** ("connector **124**") at the end of outlet tube **120**. Persons of skill in the art will recognize that the two-way valves may be connected to outlet tube **120** in any convenient position within the length of outlet tube **120** and that valves having more than two outlets may also be used.

[0042] Figure 3 is an exploded top perspective view of lapevac **100**. Inlet hose **112** is seen attached to inlet attachment **112a**. Inlet assembly **130** includes inlet **131** which covers the fan or pump assembly to include impeller cover **132**, impeller **133**, fan **134**, and fan mount **134a** which are all attached to motor **136**. Battery cover **111a** covers battery (ies) **138** used to power motor **136**. Although a plurality of AA batteries are shown in Figure 3, persons of skill in the art will recognize that a single battery, various appropriate battery assemblies with different capacities, or alternative ac power sources may be used to provide power to motor **136**.

[0043] Outlet **142** covers filter **140** positioned on the downstream side of fan assembly **130**. In the preferred embodiment shown, filter **140** includes activated carbon media **141a** as a prefilter plus ultra low particulate air (ULPA) filter **141b**. Outlet attachment **120a** extends from outlet **142** and is seen connected to t-tap valve **150**. One end of outlet tube **120** is connected to t-tap valve **150**, while the other end is connected to connector **124**. A locking means **126** is positioned on at least one outlet of y-connector **124** to enable y-connector **124** to be securely attached to an additional component. In one embodiment, locking means **126** is a luer lock. Cap **127** is used to block an unused outlet of y-connector **124**. In a preferred embodiment, locking means **116**, such as a luer lock, may be positioned at the input end of inlet tube **112** as shown in Figures 2 and 3. Locking means utilized throughout the invention are defined as connections between two components that prevent the escape of vapor, liquid, or fumes from the connection itself. Examples of locking means are luer locks, tube connections in which one tube is inserted into another tube, interference fittings, Colder couplers and other connectors known t those skilled in the art that prevent the escape of fumes from a connection point.

[0044] Y-connector **124** receives filtered gas from lapevac **100**. One of the two outlets of y-connector **124** can be connected to an insufflator while the second outlet can be connected to a second inlet into the abdominal cavity enabling gas filtered by lapevac **100** ("filtered gas") to be pumped into the abdominal cavity at two locations to help remove waste vapors generated by the laparoscopic surgical procedures.

[0045] Figure 3A depicts an enlarged view of wick assembly **114** incorporated into inlet tube **112**. Inlet tube **112** is cut way to more clearly show wick **115**. Luer lock **116** is shown at the inlet end of inlet tube **112**.

[0046] Figure 4 is a top perspective view depicting the components of wick assembly **114** joined together in an assembled condition. Luer lock **116** is shown at the inlet end of inlet tube **112**. Interference fitting **117** ("fitting **117**") is attached to luer lock **116** and wick **115**. Wick assembly **114** is inserted into inlet tube **112** and held in place by the friction of interference fitting **117** against the inner wall of inlet tube **112**. Wick **115** is in the form of a strand or filament that extends into inlet tube **112**. Preferably, wick **115** is fabricated from a hydrophilic material such as polyvinyl alcohol (PVA) or cotton. Wick **115** is sized with a diameter small enough to allow sufficient space for airway **119** between wick **115** and inner wall of inlet tube **112** to form a passage to allow smoke, air and other fluids to be easily drawn into inlet tube **112** and pass through filter **140** of lapevac **100** to outlet tube **120** in the form of filtered gas. By hydrophilic is meant the property of attracting and to at least some extent absorbing liquids and fluids.

[0047] Figure 4A is a top perspective view of partially disassembled wick assembly **114**. Fitting **117** is attached to luer lock **116** and inserted into inlet tube **112**. Luer lock **116** or other locking means used should be hollow in order to allow the flow of fluid, including vapors and gases, into and through inlet tube **112**. Similarly, fitting **117** should also be hollow to allow for sufficient air flow to move incoming vapor and gas without taxing lapevac **100**. Wick **115** is attached to fitting **117** and the luer lock-fitting-wick assembly is inserted into inlet tube **112**. Figure 4B is a side view of wick assembly **114** showing more clearly fitting **117** and wick **115** within inlet tube **112** and airway **119**.

[0048] Figure 5 is a side view of wick **115** fabricated from PVA. In the embodiment shown, wick **115** is about 20 inches long. Figure 5A is an end view of wick **115** in which wick **115** possesses a rectangular cross section with a width of about 0.12

inches and a height of about 0.08 inches. Figure 5B is an isometric view of wick **115**. PVA is one of the preferred materials for fabricating wick **115**. When dry it is rigid hydrophilic foam. In the presence of water or humidity it becomes soft and flexible with good chemical resistance and good water absorption properties.

[0049] Lapevac **100** is used during laparoscopic surgery to keep the field of view while performing surgical procedures. The inflation creates space within the cavity thereby making it easier to perform surgery. A separate insufflator inflates the abdominal cavity (or other cavity) by pumping air or other gas (es) into the abdominal cavity. To remove surgically generated smoke and other vapors, lapevac **10** removes smoke and other vaporous waste into inlet tube **112** through filter **140** and out outlet tube **120** as filtered gas. The second or downstream end of outlet tube **120** is attached to a hollow channel inserted into the abdominal cavity and to the insufflator by means of connector **124**. Using this system, a recirculating stream of filtered gas or air enters the abdominal cavity as the smoke and waste filled vapors are removed to keep the abdominal cavity under a relatively constant inflation pressure.

[0050] Although lapevac system **100** is effective in maintaining cavity inflation pressure, one problem that occurs during its operation is the clogging of inlet tube **112** and filter **140** by solid waste, water and humidity carried out of the abdominal cavity by the incoming waste stream. Because the cavity is moist and may be heated above normal temperature by some surgical procedures such as cauterization, surgical wastes can be driven off the cavity wall and internal organs in the form of particles, vapor, and liquids from broken cells and tissues. In addition, vapors within the cavity itself can be drawn into the waste stream.

[0051] Because it is hydrophilic, wick **115**, attracts and retains the solid moist waste and the aqueous liquid waste that is drawn into inlet tube **112**. Because it is sized to allow for a large airway **119** between the inner wall of inlet tube **112** and wick **115**, relative to the size of wick **115**, wick assembly **114** allows waste stream vapors and gases to move without substantial additional restriction to filter **140**. A preferred length of wick **115** is about 20 inches as this provides sufficient length for exposing the waste stream to the hydrophilic attraction of wick **115**. In addition, the preferred rectangular shape provides more surface area to attract and hold waste particles and vapors than

supplied by a round cylindrical shape.

[0052] It will be recognized that wick assembly **114** is also effective with passive laparoscopic filtration systems. A passive laparoscopic filtration system lacks the fan to actively pull waste vapors from the abdominal cavity, but instead relies on pressure supplied by the insufflator to push surgical waste through an inlet and wick assembly and filters.

[0053] Another problem that may occur during laparoscopic surgery is the insufficient removal of waste vapor from the cavity and stratification of water vapor in the cavity which can lead to visualization problems for those observing the procedures within the abdominal cavity. This waste vapor can be purged by means of a two-way relief valve **150** placed in the filtered gas outlet path within outlet tube **120**. Relief valve **150** provides the user with the ability to accelerate clearing and/or removal of stratified laparoscopic filtration waste vapor by opening a divert path while blocking the recirculating filtered gas through the normal outlet path back to the cavity. This diversion provides a sudden pressure change by supplying a rapid evacuation capability.

[0054] Figures 6A-D show t-tap two way valve **150** ("valve **150**") configured in the divert mode. Figure 6A is an isometric view of valve **150** showing valve inlet **151**, divert **152**, outlet **153**, and barrel housing **155**. Figure 6B is a top view of valve **150**. Figure 6C is a side view of valve **150** taken from the side facing outlet **153**. It can be seen that in the divert mode, outlet **153** is closed.

[0055] Figure 6D is a cross section of valve **150** taken along line H-H in Figure 6B. The arrow shows fluid flow along valve inlet **151** and through divert **152**. Valve barrel **154** ("barrel **154**") sits within divert **152** and extends past inlet **151** and outlet **153** into barrel housing **155**. In the divert mode shown, barrel passages **154a** are positioned below and blocked from the fluid pathway shown by the arrows. Thus, the filtered gas from lapevac **100** is diverted through barrel channel **154b** and out divert **152** thereby relieving the back pressure situation.

[0056] Figures 7A-D depict t-tap two-way valve **150** configured in the flow through mode allowing filtered gas to return to the abdominal cavity. Figure 7A is an isometric view of valve **150** showing barrel **154** extending from the top of divert **152**. Figure 7B shows a top view of valve **150** in the open position. Figure 7C is a side view

facing the side of outlet **153** in which is seen the pass through channel open to outlet **153**.

[0057] Figure 7D is a cross section of valve **150** taken along line I-I in Figure 7B showing the channel configuration when valve **150** is in the open mode. Barrel **154** is shown extended above the top edge of divert **152**. This places barrel passages **154a** into channel **151a** (simultaneous alignment with inlet **151** outlet **153**) and blocks entrance into divert **152**. Filtered gas then exits through outlet **153** into outlet tube **120** (not shown in Figure 7D) and into the abdominal cavity.

[0058] Figure 8A is a top view of a second embodiment of the two-way divert valve, namely stopcock valve **170** ("valve **170**"), in the closed or blocking mode. By blocking is meant that no fluid can enter valve **170**. Figure 7B is a side view of valve **170**. Rotor **172** is seen at the junction of inlet **171**, divert **174**, and outlet **173**. Persons of skill in the art will recognize that rotor **172** comprises three fluid flow passages **175** within a housing (not shown) with two passages **175** on opposite sides of rotor **172** and the third passage **175** at right angles between the other two passages. In the closed (no flow) position, the blocked side, lacking a passage **175**, faces inlet **171**. This configuration closes the passage of filtered gas in any direction through valve **70**. In the divert position, Figure 8C, the blocked side is rotated to face outlet **173**. In this configuration, filtered gas flows through divert **172**. In the flow through mode, Figure 8B, the blocked side is rotated to face divert **172**, forcing the filtered gas to flow through outlet **73**.

[0059] It is apparent that by positioning a two-way valve, such as valves **150** or **170**, in outlet tube **120**, the effects of back pressure from either the insufflator or unfiltered back flow from the abdominal cavity are reduced or eliminated. Filtered air can be diverted from the recirculating waste/filtered gas system until the visualization within the cavity is brought to acceptable conditions.

[0060] Thus, it is seen that the objects of the present invention are efficiently obtained, although modifications and changes to the invention should be readily apparent to those having ordinary skill in the art, which modifications are intended to be within the spirit and scope of the invention as claimed.

We Claim:

1. An improved smoke removal apparatus having a housing; inlet means for defining an inlet pathway for impure gas from a surgical cavity to said housing, wherein said inlet means include locking means for connecting said surgical cavity to said inlet pathway; filter means for filtering impurities from impure gas to form filtered gas; outlet means for defining an outlet pathway for said filtered gas from said housing to said surgical cavity; and a fan, for drawing impure gas from said surgical cavity, through said inlet means, and through said filter means to form said filtered gas and for driving said filtered gas through said outlet means into said surgical cavity, wherein said outlet means are adapted to a laparoscopic surgical instrument assembly, said improvement comprising:

a hydrophilic wick inserted into and attached to said locking means of said inlet means.

2. The improved smoke removal apparatus as recited in Claim 1 wherein said hydrophilic wick is fabricated from polyvinyl alcohol (PVA).

3. The improved smoke removal apparatus as recited in Claim 1 wherein said hydrophilic wick is fabricated from cotton.

4. The improved smoke removal apparatus as recited in Claim 1 wherein said hydrophilic wick has a rectangular cross section.

5. The improved smoke removal apparatus as recited in Claim 1 further comprising a multi-outlet valve incorporated into said outlet means.

6. The improved smoke removal apparatus as recited in Claim 5 wherein said multi-outlet is a two-way outlet valve.

7. The improved smoke removal apparatus as recited in Claim 6 wherein said two-way relief valve is a t-tap valve.

8. The improved smoke removal apparatus as recited in Claim 6wherein said two-way relief valve is a stop cock having two outlets.

9. The improved smoke removal apparatus as recited in Claim 1 wherein said filter means includes a pre-filter.

10. An improved smoke removal apparatus having a housing; inlet means for defining an inlet pathway for impure gas from a surgical cavity to said housing, wherein said inlet means include locking means for connecting said surgical cavity to said inlet pathway; filter means for filtering impurities from impure gas to form filtered gas; outlet means for defining an outlet pathway for said filtered gas from said housing to said surgical cavity; and a fan, for drawing impure gas from said surgical cavity, through said inlet means, and through said filter means to form said filtered gas and for driving said filtered gas through said outlet means into said surgical cavity, wherein said outlet means are adapted to a laparoscopic surgical instrument assembly, said improvement comprising:

a multi-outlet relief valve incorporated into said outlet means.

11. The improved smoke removal apparatus as recited in Claim 10 wherein said multi-outlet relief valve is a two-way (two outlet) relief valve.

12. The improved smoke removal apparatus as recited in Claim 11 wherein said two-way relief valve is a t-tap valve.

13. The improved smoke removal apparatus as recited in Claim 11 wherein said two-way relief valve is a modified stop cock.

14. The improved smoke removal apparatus as recited in Claim 11 further comprising a hydrophilic wick inserted into and attached to said locking means of said inlet means.

15. The improved smoke removal apparatus as recited in Claim 14 wherein said hydrophilic wick is fabricated from polyvinyl alcohol (PVA).

16. The improved smoke removal apparatus as recited in Claim 14 wherein said hydrophilic wick is fabricated from cotton.

17. The improved smoke removal apparatus as recited in Claim 14 wherein said hydrophilic wick has a rectangular cross section.

18. The improved smoke removal apparatus as recited in Claim 10 wherein said filter means includes a pre-filter.

19. An inlet means for a smoke removal apparatus comprising:

an inlet tube having a first end and a second end and a locking means at said second end to attach to an inlet of said smoke removal apparatus; and,

a hydrophilic wick assembly, said hydrophilic wick assembly comprising:

a hydrophilic wick;

a friction fitting attached to said hydrophilic wick, said friction fitting defining an orifice; and,

a hollow locking means attached to said friction fitting;

wherein said friction fitting forms an attachment with said inlet tube and said wick of said hydrophilic wick assembly is inserted inside said inlet tube so as to form an airway between said inlet tube and said hydrophilic wick.

20. The inlet means as recited in Claim 19 wherein said hydrophilic wick is PVA.

21. The combination inlet tube and hydrophilic wick assembly as recited in Claim 19 wherein said hydrophilic wick is cotton.

22. An outlet means for a smoke removal apparatus comprising:
an outlet tube having a first end and a second end comprising:
said first end attached to an outlet of said smoke removal apparatus; and,
a locking means at said second end; and,
a multi-outlet relief valve comprising
a valve inlet attached to said locking means at said outlet tube second end;
a first two-way relief valve outlet attached to a second tube; and,
one or more second relief outlets, said one or more second relief valve outlets configured to accelerate filtration from said smoke removal apparatus.

23. The outlet means for a smoke removal apparatus as recited in Claim 22 wherein said multi-outlet relief valve has two outlets (two-way).

24. A two way relief valve comprising:
a barrel housing, said barrel housing defining a divert channel;
a barrel contained within said barrel housing and movable within said divert channel;
a pair of barrel passages defined by said barrel and positioned on opposite sides of said barrel;
an inlet passage connected to or integral with said central housing;
an outlet passage connected to or integral with said barrel housing and positioned on an opposite side from said inlet passage;
wherein said barrel can be moved within said divert channel to a closed position thereby opening said divert channel and closing said outlet passage; and,
wherein said barrel can be moved within said divert channel to close said divert channel and open said outlet passage by moving said pair of barrel passages into simultaneous alignment with said inlet passage and said outlet passage.

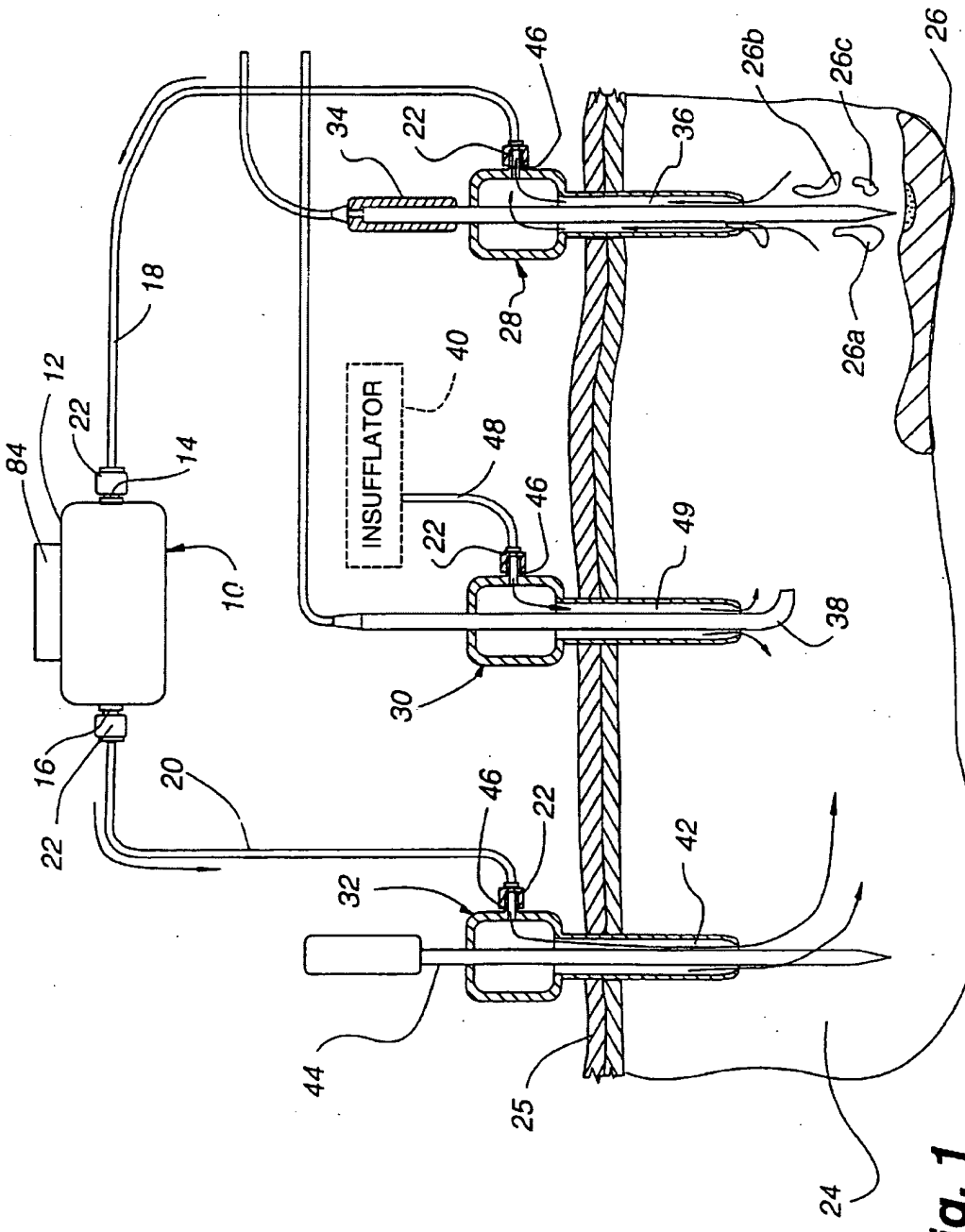

Fig. 1

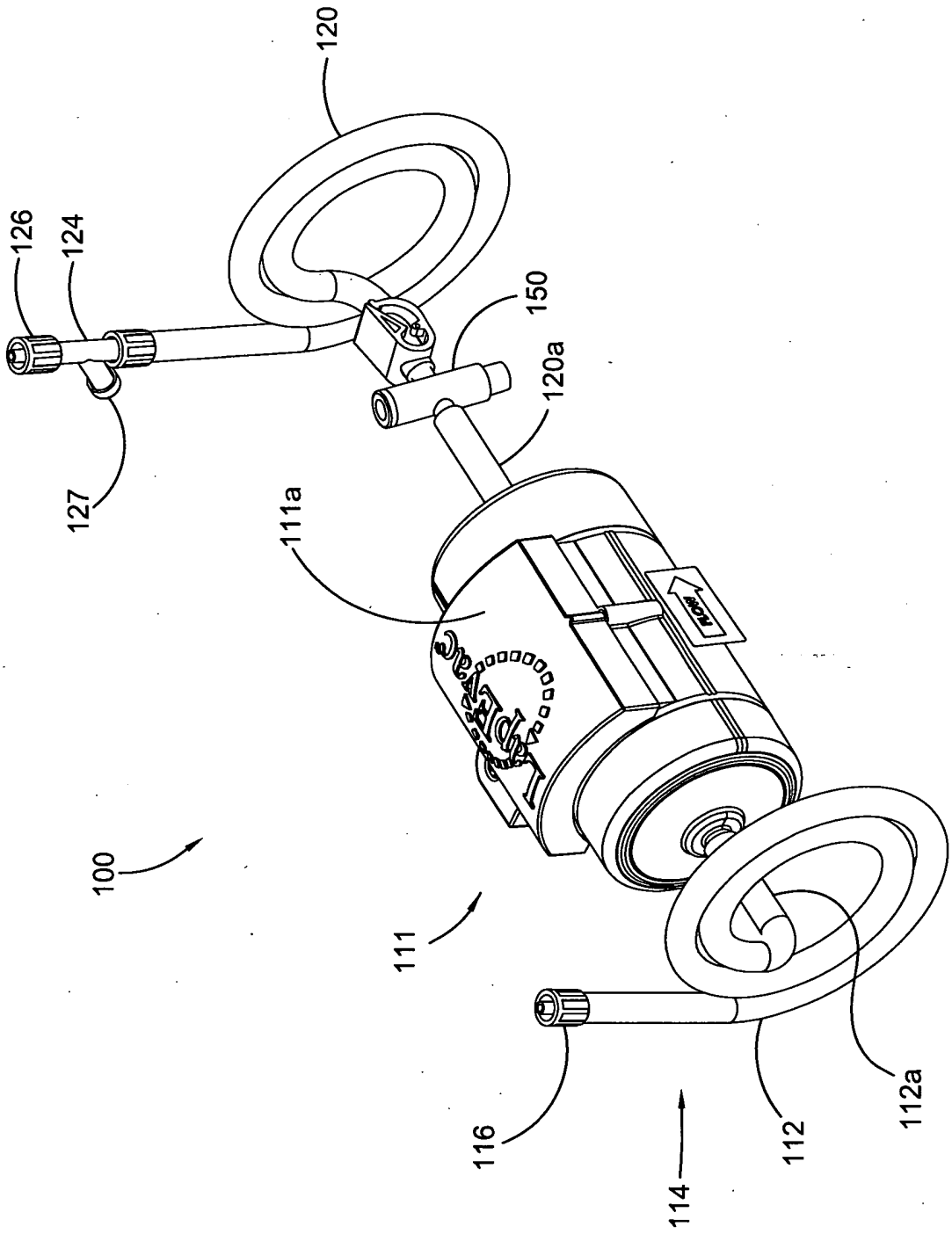

Fig. 2

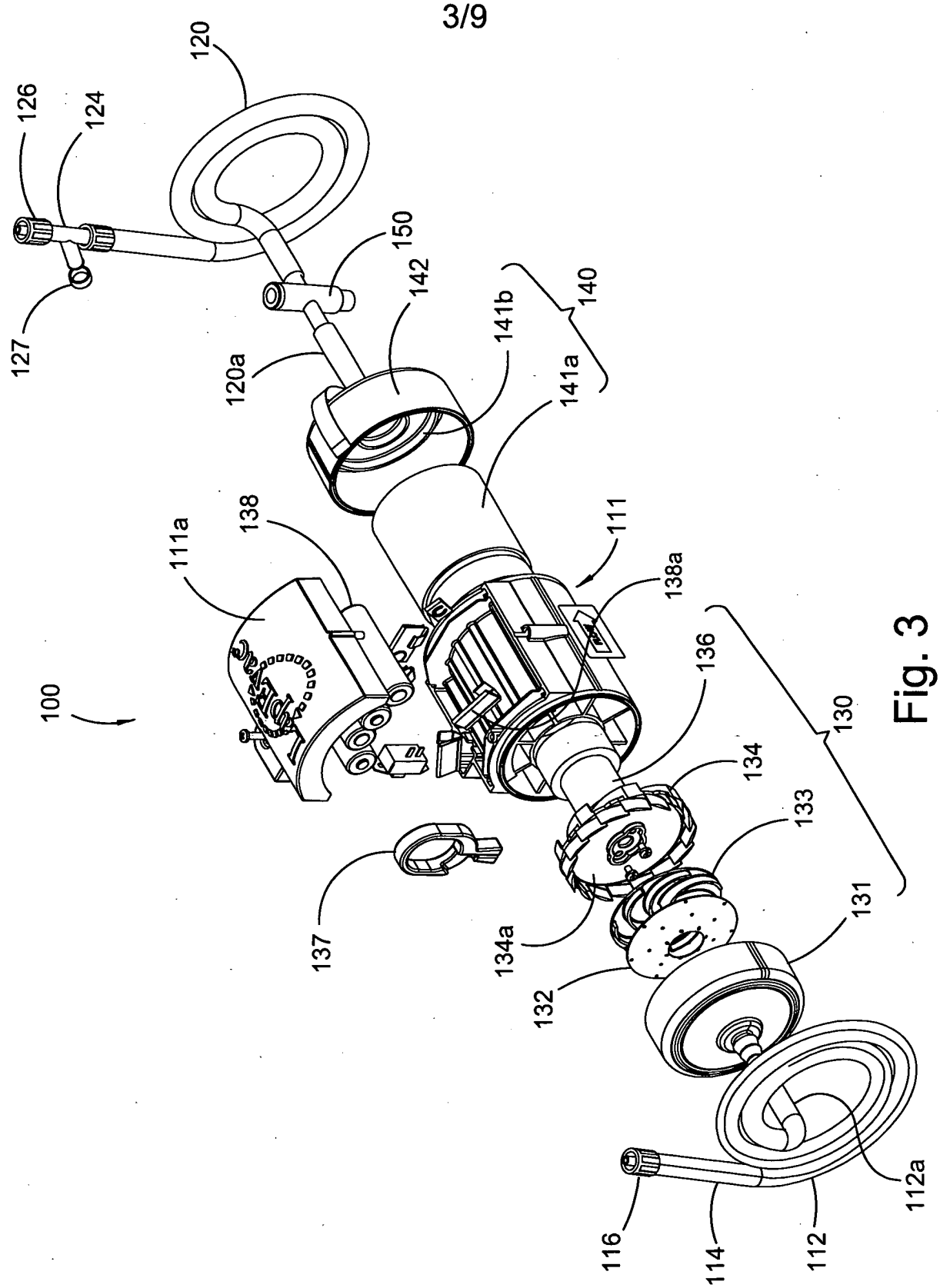
120
126
124
150
142
140
141b
127
120a
141a
138
111a
111
138a
136
100
130
134
133
137
131
134a
132
112a
116
114
112

Fig. 3

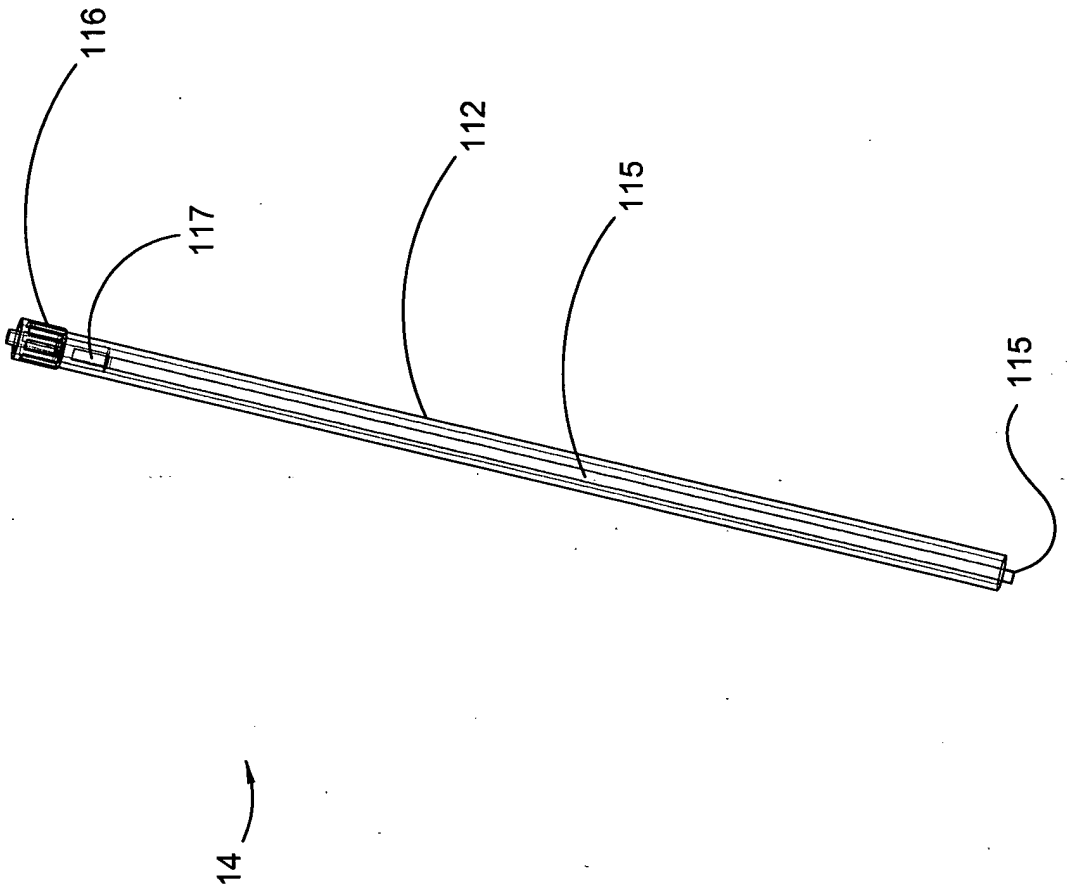

Fig. 3A

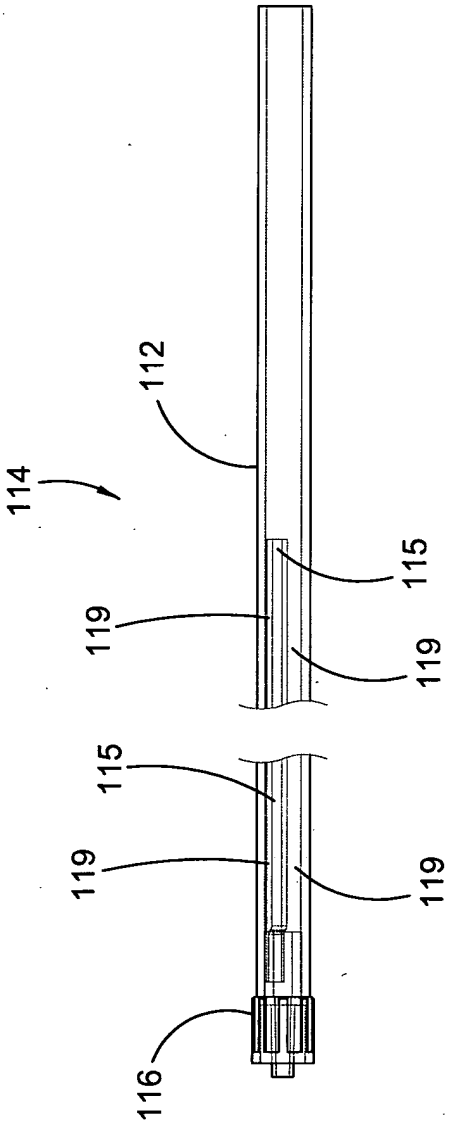

Fig. 4B

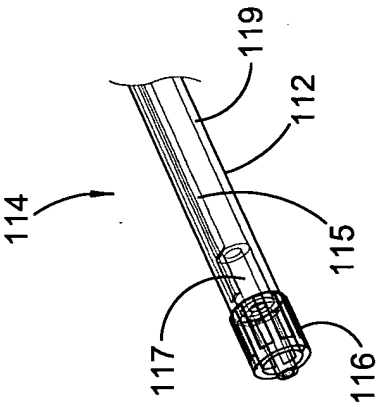

Fig. 4

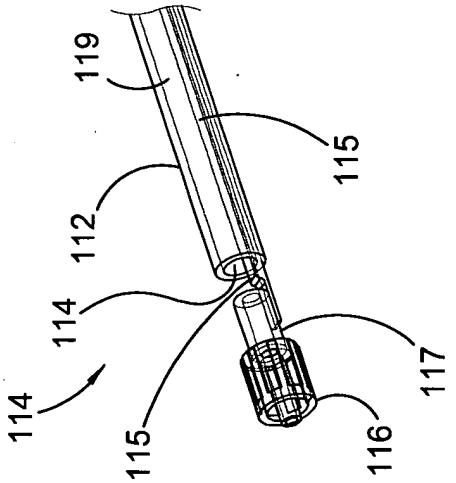

Fig. 4A

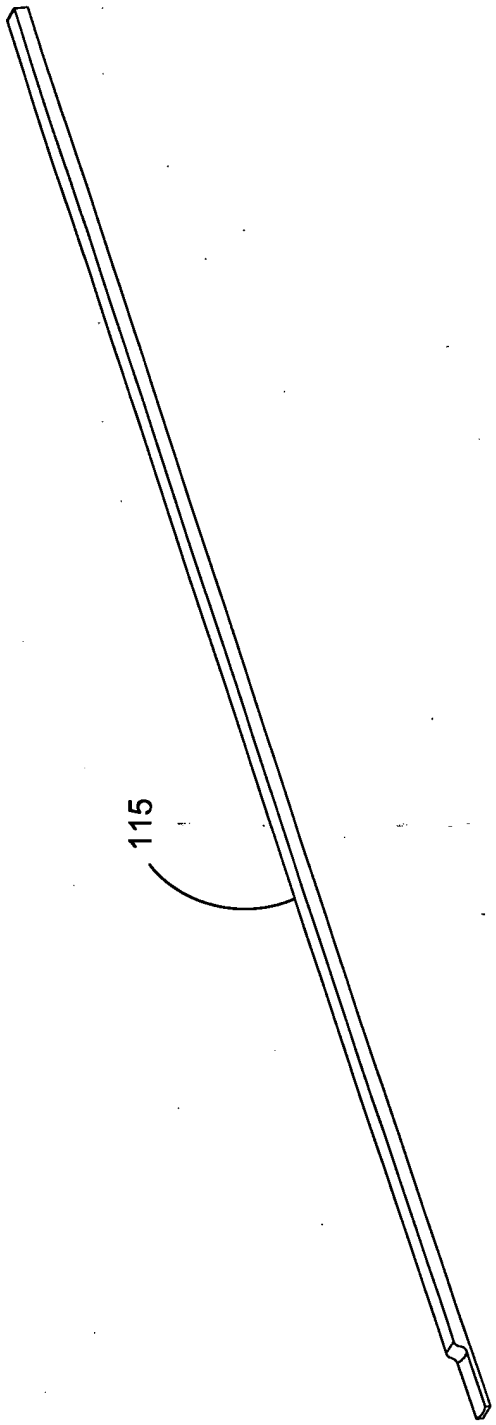

Fig. 5B

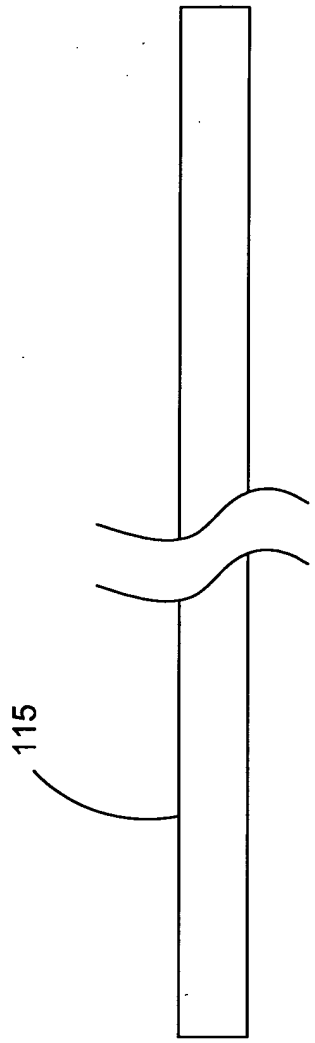

Fig. 5

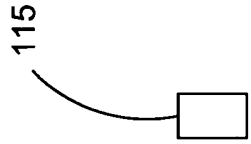

Fig. 5A

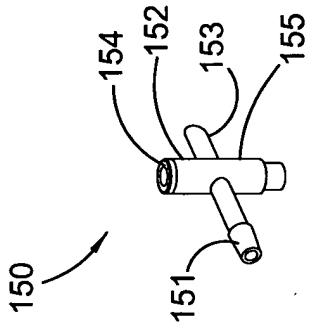

Fig. 6A

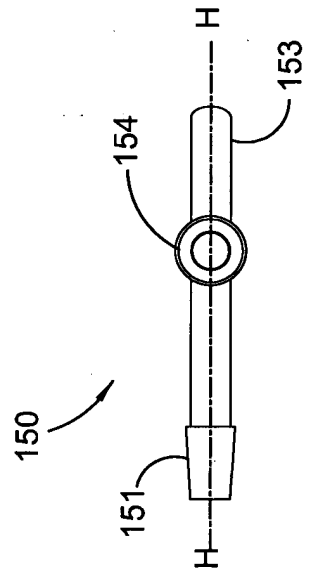

Fig. 6B

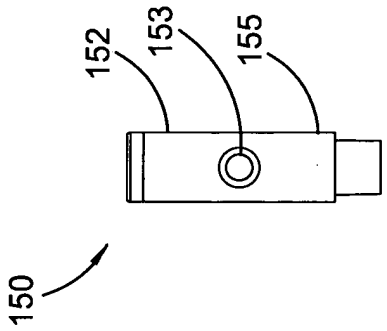

Fig. 6C

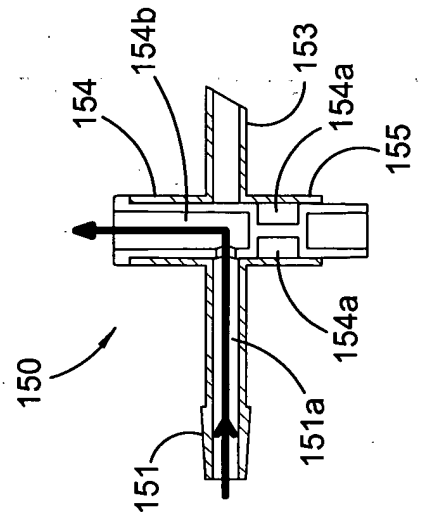

Fig. 6D

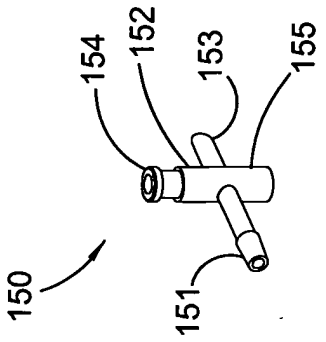

Fig. 7A

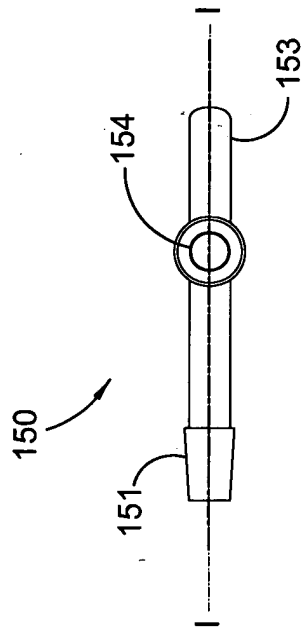

Fig. 7B

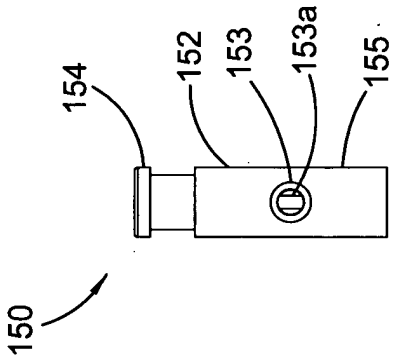

Fig. 7C

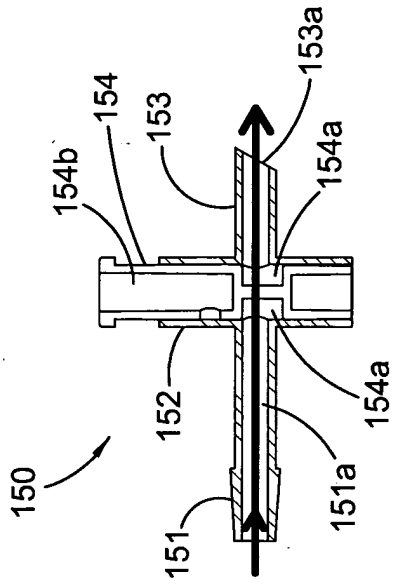

Fig. 7D

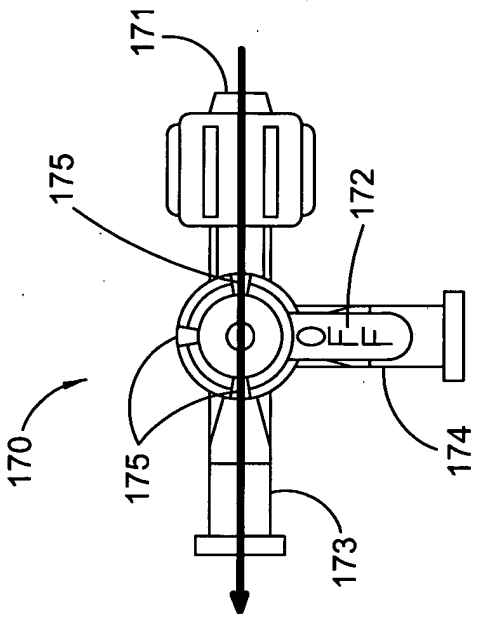

Fig. 8B

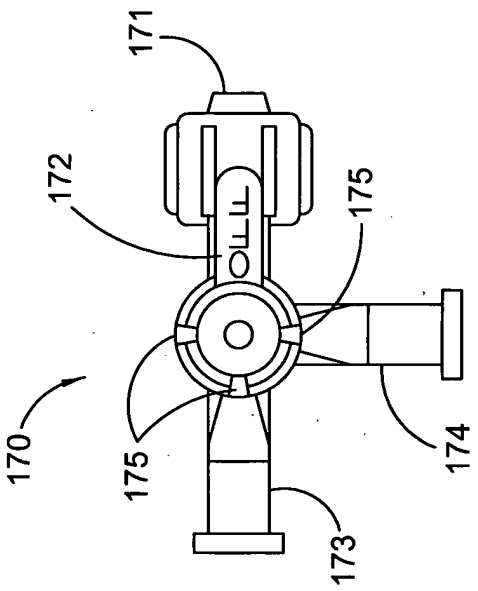

Fig. 8A

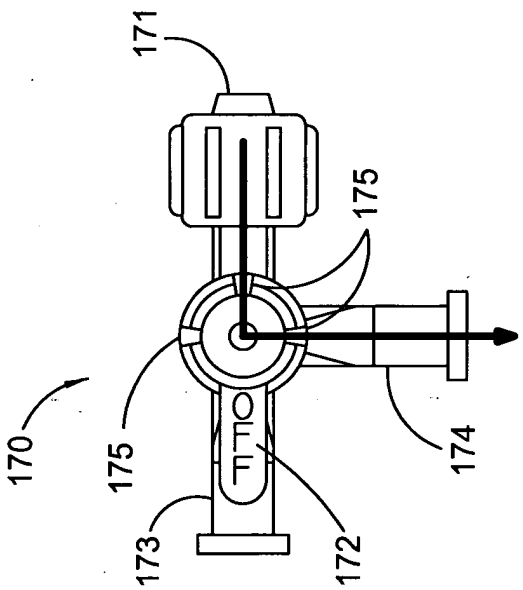

Fig. 8C

专利名称(译)	用于一次性腹腔镜排烟系统的吸液阀和安全阀		
公开(公告)号	EP2117621A2	公开(公告)日	2009-11-18
申请号	EP2008726317	申请日	2008-02-29
[标]申请(专利权)人(译)	MEDTEK DEVICES公司的DBA BUFFALO过滤器		
申请(专利权)人(译)	MEDTEK DEVICES，INC.，DBA BUFFALO FILTER		
当前申请(专利权)人(译)	BUFFALO FILTER LLC		
[标]发明人	DEAN ROBERT O KAJDAS JAY T		
发明人	DEAN, ROBERT, O. KAJDAS, JAY, T.		
IPC分类号	A61M1/00 B01D46/10 A61B18/00 B01D46/00		
CPC分类号	A61B18/00 A61B2218/008 B01D46/0036 B01D46/10 Y10T137/87708		
优先权	60/904270 2007-03-01 US		
其他公开文献	EP2117621A4 EP2117621B1		
外部链接	Espacenet		

摘要(译)

本发明涉及一种用于腹腔镜手术的改进的排烟装置。一种改进是位于烟雾装置的入口系统内的亲水芯，用于吸收水分并捕获进入烟雾排出装置的外科手术废物。第二个改进是插入烟雾排出装置的出口系统中的多出口阀，以使手术部位能够快速减压。