US 20150342449A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2015/0342449 A1**

POLL et al.

(43) **Pub. Date: Dec. 3, 2015**

(54) **VIEW OPTIMIZER AND STABILIZER FOR USE WITH SURGICAL SCOPES**

(71) Applicants: **Wayne L. POLL**, New Albany, OH (US); **Matthew J. HUDDLESTON**, Galena, OH (US); **Caroline M. CRISAFULLI**, Columbus, OH (US); **Adam LANDIS**, Reynoldsburg, OH (US); **Gregory P. DRACH**, Liberty Township, OH (US)

(72) Inventors: **Wayne L. POLL**, New Albany, OH (US); **Matthew J. HUDDLESTON**, Galena, OH (US); **Caroline M. CRISAFULLI**, Columbus, OH (US); **Adam LANDIS**, Reynoldsburg, OH (US); **Gregory P. DRACH**, Liberty Township, OH (US)

(21) Appl. No.: **14/733,752**

(22) Filed: **Jun. 8, 2015**

Related U.S. Application Data

(63) Continuation of application No. 12/635,632, filed on Dec. 10, 2009, now Pat. No. 9,050,037.

(60) Provisional application No. 61/121,514, filed on Dec. 10, 2008, provisional application No. 61/170,864, filed on Apr. 20, 2009.

Publication Classification

(51) **Int. Cl.**

A61B 1/12 (2006.01)

A61B 1/313 (2006.01)

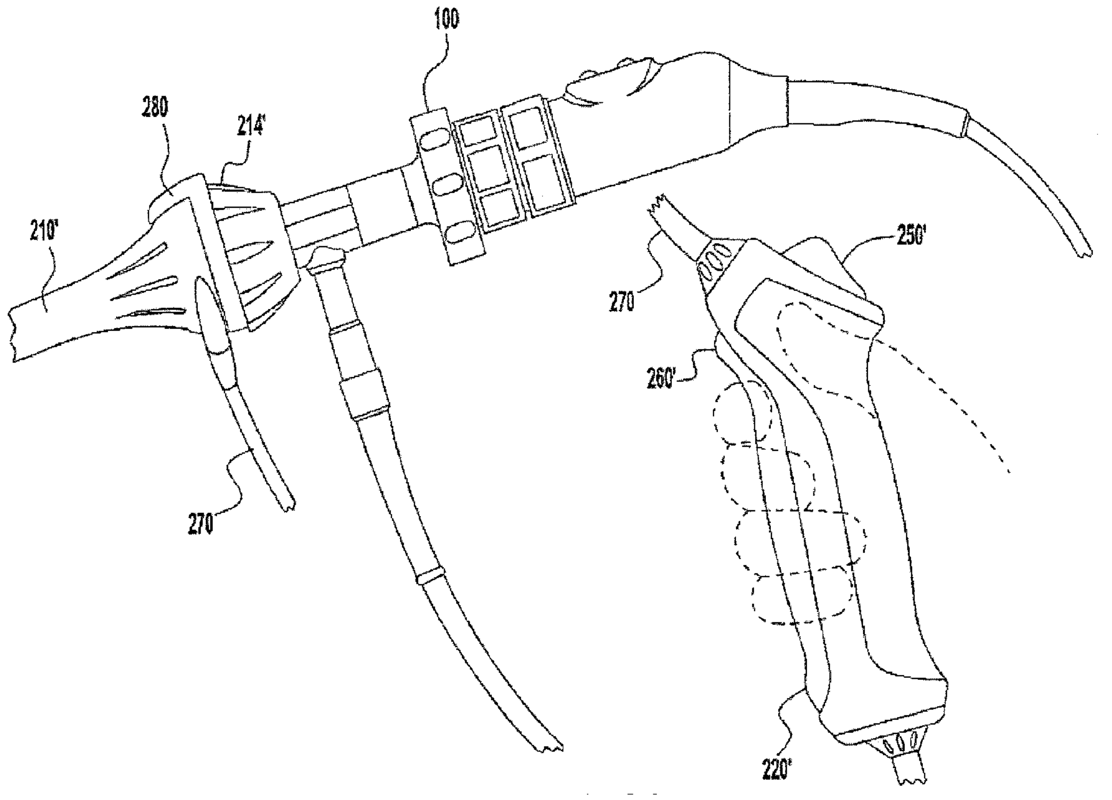
A61B 1/00 (2006.01)

(52) **U.S. Cl.**

CPC ***A61B 1/126*** (2013.01); ***A61B 1/127*** (2013.01); ***A61B 1/00135*** (2013.01); ***A61B 1/313*** (2013.01)

(57) **ABSTRACT**

A method of defogging a lens of a laparoscope includes: (1) inserting the laparoscope into a sheath; (2) engaging a fork stabilizing feature of the sheath with a light post of the laparoscope to prevent rotational movement of the sheath relative to the scope; (3) activating a locking mechanism on the sheath to longitudinally fix a distal end of the laparoscope relative to a distal end of the sheath; and (4) providing gas to a plurality of gas lumens within a wall of the sheath such that the gas flows through the gas lumens and over the lens of the laparoscope to defog the lens while the laparoscope is in a body cavity.



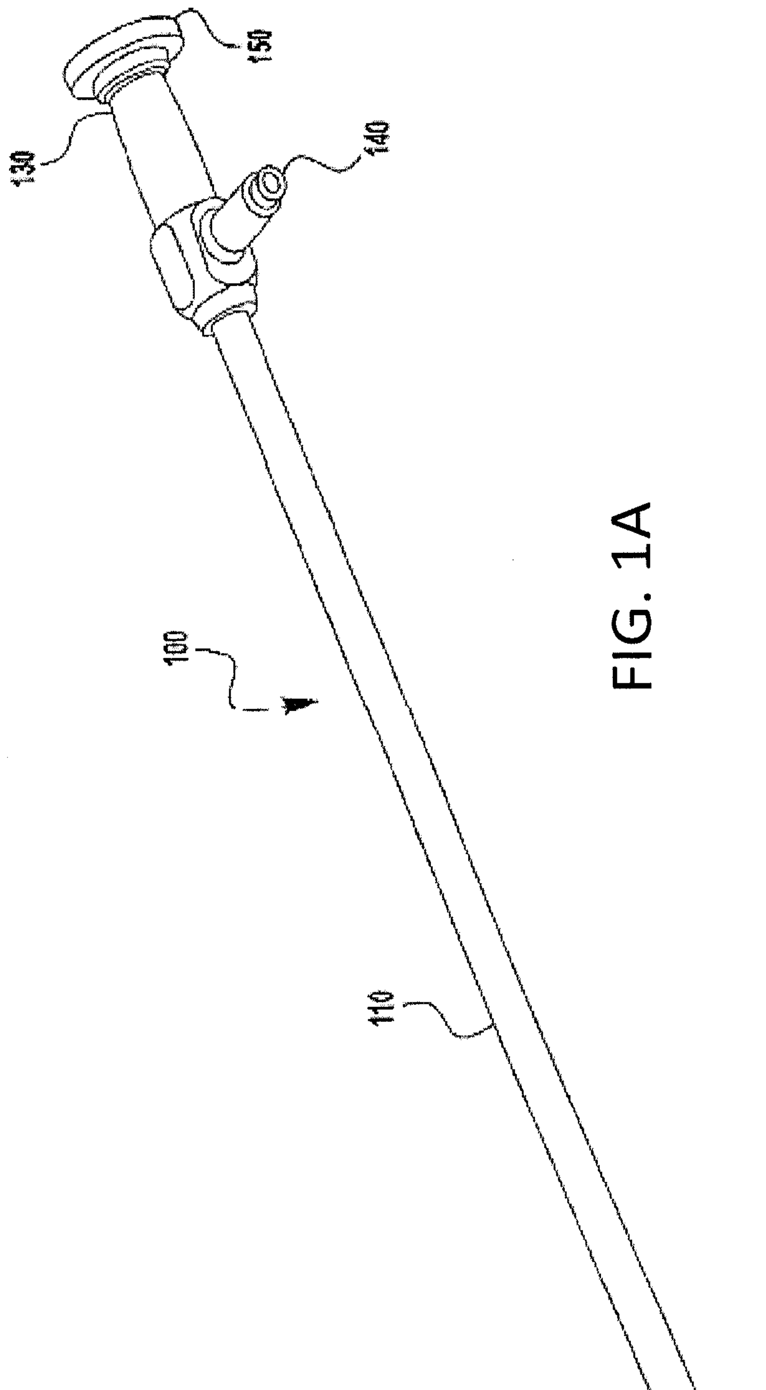


FIG. 1A

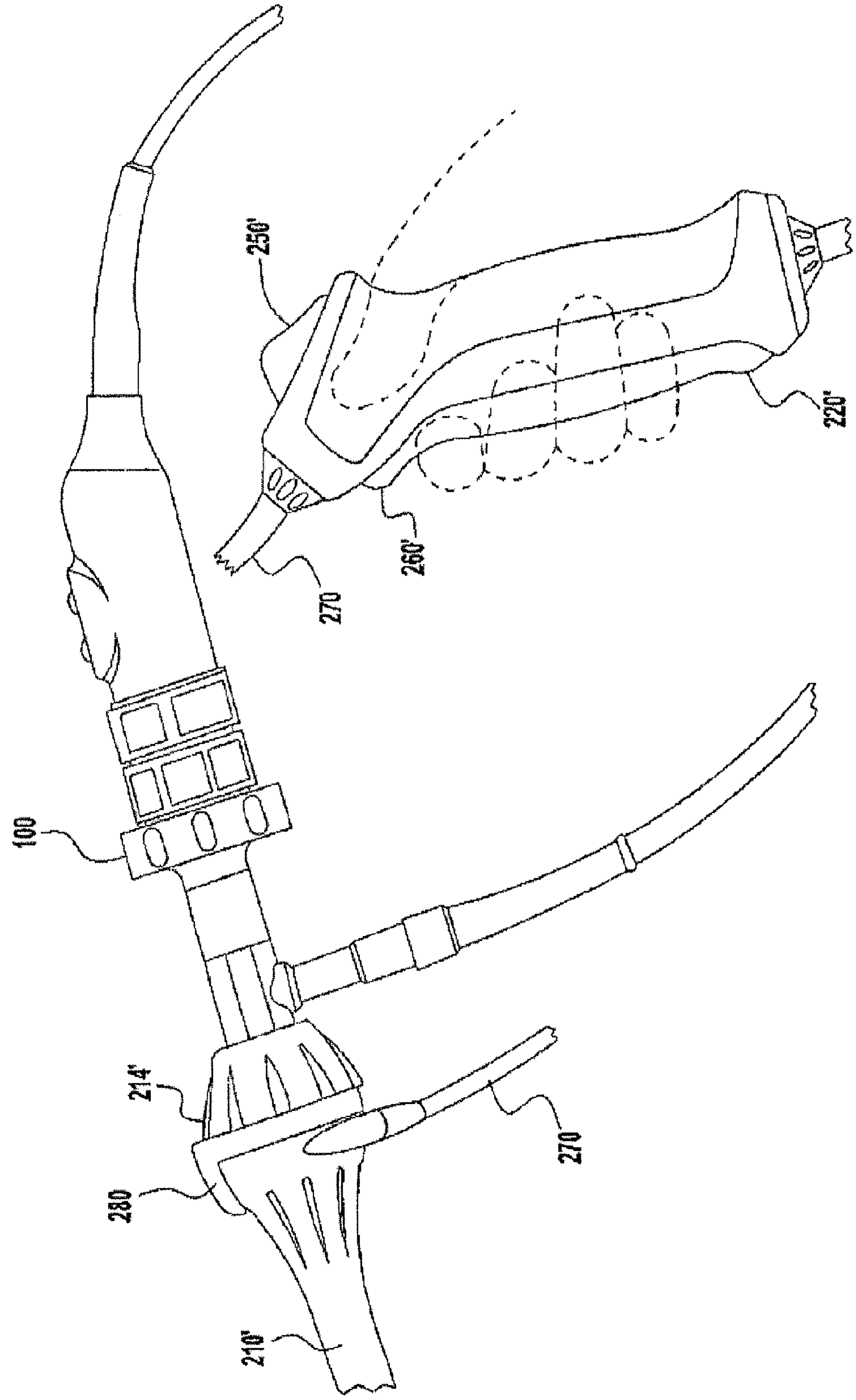


FIG. 2A

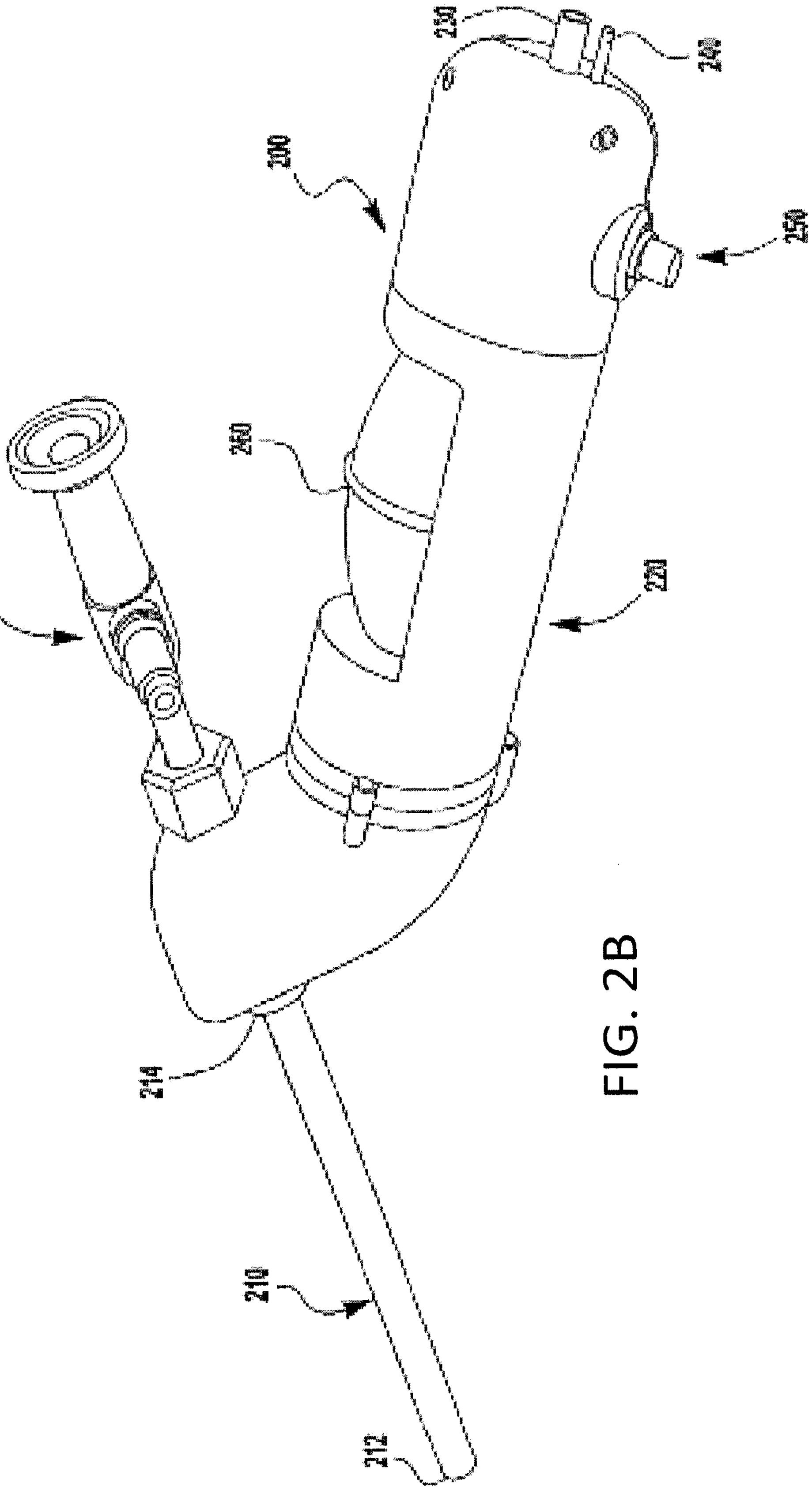


FIG. 2B

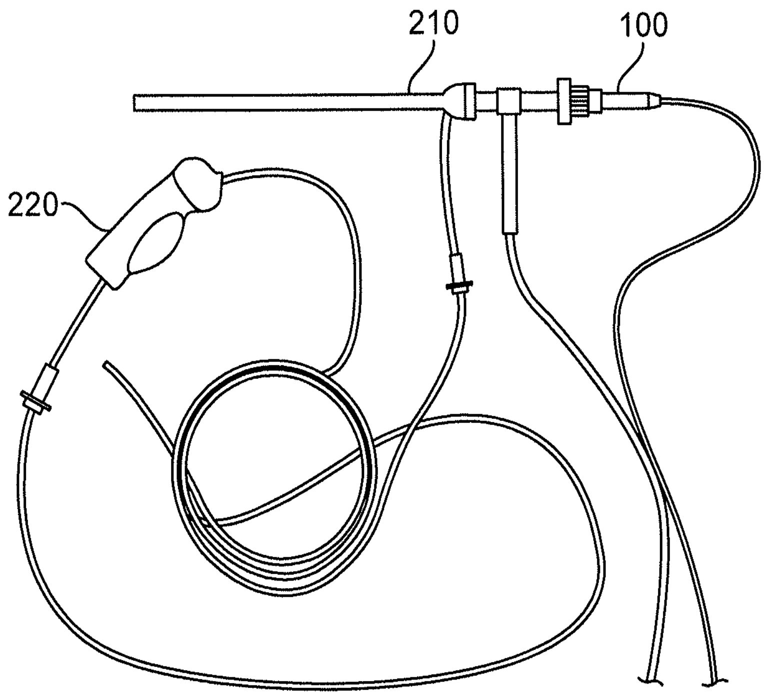


FIG. 2C

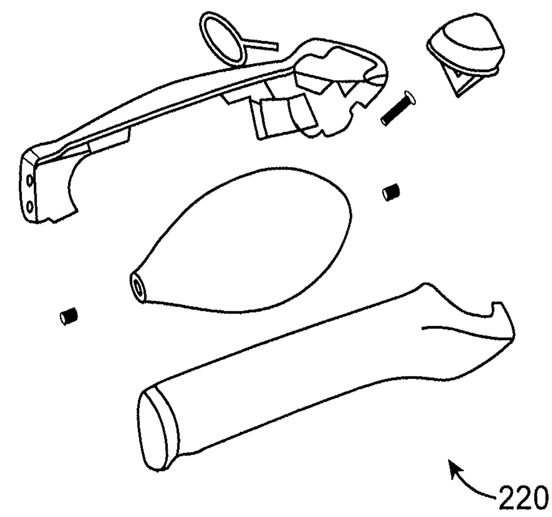


FIG. 3A

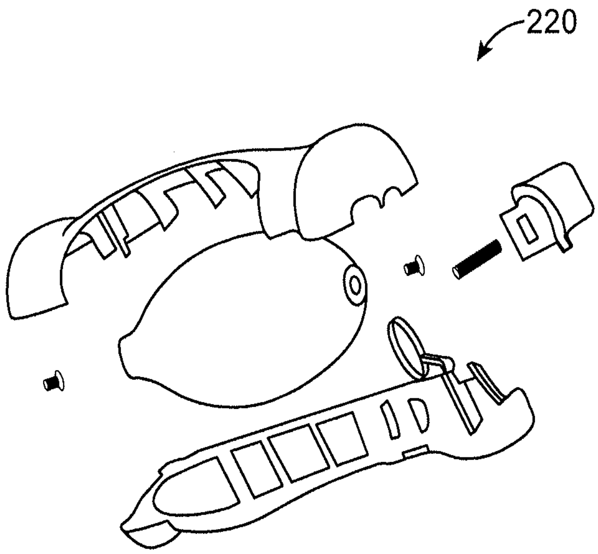


FIG. 3B

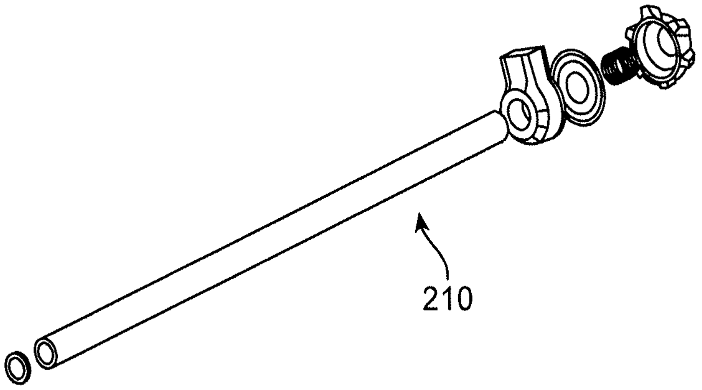


FIG. 3C

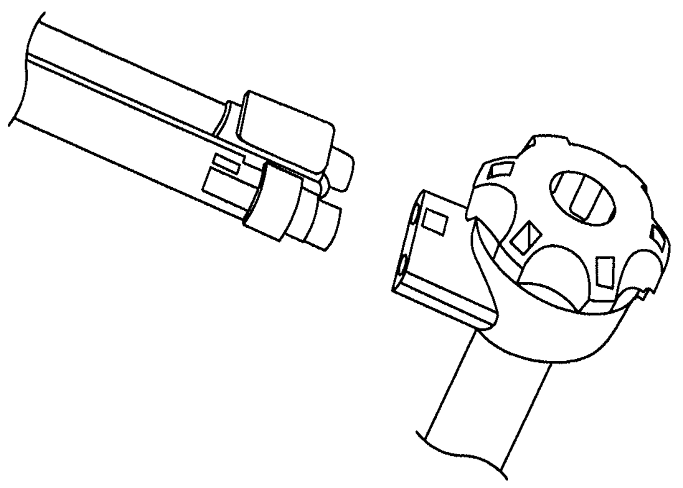


FIG. 3D

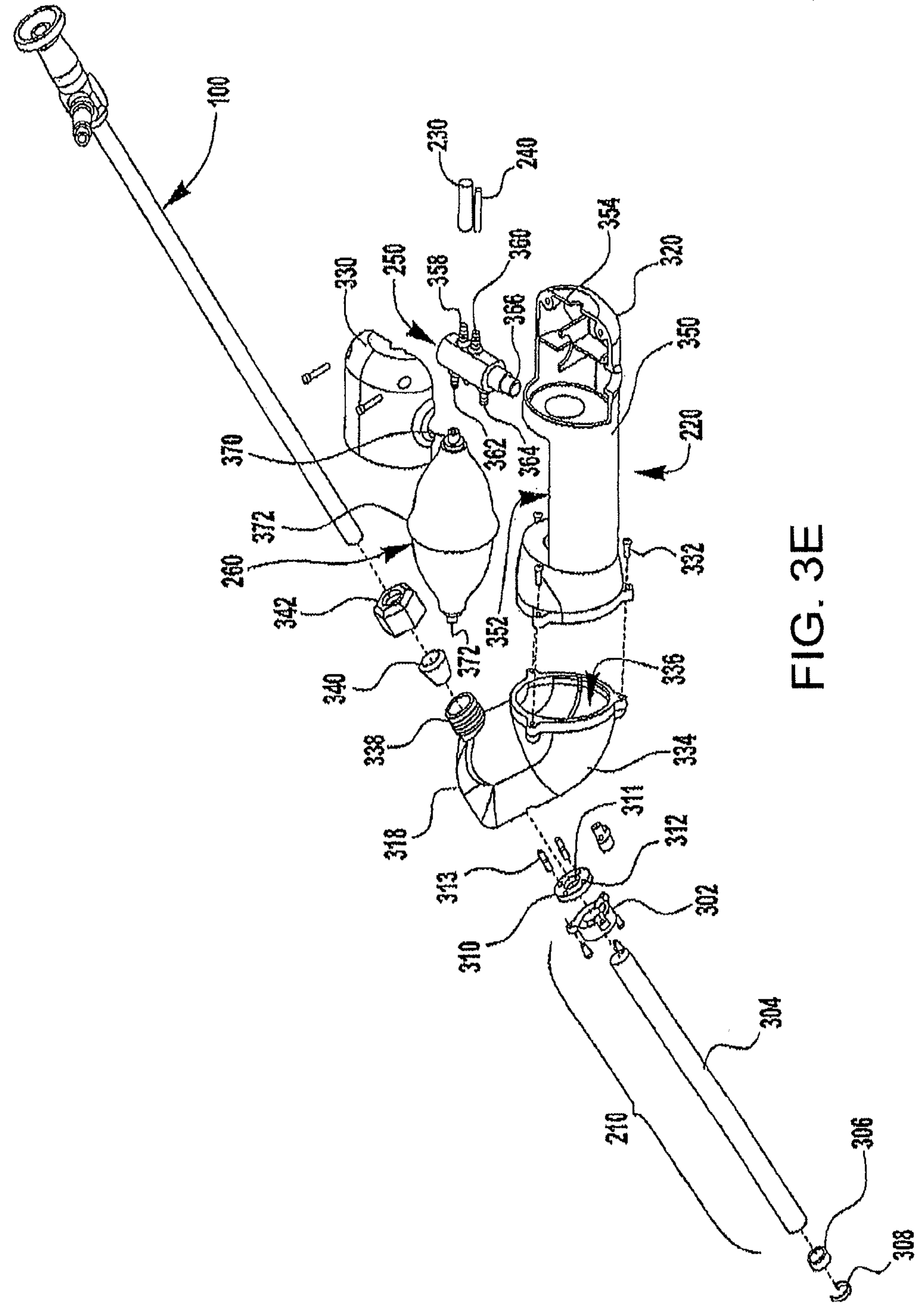

100
230
240
354
360
320
330
250
358
366
350
220
370
362
364
372
260
342
352
332
336
340
338
334
318
311
312
313
302
310
304
210
306
308

FIG. 3E

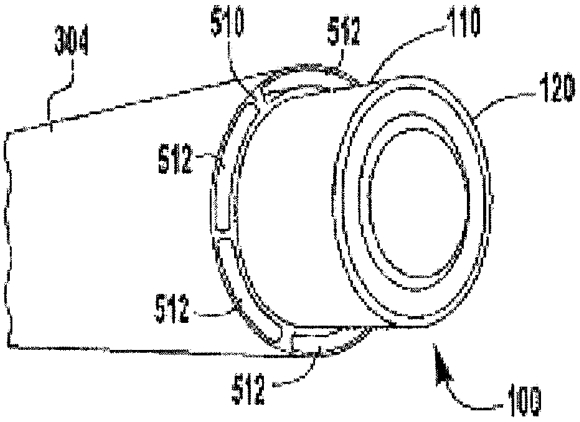


FIG. 4A

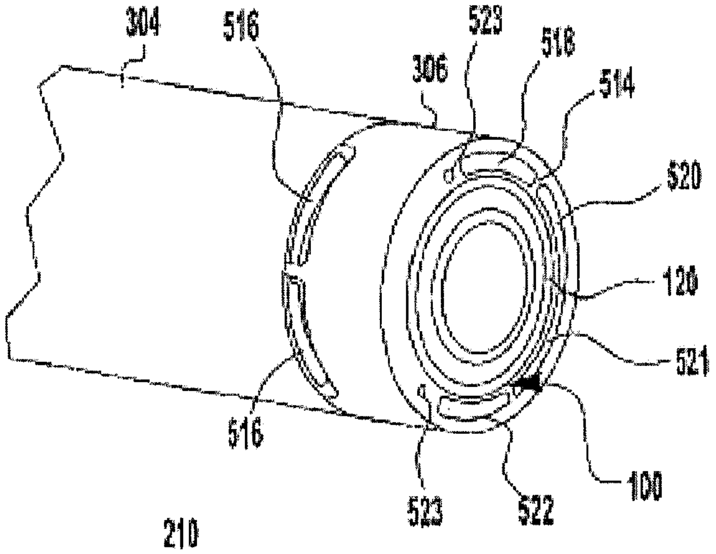


FIG. 4B

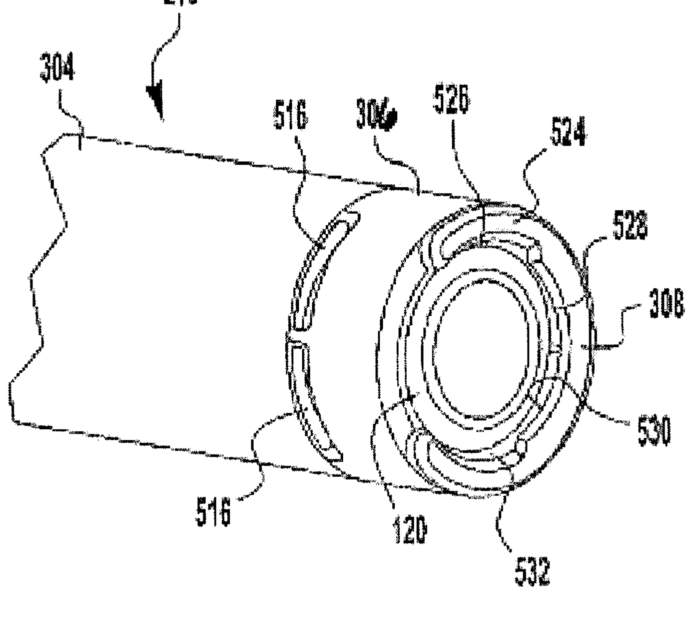


FIG. 4C

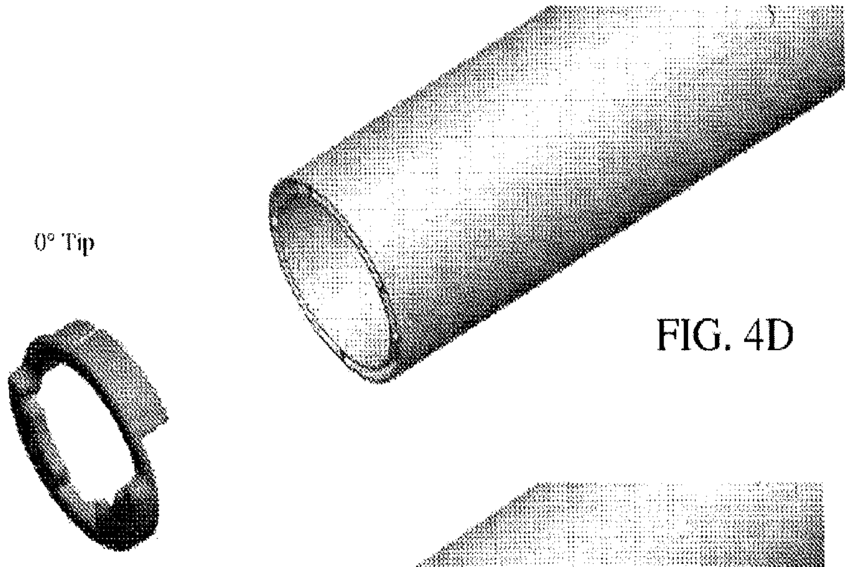


FIG. 4D

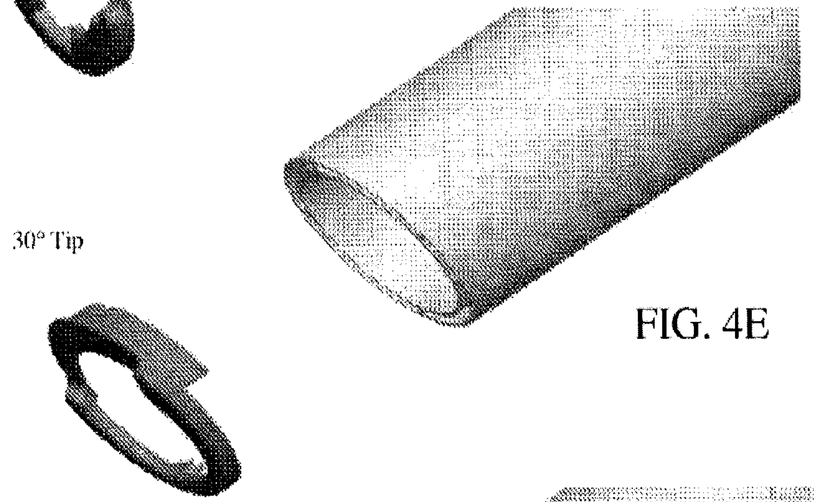


FIG. 4E

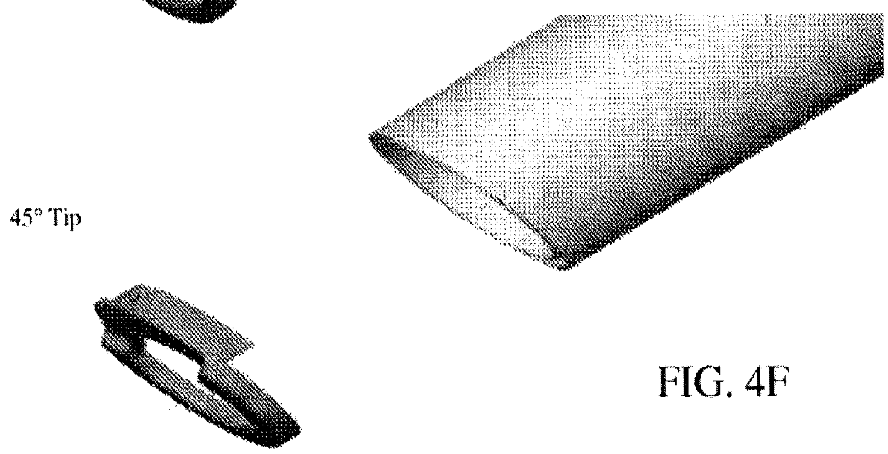


FIG. 4F

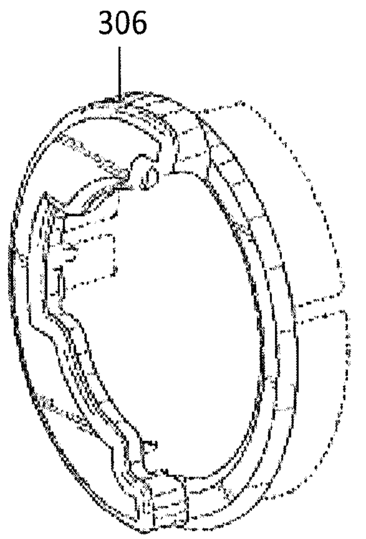


FIG. 4G

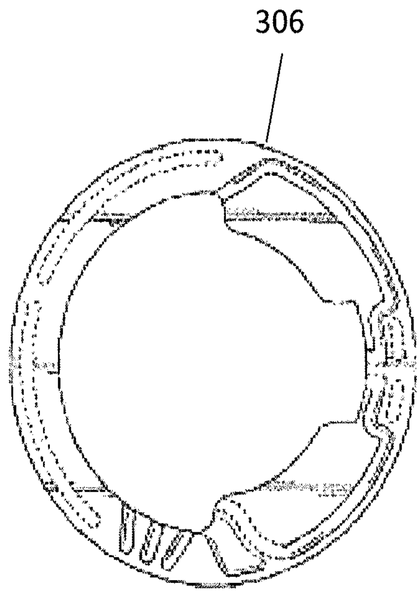


FIG. 4H

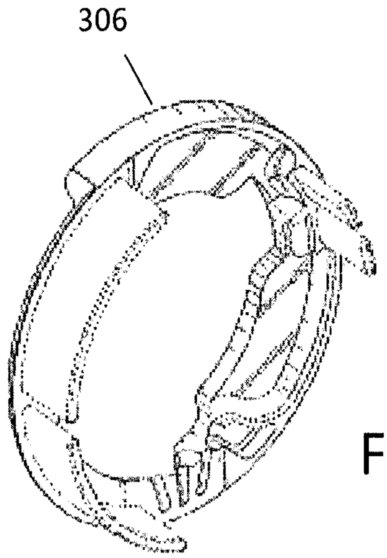


FIG. 4I

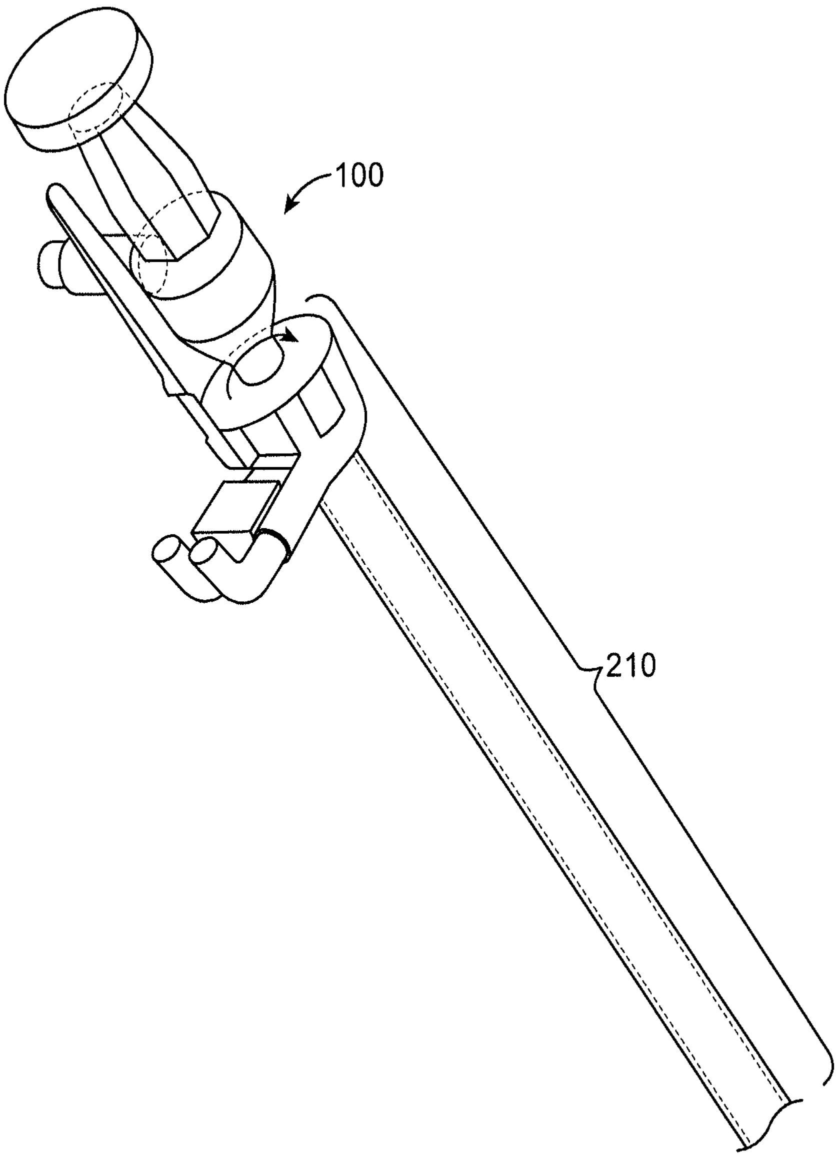


FIG. 4J

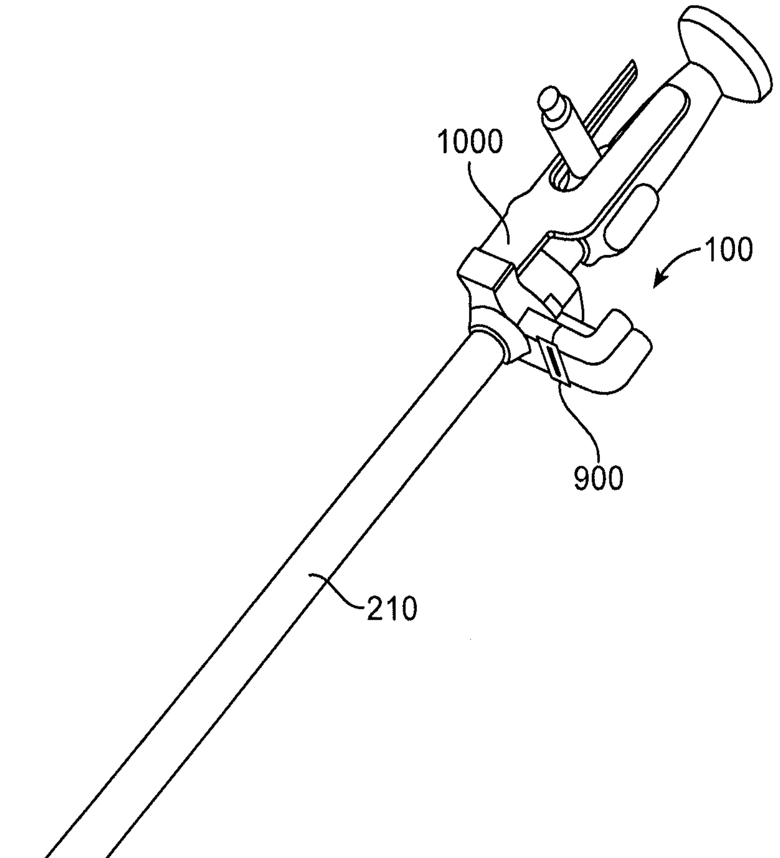


FIG. 4K

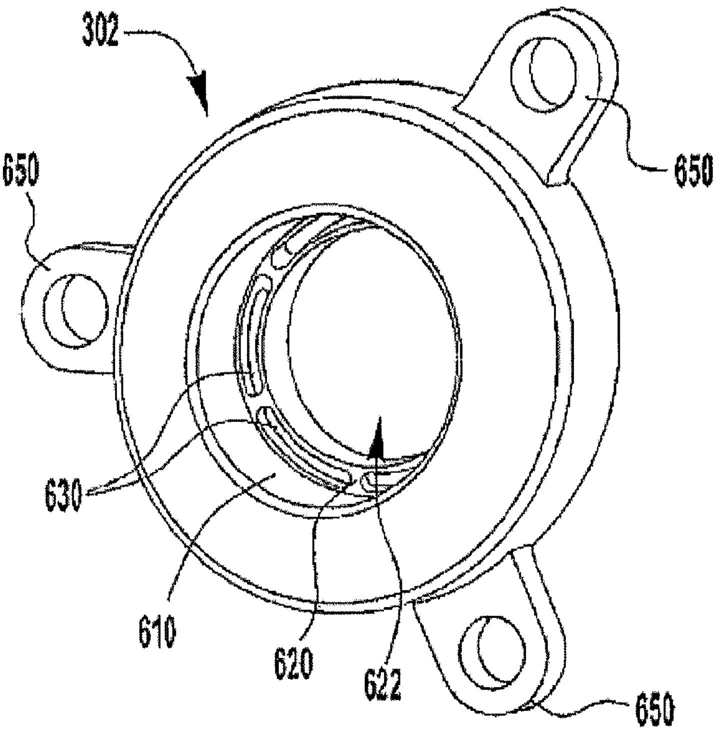

302
650
650
630
610
620
622
650

FIG. 5A

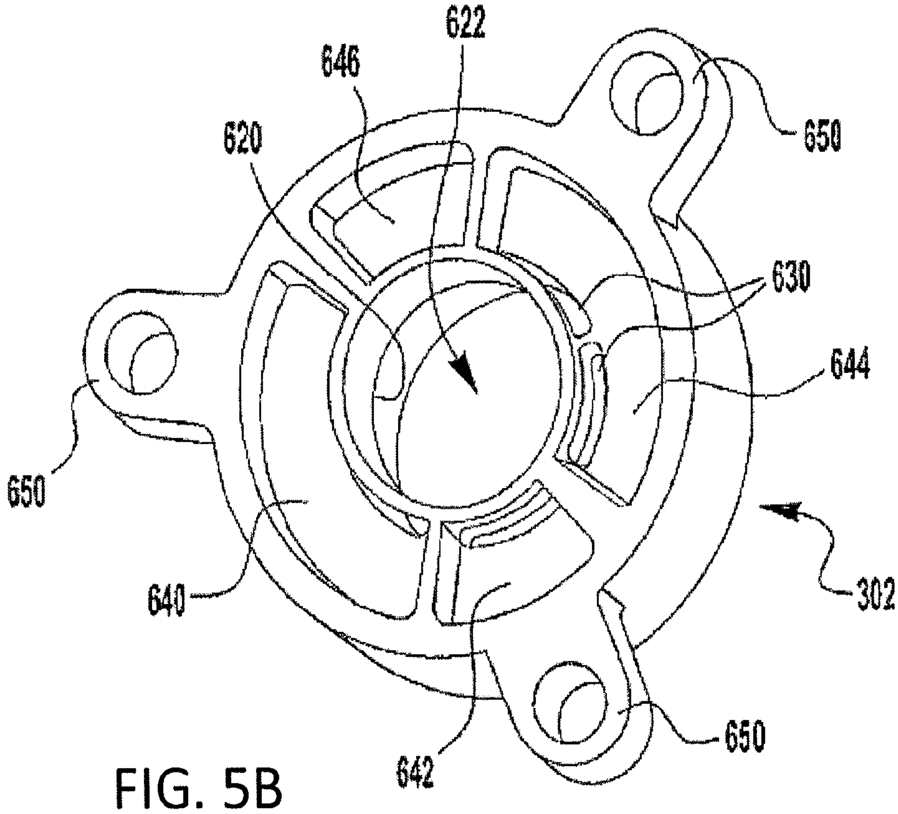

622
646
620
650
630
644
650
640
302
642
650

FIG. 5B

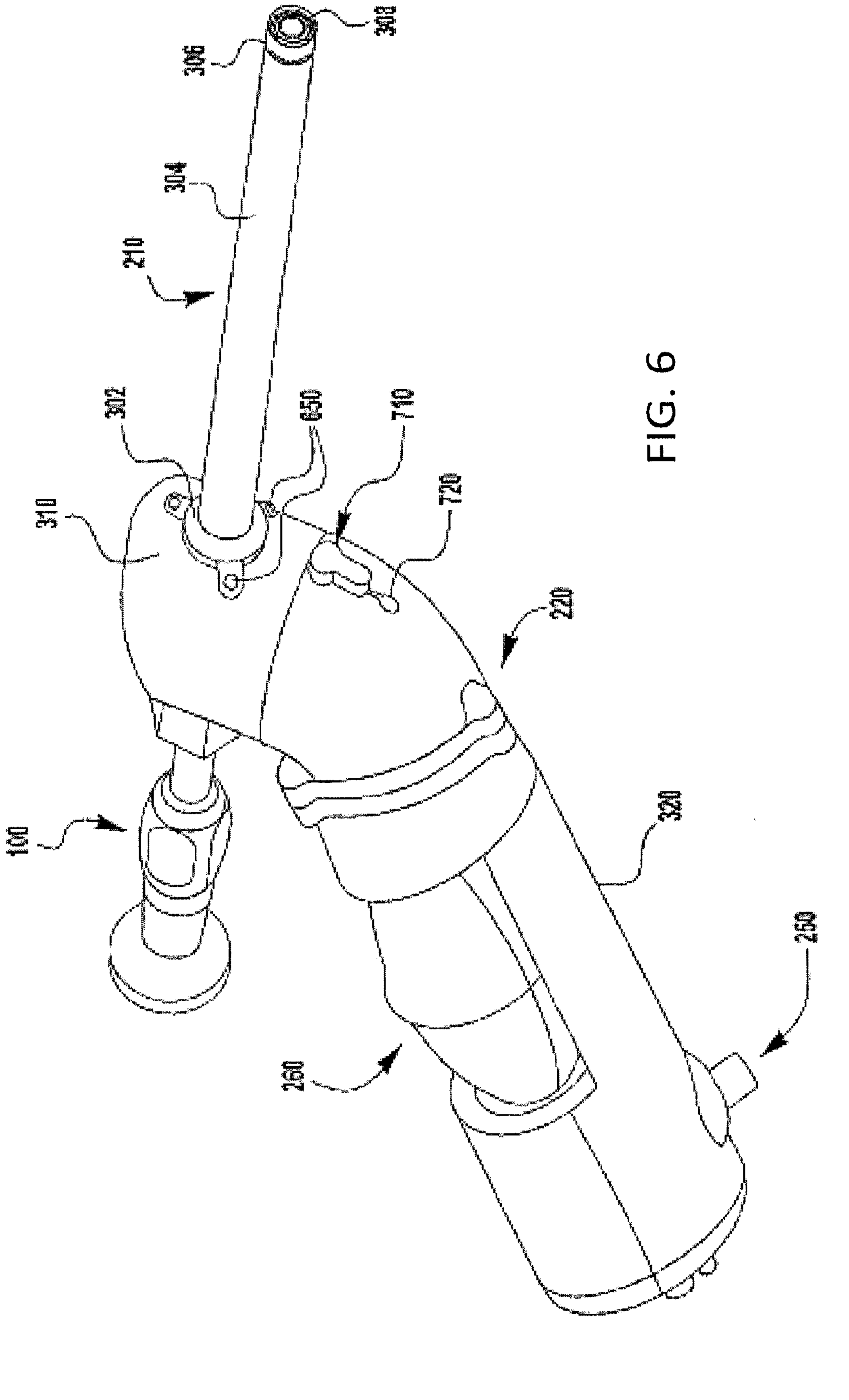


FIG. 6

FIGURE 7

Scope Temperature Distribution, Dry Tip Wipe

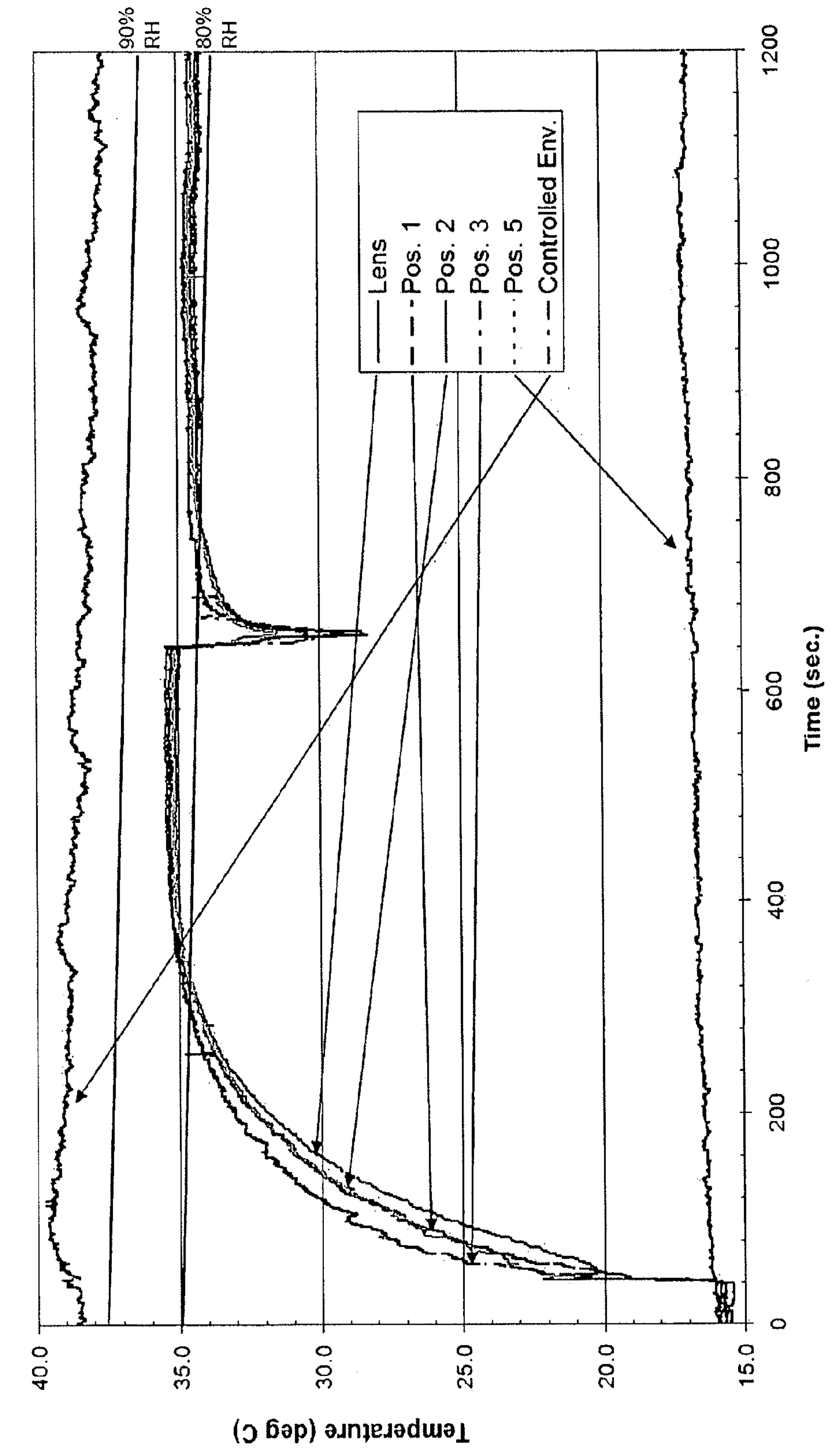
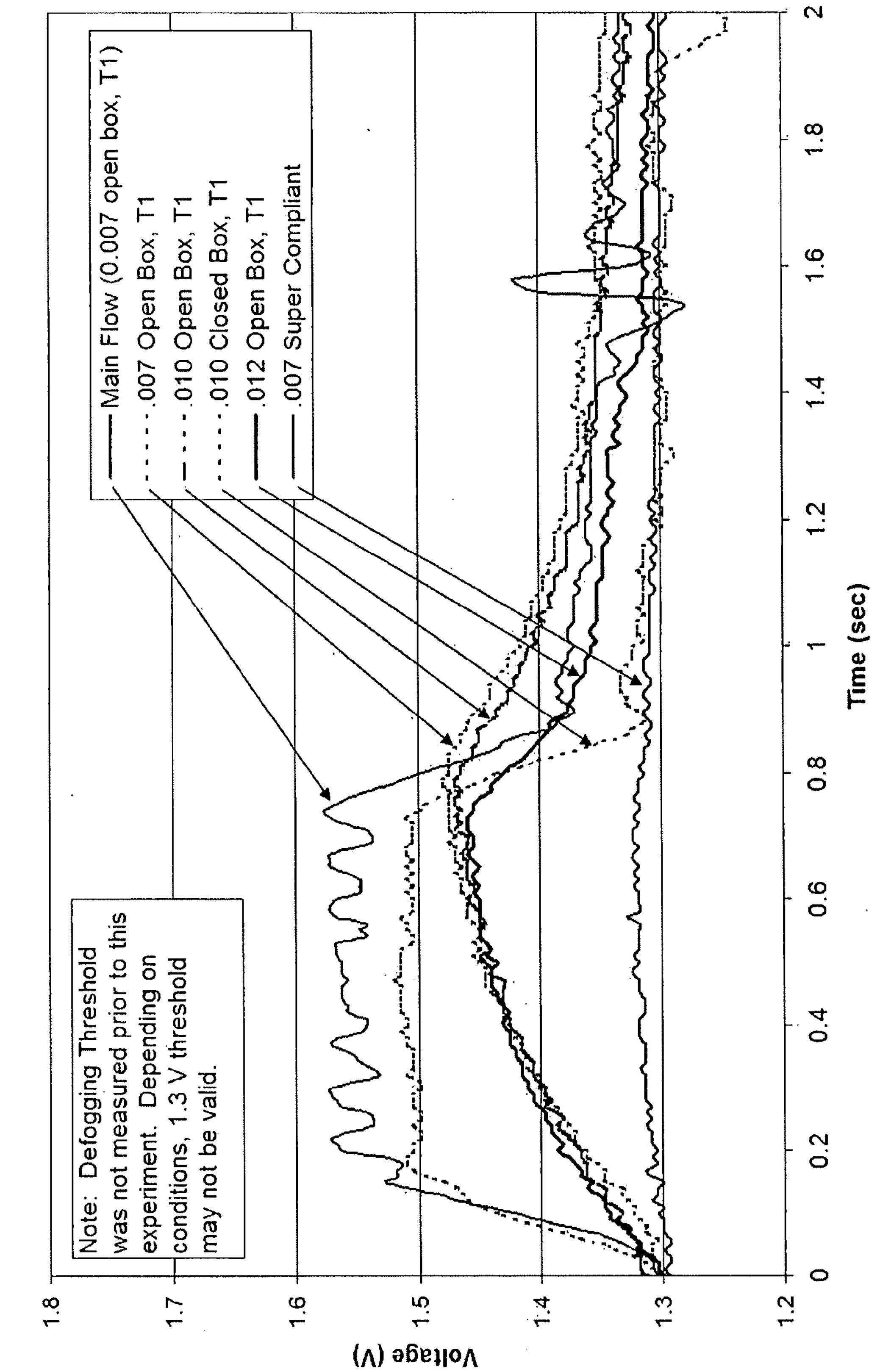


FIGURE 8


Note: Defogging Threshold was not measured prior to this experiment. Depending on conditions, 1.3 V threshold may not be valid.
Main Flow (0.007 open box, T1)
.007 Open Box, T1
.010 Open Box, T1
.010 Closed Box, T1
.012 Open Box, T1
.007 Super Compliant
Voltage (V)
Time (sec)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

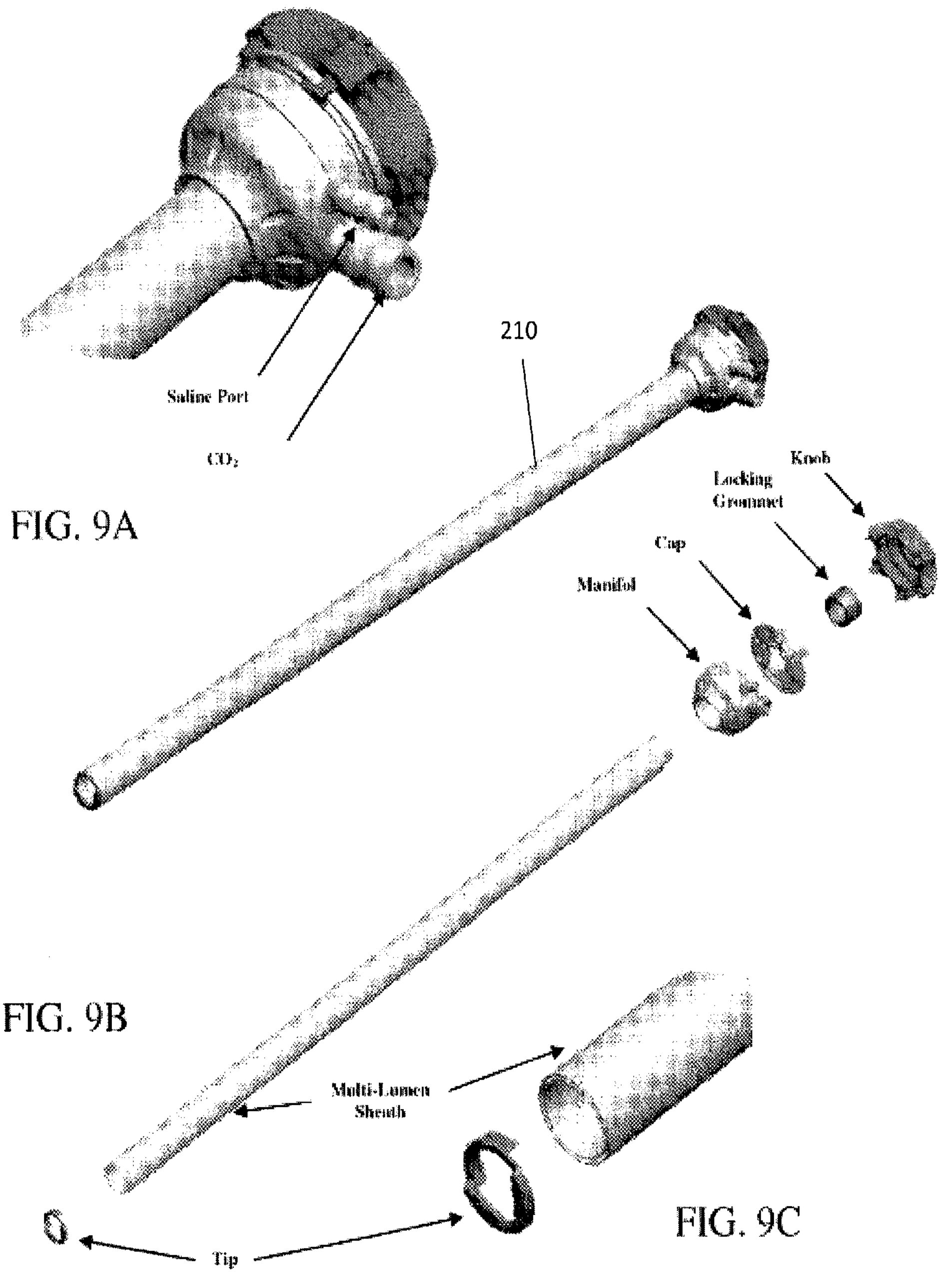


FIG. 9A

FIG. 9B

FIG. 9C

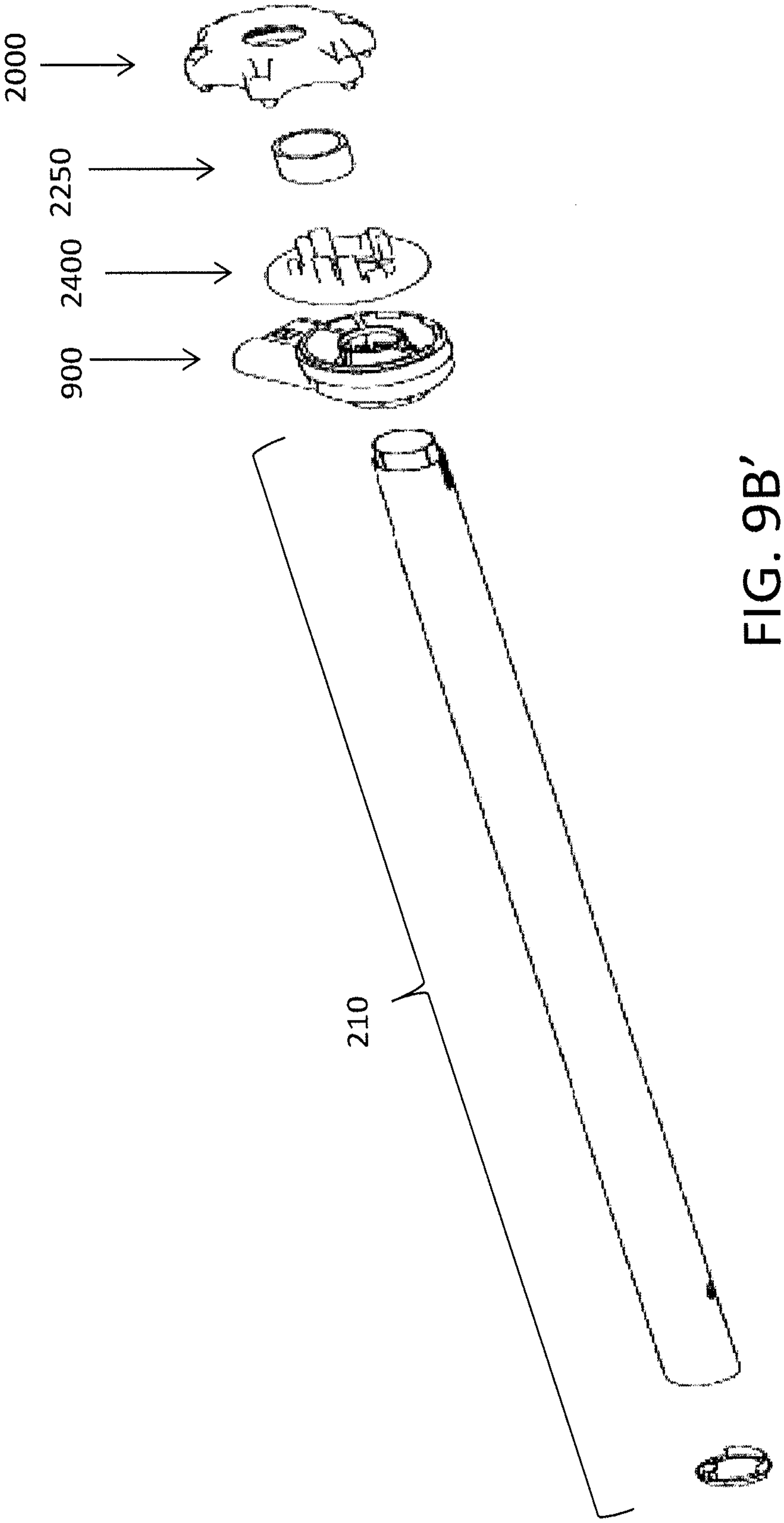


FIG. 9B’

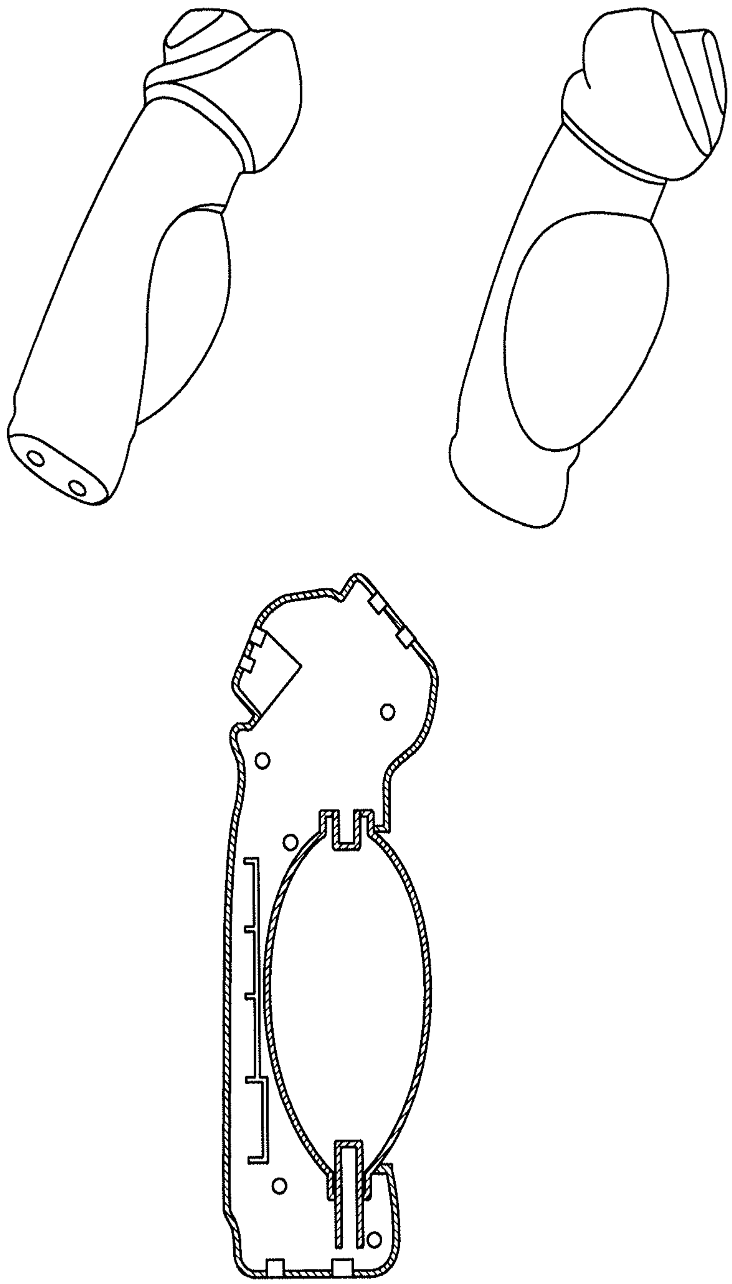


FIG. 10

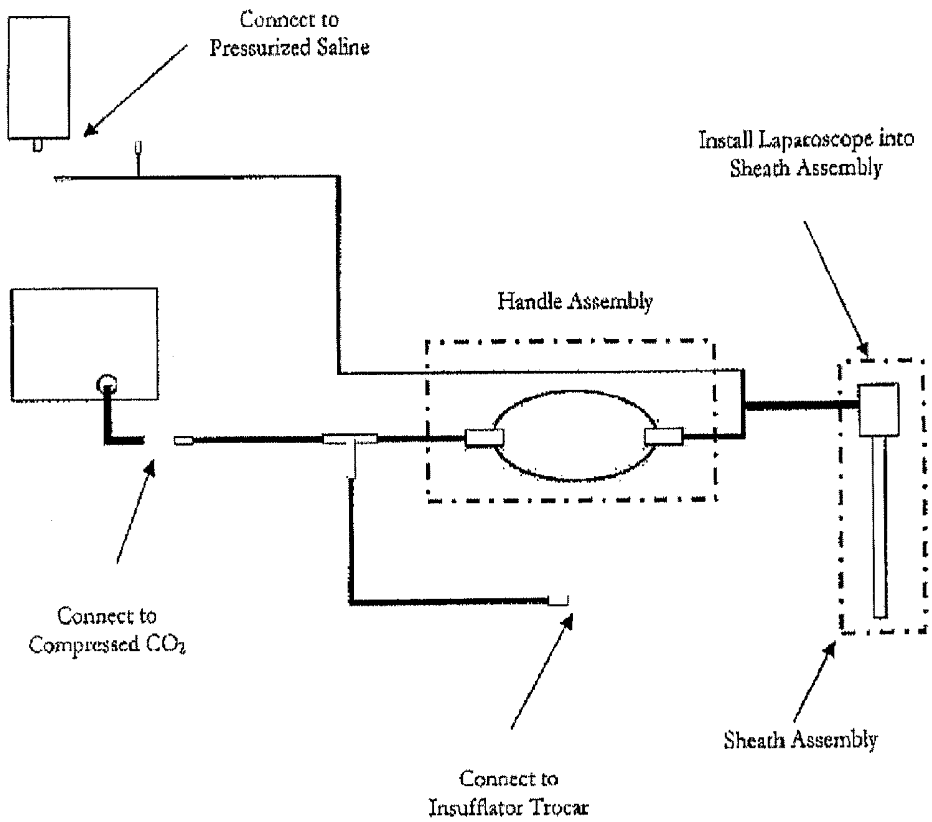

Connect to
Pressurized Saline
Install Laparoscope into
Sheath Assembly
Handle Assembly
Connect to
Compressed CO_2
Connect to
Insufflator Trocar
Sheath Assembly

FIG. 11

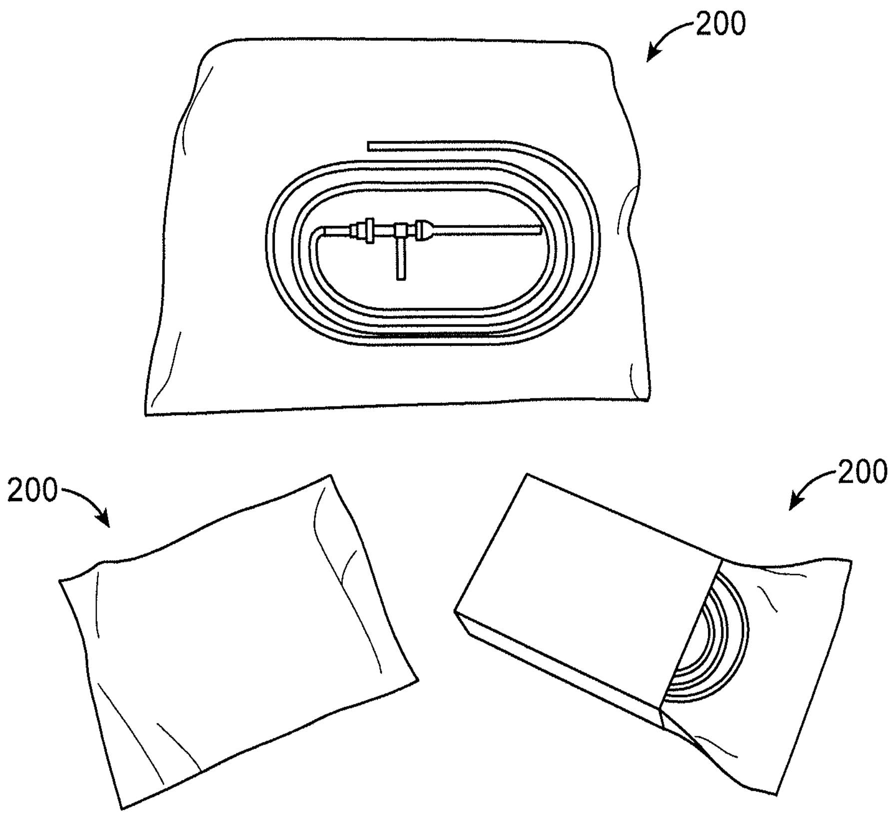


FIG. 12

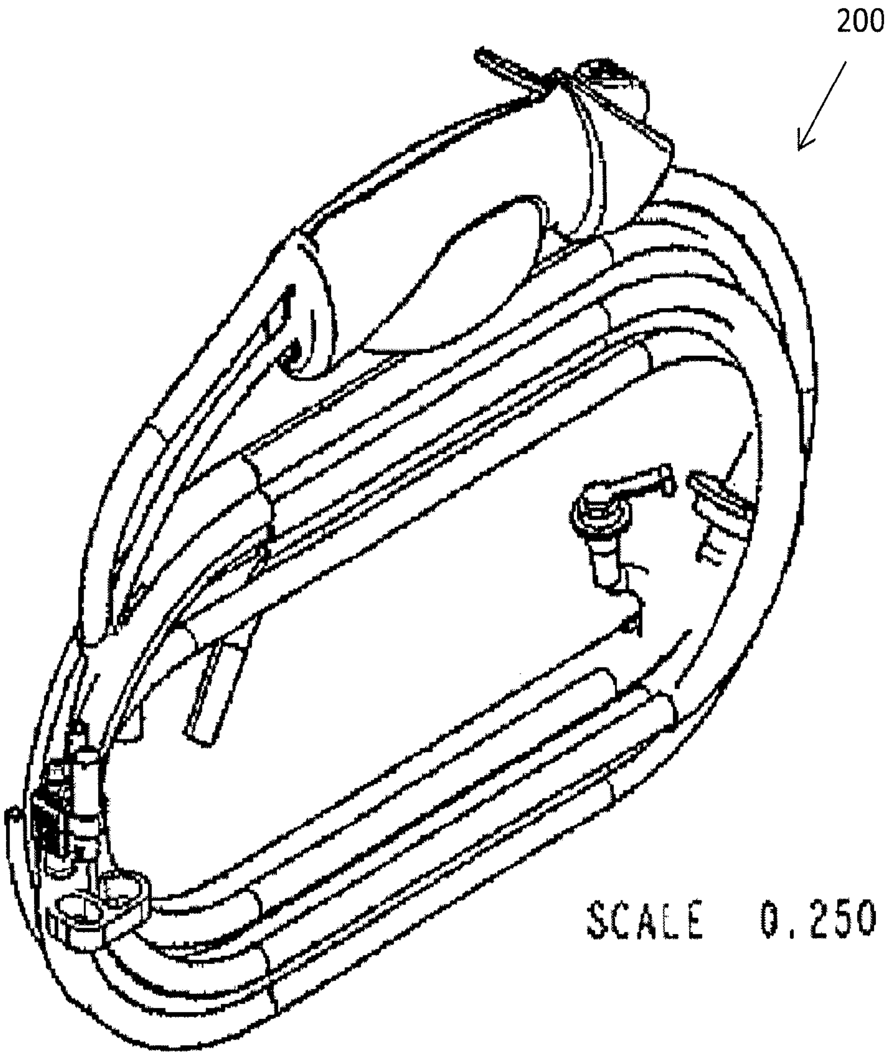


FIG. 13

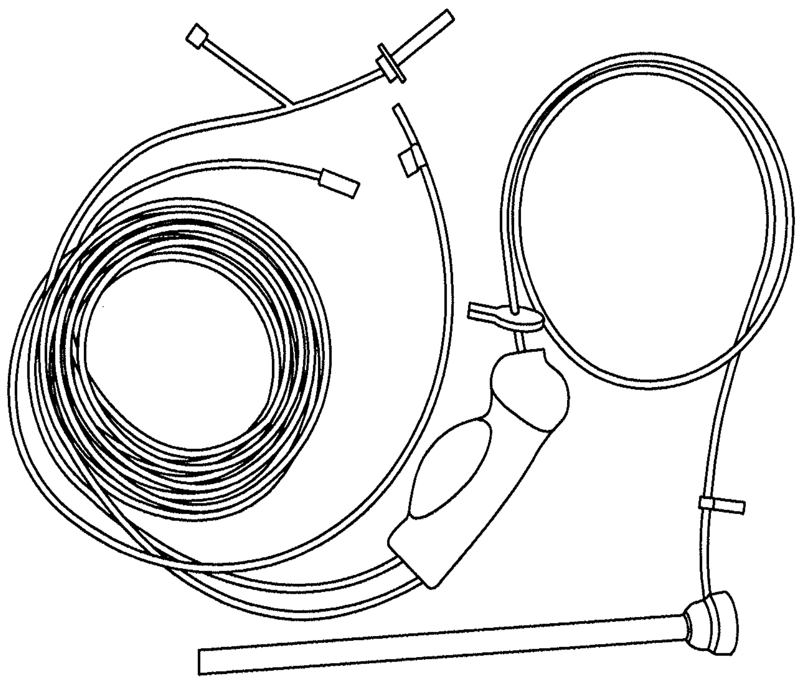


FIG. 14

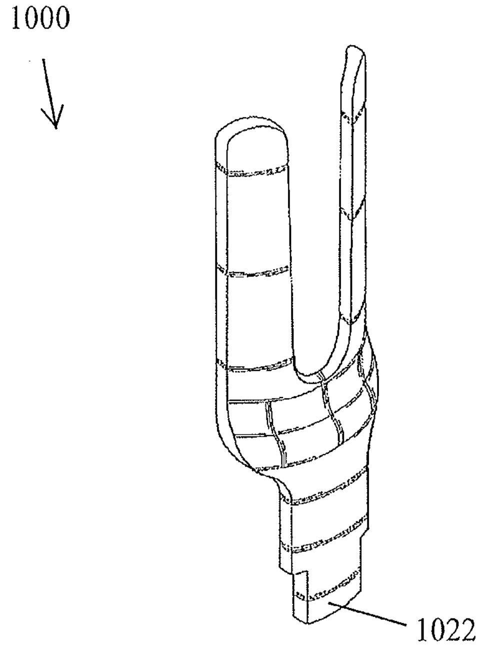


FIG. 15A

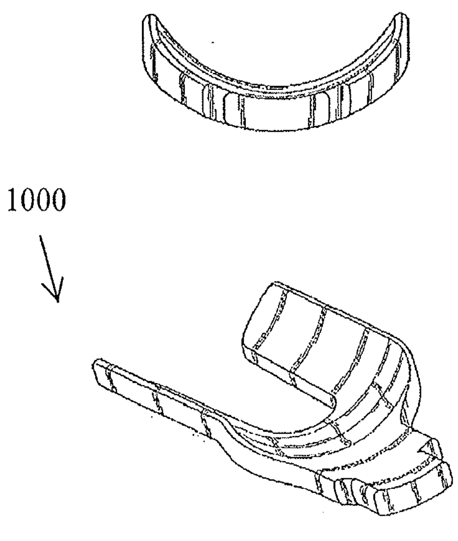


FIG. 15B

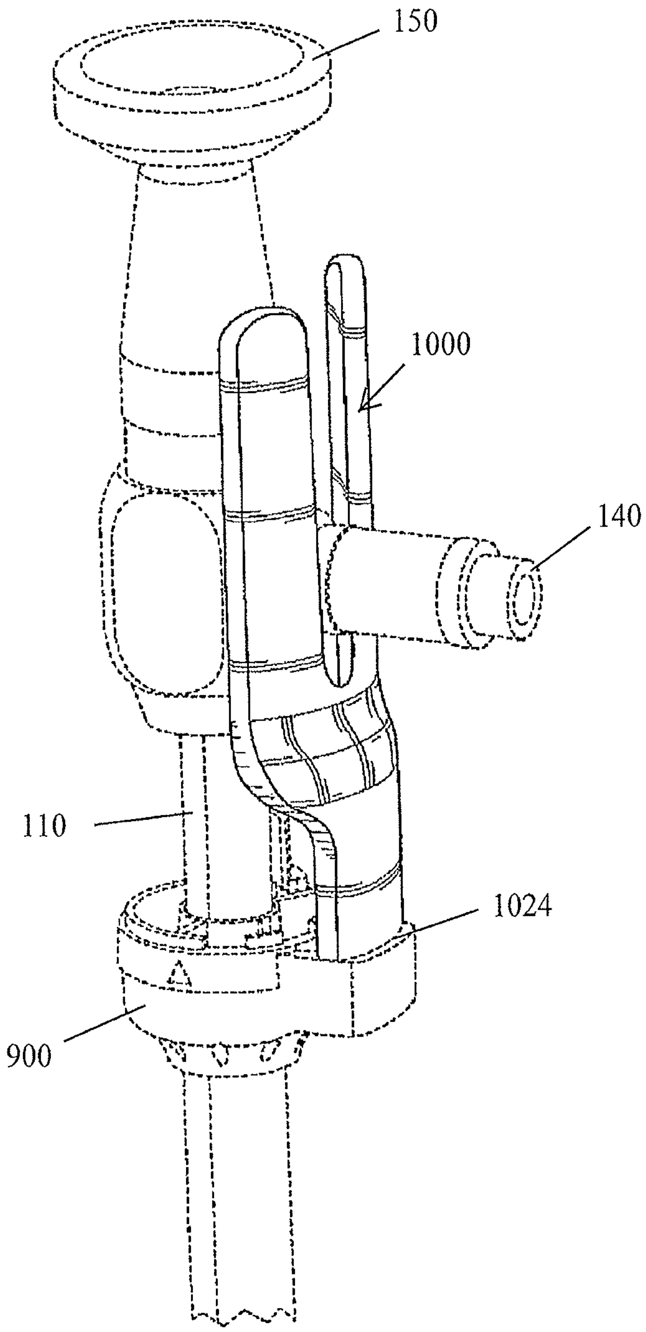


FIG. 15C

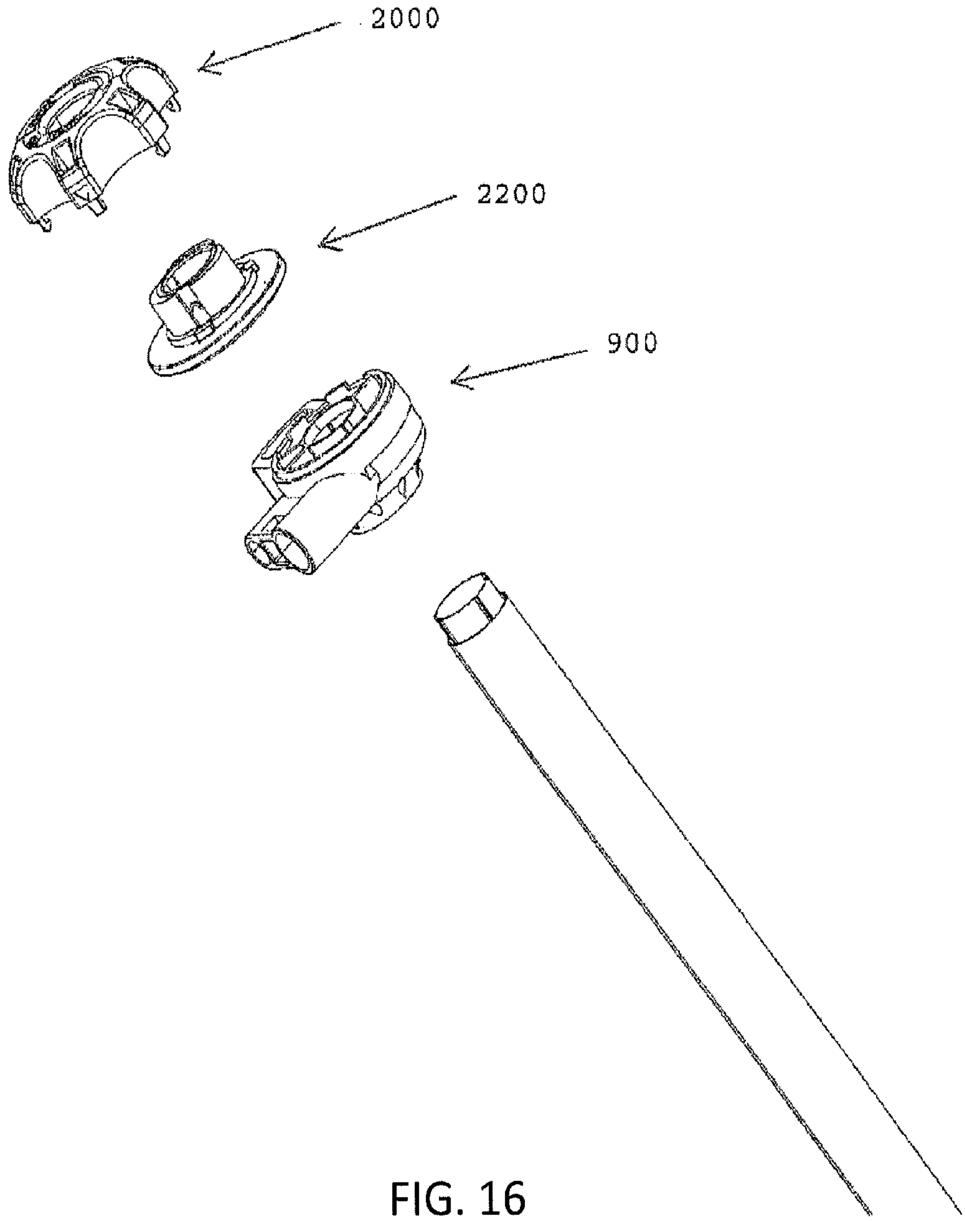


FIG. 16

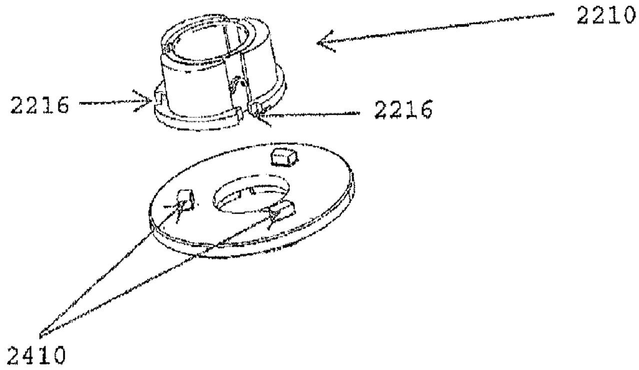


FIG. 17A

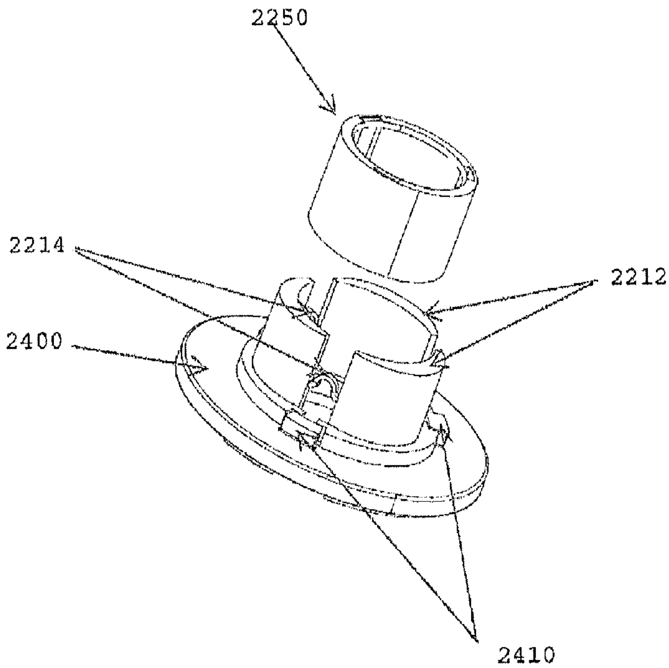


FIG. 17B

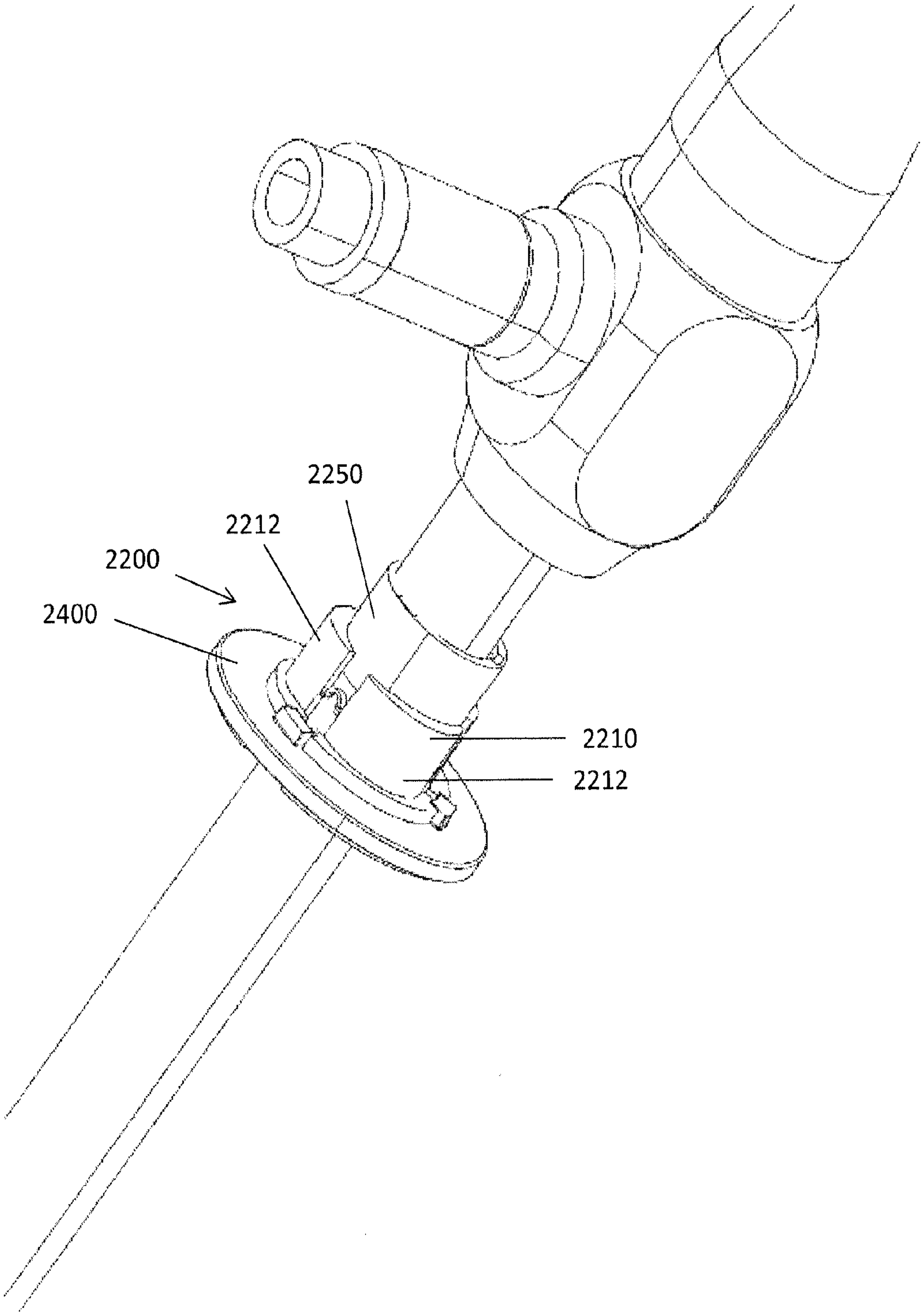


FIG. 17C

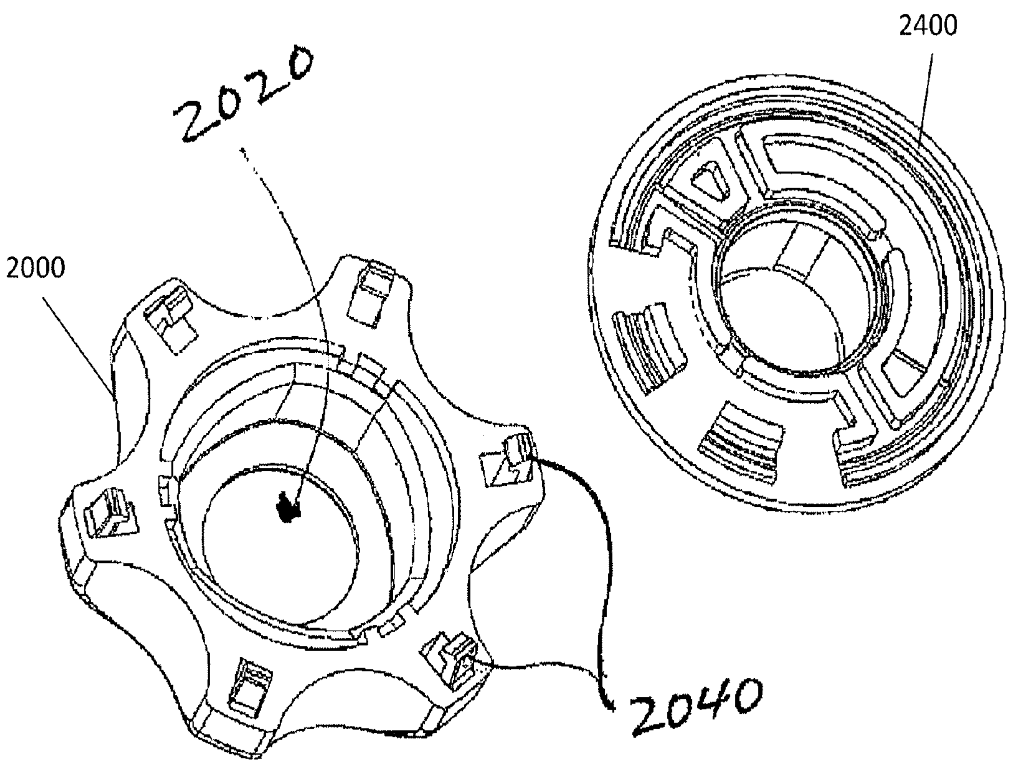


FIG. 18A

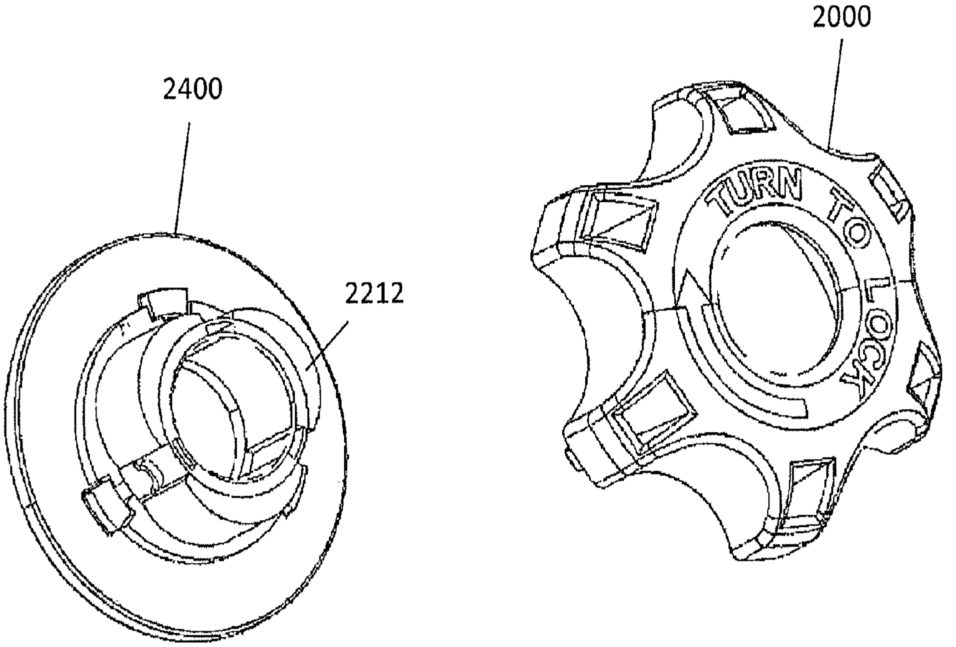


FIG. 18B

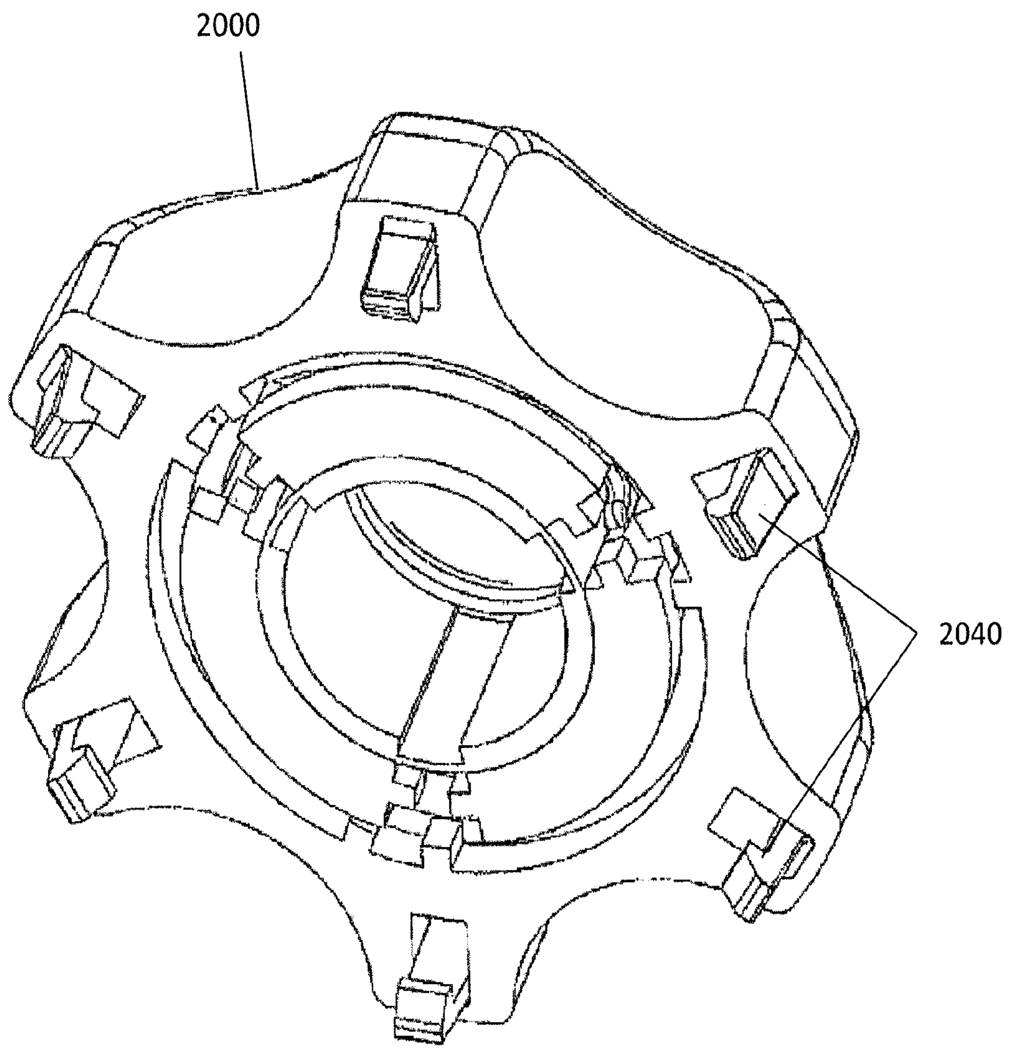


FIG. 18C

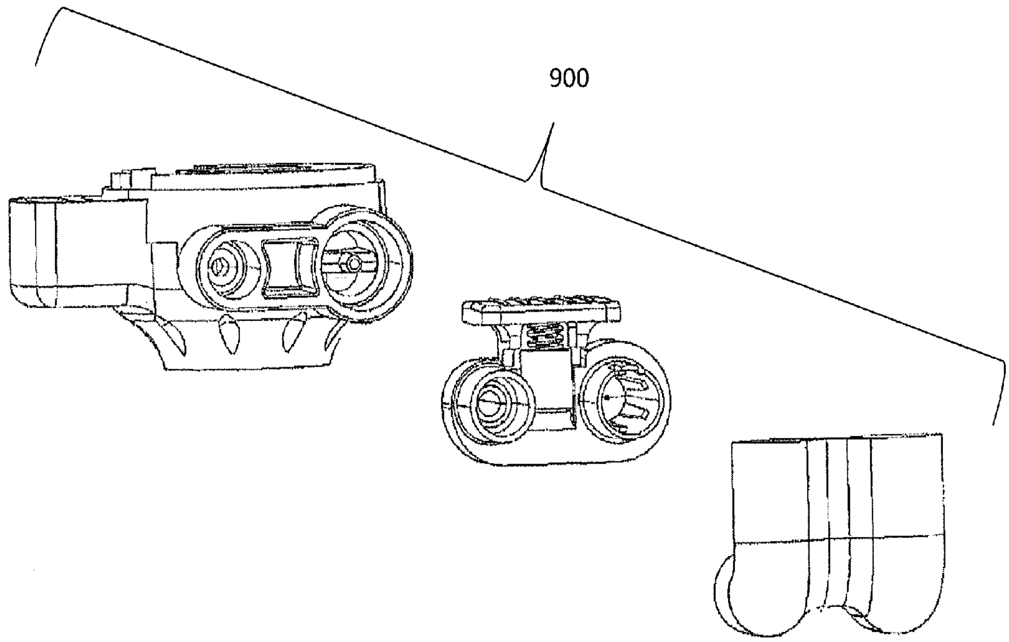


FIG. 19A

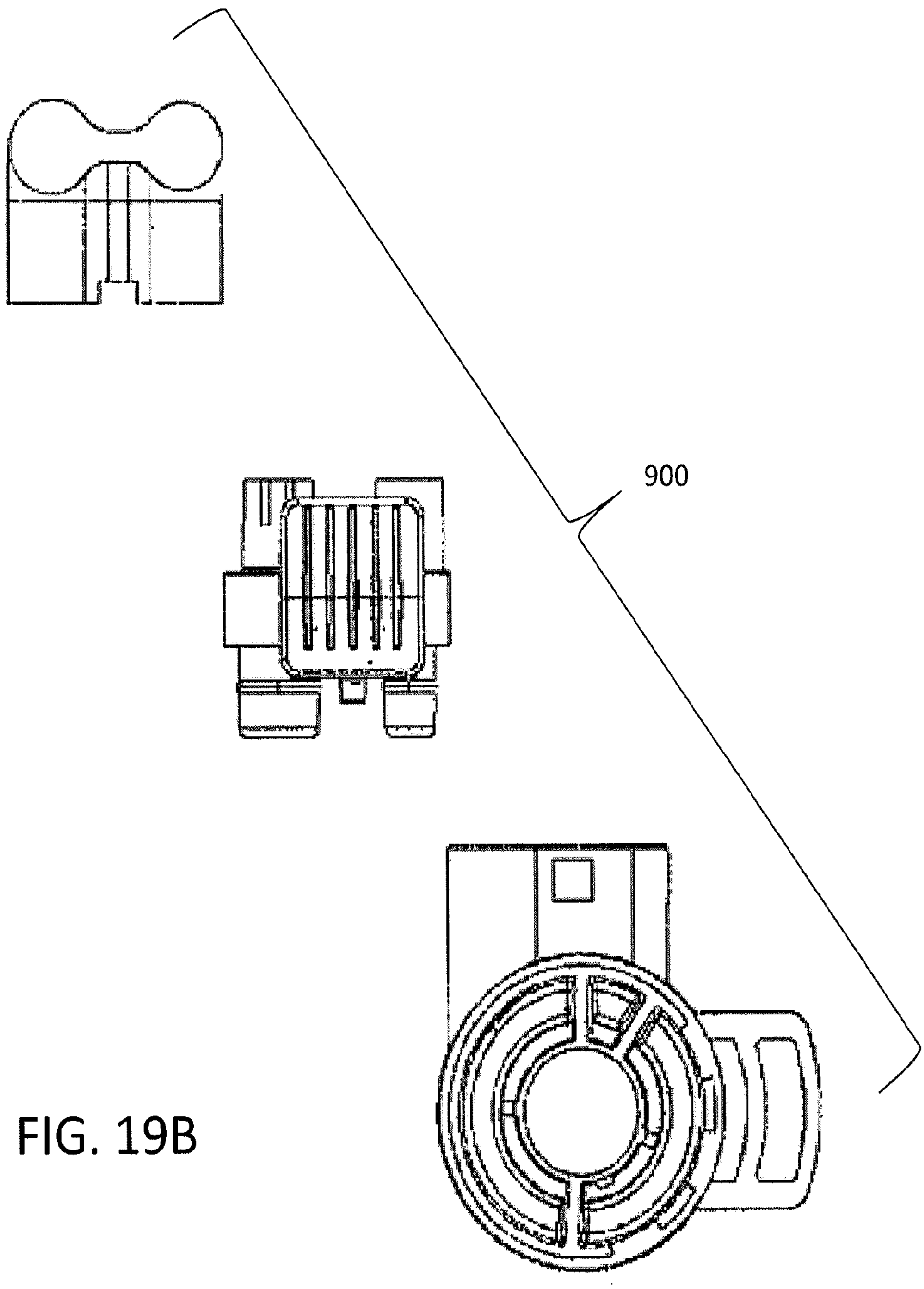


FIG. 19B

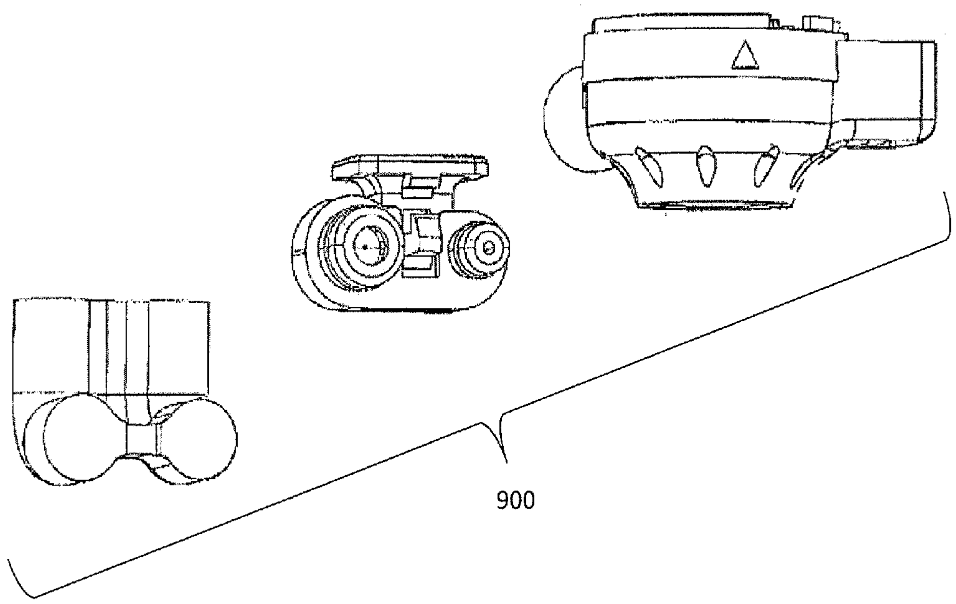


FIG. 19C

VIEW OPTIMIZER AND STABILIZER FOR USE WITH SURGICAL SCOPES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 12/635,632, filed Dec. 10, 2009, titled "VIEW OPTIMIZER AND STABILIZER FOR USE WITH SURGICAL SCOPES," now U.S. Pat. No. 9,050,037, which claims priority to U.S. Provisional Patent Application No. 61/121,514, filed on Dec. 10, 2008 and 61/170,864 filed Apr. 20, 2009, the entirety of which applications are incorporated by reference herein.

[0002] U.S. patent application Ser. No. 12/635,632 is related to U.S. patent application Ser. No. 11/765,340, filed Jun. 19, 2007 and to PCT Application No. PCT/US2008/067426, filed Jun. 19, 2008, the entirety of which applications are incorporated by reference herein.

FIELD

[0003] The present application relates generally to various embodiments of a device for maintaining visualization with surgical scopes. More particularly, this application relates to various embodiments of a view optimizer adapted to shield, clean and defog or clean the lens of a surgical scope, such as a laparoscope, while the surgical scope is being used to perform a surgical procedure within a cavity of a patient's body.

BACKGROUND

[0004] Minimally invasive surgical procedures utilizing surgical scopes are desirable because they often provide one or more of the following advantages: reduced blood loss; reduced post-operative patient discomfort; shortened recovery and hospitalization time; smaller incisions; and reduced exposure of internal organs to possible contaminants.

[0005] Generally, minimally invasive surgeries utilize scopes, such as laparoscopes, that permit remote visualization of a surgical site within a patient's body while the surgical procedure is being performed. During a laparoscopic procedure, the patient's abdominal or pelvic cavity is accessed through two or more relatively small incisions rather than through a single large incision that is typical in a conventional surgery. Surgical scopes, such as laparoscopes, usually consist in part of a rigid or relatively rigid rod or shaft having an objective lens at one end and an eyepiece and/or integrated visual display at the other. The scope may also be connected to a remote visual display device or a video camera to record surgical procedures.

[0006] In laparoscopic surgeries, the abdomen is typically inflated with a gas through the use of an insufflator, to distend the abdominal space by elevating the abdominal wall above the internal organs and thereby create a sufficient working and viewing space for the surgeon. Carbon dioxide is usually used for insufflation, though other suitable gases may also be used. Conventional insufflators are adapted to cycle on and off to maintain a preset and suitable pressure within the patient's body cavity.

[0007] The local environment within a patient's abdominal space is generally rather warm and humid, and the use of devices such as harmonic scalpels and other cutting and coagulating devices generate mist, smoke, and other debris that is released into the surgical field and often becomes suspended throughout the expanded abdominal space. Additionally, blood, bodily fluids, pieces of tissue, fat or other bodily material may come in contact with or even attach to the lens. As a result of these conditions, visualization through the scope can be significantly diminished. Typically, the only solution to fogging and debris collection on the lens is removal of the scope from the body cavity and defogging or cleaning the lens by wiping it with a cloth, warming the scope tip, or utilizing another defogging method. The need to remove the scope to defog and remove debris from the lens is inconvenient for the scope operator and the surgeon and can interrupt and undesirably prolong surgical procedures.

SUMMARY OF THE DISCLOSURE

[0008] Embodiments of a device for maintaining visualization with a surgical scope are provided. The embodiments of the device are adapted to shield, defog or clean the lens of the surgical scope while the surgical scope is being used to perform a surgical procedure within a patient's body. Some embodiments include features for stabilizing the scope and its position relative to the view optimizer and for locking the view optimizer to a surgical scope.

[0009] Additional features and advantages of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The features and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out herein.

[0010] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention.

[0011] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the invention, and together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present invention may be more readily understood by reference to the following drawings wherein:

[0013] FIG. **1**A is a perspective view of a laparoscope;

[0014] FIG. **1**B is a perspective view of a trocar;

[0015] FIG. **2**A is a perspective view of an exemplary embodiment of the view optimizer showing the lens guard and flow controller as separate parts interconnected with tubing;

[0016] FIG. **2**B shows a perspective view of another exemplary embodiment of the view optimizer showing the lens guard and the flow controller with integrated construction;

[0017] FIG. **2**C is a photograph of yet another exemplary embodiment of the view optimizer showing the lens guard and flow controller as separate parts which are interconnected with tubing, where with the lens guard is engaged with a conventional laparoscope and is connected via tubing with the flow controller and the flow controller is connected to additional tubing for interconnection with sources of saline and CO_2 and a conventional insufflator trocar;

[0018] FIGS. **3**A, **3**B, **3**C and **3**D show in four panels exploded perspective views of the flow controller and the lens guard of the view optimizer of FIG. **2**C;

[0019] FIG. **3**E shows an exploded perspective view of the view optimizer of FIG. **2**B;

[0020] FIG. 4A shows a magnified perspective view of the guard tube of the lens guard of a view optimizer with a conventional laparoscope inserted therethrough;

[0021] FIG. 4B shows a magnified perspective view of the guard tube and exhaust ring of the lens guard of a view optimizer;

[0022] FIG. 4C shows a magnified perspective view of the guard tube, exhaust ring and end ring of the lens guard of a view optimizer;

[0023] FIG. 4D shows a magnified perspective view of a guard tube and exhaust ring of the lens guard of the view optimizer of FIGS. 3A-3D adapted for use with a surgical scope having a 0° tip;

[0024] FIG. 4E shows a magnified perspective view of a guard tube and exhaust ring of the lens guard of the view optimizer of FIGS. 3A-3D adapted for use with a surgical scope having a 30° tip;

[0025] FIG. 4F shows a magnified perspective view of a guard tube and exhaust ring of the lens guard of the view optimizer of FIGS. 3A-3D adapted for use with a surgical scope having a 45° tip;

[0026] FIGS. 4G, 4H and 4I show a front perspective, rear plan and rear perspective views of an embodiment of the lens guard exhaust ring;

[0027] FIG. 4J shows an alternate side view of the lens guard depicted in FIG. 2C and FIG. 4K;

[0028] FIG. 4K shows a side perspective view of the lens guard depicted in FIG. 2C upper panel;

[0029] FIG. 5A shows a magnified front perspective view of the adapter ring of the lens guard of the view optimizer of FIG. 2B;

[0030] FIG. 5B shows a magnified rear perspective view of the adapter ring of the lens guard of the view optimizer of FIG. 2B;

[0031] FIG. 6 shows an alternate perspective view of the view optimizer of FIG. 2B;

[0032] FIG. 7 shows results of analysis of humidity and fogging; and

[0033] FIG. 8 shows results of evaluation of effect of introduction of compliant accumulator on flow across laparoscope lens;

[0034] FIG. 9A shows an perspective view of the lens guard of the view optimizer of FIG. 2C and FIGS. 3A-3D;

[0035] FIG. 9B and FIG. 9B' show an exploded perspective view of the lens guard of the view optimizer of FIG. 2C and FIGS. 3A-3D;

[0036] FIG. 9C shows a magnified perspective view of the tip and exhaust ring of the guard tube of the lens guard of the view optimizer of FIG. 2C and FIGS. 3A-3D;

[0037] FIG. 10 shows alternate perspective views of the flow controller of the view optimizer of FIG. 2C and FIGS. 3A-3D and a cutaway view of the flow controller of the view optimizer of FIG. 2C, detailing the mechanisms for actuation of liquid flow and bolus flow of FIG. 2C and FIGS. 3A-3D;

[0038] FIG. 11 shows a schematic of an embodiment of the view optimizer detailing the connectivity of the flow controller (marked handle assembly) with sources of saline and CO_2 and the insufflator trocar, and with the and guard tube (marked sheath assembly) which is adapted to receive the surgical scope;

[0039] FIG. 12 shows three views of the exemplary embodiment of the view optimizer shown in FIG. 2C as packaged,

[0040] FIG. 13 shows a scaled drawing (0.250) of the exemplary embodiment of the view optimizer shown in FIG. 12, coiled for packaging;

[0041] FIG. 14 is a photograph of the view optimizer embodiment of FIG. 2C and FIGS. 3A-3D with annotations identifying kit components and alternate descriptors for view optimizer components;

[0042] FIG. 15A shows a front perspective view of a surgical scope stabilizer;

[0043] FIG. 15B upper panel is a bottom side view thereof; lower panel is a bottom perspective view thereof;

[0044] FIG. 15C is a front perspective view of a surgical scope stabilizer in the environment of a sheath manifold and surgical scope;

[0045] FIG. 16 shows an exploded perspective view of the components of the scope locking mechanism, which include a locking knob, cam grip, manifold and sheath;

[0046] FIG. 17A shows an alternate perspective view of the components of the cam grip shown in FIG. 16;

[0047] FIG. 17B shows an alternate perspective view of the components of the cam grip shown in FIG. 16;

[0048] FIG. 17C shows a side perspective view of the cam grip with a laparoscope inserted therethrough;

[0049] FIG. 18A shows a perspective view of the bottom of the locking knob and cam grip components;

[0050] FIG. 18B shows a top perspective view of the of the locking knob and cam grip components;

[0051] FIG. 18C shows a bottom perspective view of the locking knob and cam grip engaged;

[0052] FIG. 19A shows a side perspective view of the manifold partially disassembled;

[0053] FIG. 19B shows a top plan view of the partially disassembled manifold shown in FIG. 19A; and

[0054] FIG. 19C shows an alternate side perspective view of the partially disassembled manifold shown in FIG. 19A.

DETAILED DESCRIPTION

[0055] The present invention will now be described with occasional reference to specific embodiments of the invention. This invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will fully convey the scope of the invention to those skilled in the art.

[0056] Except as otherwise specifically defined herein, all terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. The terminology used in the description of the invention herein is for describing particular embodiments only, and is not intended to be limiting of the invention. As used in the description of the invention and the appended claims, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0057] Unless otherwise indicated, all numbers expressing quantities, properties, and so forth as used in the specification and claims are to be understood as being modified in all instances by the term "about." Accordingly, unless otherwise indicated, the numerical properties set forth in the following specification and claims are approximations that may vary depending on the desired properties sought to be obtained in embodiments of the present invention. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of the invention are approximations, the numerical values to the extent that such are set forth in the specific examples are reported as precisely as possible. Any numerical values, however, inherently contain certain errors necessarily resulting from error found in their respective measurements.

[0058] Described herein are various embodiments of a device for use with surgical scopes. In some embodiments, this application relates to various embodiments of view optimizer devices of varying constructions for use with laparoscopes, the view optimizer device being adapted to shield, defog or clean the lens of the laparoscope while the laparoscope is being used to perform a surgical procedure within a patient's body, thereby enhancing patient safety by maintaining clear and stable visualization of the surgical field. In certain embodiments disclosed herein the devices are adapted to connect with the insufflation circuit and irrigation systems resident in the standard surgical suite, diverting only a small fraction of the flow from these systems to provide device functionality and requiring no power source. The devices function to prevent fogging and deflect and remove from the lens of the surgical scope solid and aerosolized surgical debris, including blood, smoke, saline, tissue and other materials and debris in the surgical field. These functions are achieved through means that include intermittent or continuous flow of gas, typically CO_2, across the distal end, delivery by manual or automated means of a saline flush or a CO_2 burst over the lens, and venting through either a conventional trocar or other means incorporated in the inventive devices. The device functions are achieved without the need for withdrawal of the surgical scope from the surgical trocar so as to enable maintenance if the surgical image. Though the various device embodiments are referred to herein as a view optimizer, and though the various device component parts and functions have likewise been given descriptors herein, it will be appreciated that such descriptor designations are not intended to and do not limit in any way the device's and component's use and operation for a variety of purposes as further described herein in addition to controlling, improving and maintaining and improving desirable visualization of a laparoscopic surgical field.

Conventional Devices

[0059] Referring to FIG. **1**A, a perspective view of an exemplary, conventional laparoscope **100** is shown. The laparoscope **100** has an elongated cylindrical main body **110** having a distal end **120** and an imaging end **130**. The main body **110** of the laparoscope may be either rigid or flexible, depending on the procedure the laparoscope is being used to perform, as well as the type of laparoscope being utilized. An objective lens (not shown in FIG. **1**A) is disposed within the distal end **120** of the main body **110**, the objective lens being generally transverse to the longitudinal axis of the main body **100**. Generally, laparoscope **100** includes an illumination system, which can be any type of suitable illumination system, such as a network of fiber optic cables, housed within the main body **110** of laparoscope **100** for illuminating the surgical site being imaged by the operative lens of the laparoscope. Laparoscope **100** includes an illuminator connector **140** for the connection of an external light source, which supplies the illumination system with illuminating light.

[0060] The imaging end **130** of the main body **110** of the laparoscope **100** includes an eyepiece **150**. Conventional laparoscopes include an image transmission system (not shown in FIG. **1**A), which can be selected from any type of suitable image transmission systems, such as a system of lens, lens rods or other optical components, housed within the main body **110** of the laparoscope for transmitting the image viewed by the objective lens to the eyepiece **150**, thus allowing the scope operator to view within the patient's abdominal cavity. It is well known in the art that a video camera or other visual display device can be operatively connected to the eyepiece **150** or other portion of the laparoscope **100** to convert the optical signal into a video signal, which is ultimately processed by a video processing means to produce a video image on a monitor or for storage on magnetic tape or other storage media.

[0061] Referring now to FIG. **1**B, a perspective view of an exemplary, conventional trocar **800** is shown. Trocar systems are surgical devices used to obtain access to a body cavity to perform various surgical procedures, such as, for example, laparoscopic surgery or arthroscopic surgery.

[0062] It should be understood that the laparoscope device is typically used in conjunction with a trocar which directs access of the scope to the laparoscopic surgical field. It should be further understood that conventional trocars are, by design, adapted with cannulas that have a diameter suitable to receive conventional scopes, and that any attachments to a conventional surgical scope, such as the view optimizer device and embodiments described herein, will be sized to fit over a portion of a conventional scope and capable of being inserted into the cannula of a conventional trocar. And it will be appreciated that in its various embodiments, the view optimizer of the present application can be used in connection with a variety of trocars and with a variety of laparoscopes and other surgical scopes of varying construction wherein the trocar is adapted to receive a scope within a cannula or like tube.

[0063] It is well known in the art that trocar systems typically include, among various optional features, a pointed rod-like device or obdurator fitted into a tube-like device or cannula and a port and a stopcock for permitting the introduction and venting of a pressurized fluid through the cannula for insufflating a body cavity when providing a pneumoperitoneum. In use, a pointed end of the obdurator projects out an end of a cannula and is used to penetrate the outer tissue of the body cavity. After the tissue is penetrated and the body cavity is accessed by the trocar system, the obdurator is then withdrawn while the cannula is retained in the cavity. The body cavity can then be accessed by surgical instruments via the cannula to perform various surgical procedures, or the cannula can simply be used as a drainage outlet. The trocar illustrated in FIG. **1**B has a stopcock valve **810** for opening and closing a port **820**. The valve may be operated by hand, for example, by a surgeon or a surgical assistant, and moved between two or more positions to control the flow of fluid, such as gas, through the cannula **830** and thus between the surgical suite and the surgical field within the patient's body cavity.

[0064] It should be understood that the laparoscope and trocar devices discussed above are representative of conventional scopes such as laparoscopes and trocars. It should be further understood that conventional trocars are, by design, adapted with cannulas that have a diameter suitable to receive conventional scopes, and that any attachments to a conventional surgical scope, such as the view optimizer device and embodiments described herein, will be sized to fit over a portion of a conventional scope and capable of being inserted into the cannula of a conventional trocar. And it will be appreciated that in its various embodiments, the view optimizer device of the present application can be used in connection with a variety of trocars and with a variety of laparoscopes or other surgical scopes of varying constructions wherein the trocar is adapted to receive a scope within a cannula or like tube.

View Optimizing Devices—General Construction

[0065] Referring now to FIG. **2**A and FIG. **2**C show exemplary embodiments of the view optimizer **200** of the present application having multi part construction, and FIG. **2**B shows an exemplary embodiment having unitary construction. As shown in FIGS. **2**A and **2**B and **2**C, the view optimizer **200** generally includes a lens guard **210** and a flow controller **220** (shown, respectively without and with prime (') designation). The lens guard **210** of the illustrated embodiment is adapted to receive a portion of the laparoscope **100**, most particularly the distal end **120** thereof, and a portion of the main body **110** of the laparoscope. The lens guard **210** of the illustrated embodiment is in the form of a substantially continuous cylindrical sheath or tube that encloses a significant portion of the body of the laparoscope **100**. It will be appreciated that in alternate embodiments, the lens guard **210** may be discontinuous, such that it may be formed of an open lattice or matrix that does not fully enclose the body of the laparoscope. As will be described further herein, the common structural features of the various embodiments of the lens guard **210** will be adapted to allow communication between the lens guard **210** of the view optimizer **200** at the distal end **120** of the laparoscope, on the one hand, and the flow controller **220** of the view optimizer **200** on the body **110** of the laparoscope near its imaging end **130**, on the other hand, so as to provide for the functions of the view optimizer. Referring generally to the depicted devices, the view optimizer **200** is adapted to deliver to the objective lens of the laparoscope at least one fluid selected from, for example, a liquid, such as water or saline or a surfactant or other liquid, and a gas, such as CO_2 or air, to prevent the contact of material with the objective lens of the laparoscope or to defog or clean the objective lens of the laparoscope without the need to remove the laparoscope from the surgical field.

[0066] In accordance with some embodiments, the fluid delivered to the objective lens is a gas, in some embodiments, the gas is medical grade CO_2. The gas that is delivered to the objective lens of the laparoscope **100** by the view optimizer **200** is supplied by a conventional insufflator. Of course, it should be understood that the view optimizer **200** of this application could be supplied with gas via another external source other than an insufflator, or could include a gas supply device incorporated within or provided with the view optimizer **200**, or by combinations of gas sources. Conventional insufflators are designed to insufflate a patient's abdominal cavity until a pre-determined suitable pressure for the operative procedure is reached. Once this pre-determined pressure is reached, conventional insufflators are designed to cease insufflating the cavity. Typical insufflators are designed to resume insufflation once the pressure in the cavity drops below the pre-determined pressure due to the leakage of gas through the trocars being used, through incisions in the patient's body cavity, or by some other means. In this manner, conventional insufflators typically continuously cycle between an insufflation state and a static state while being utilized during an operative procedure to maintain a pre-determined pressure within the patient's abdominal cavity.

[0067] Referring now to FIG. **2**A, the lens guard **210'** of the illustrated embodiment of the view optimizer **200** is an elongated, hollow cylindrical tube. The lens guard **210'** has a distal end **212'** and a proximal end **214'**. The distal end **212'** of the lens guard **210'** is adapted to surround the distal end **120** of the laparoscope **100**. According to the illustrated embodiment, the distal end **212'** of the lens guard **210'** does not cover or fully enclose the distal end **120** of the laparoscope. It will be appreciated that in some alternate embodiments, a lens guard **210'** may include structure that fully encloses the distal end **120** of the laparoscope, and as such is formed of a material that permits visualization. The proximal end **214'** of the lens guard **210'** is joined to the flow controller **220'** of the view optimizer **200**. The flow controller **220'** of the view optimizer **200** of the illustrated embodiment is adapted to support and enclose components of the view optimizer **200**. The flow controller **220'** of the of the view optimizer **200** supplies the lens guard **210'** with gas and/or liquid via one or more of conduits that connect to lens guard **210'**. The flow controller **220'** receives gas and/or liquid from one or more exterior sources via air inlet **230** and liquid inlet **240** and delivers the gas and/or liquid to the lens guard **210'**. The flow controller **220'** of the illustrated embodiment includes a gas/liquid flow actuator/regulator **250'** for the actuation and/or regulation of the flow of gas and/or liquid to the lens guard **210'**. The flow controller **220'** of the illustrated embodiment includes a burst flow actuator/regulator **260'** for the actuation and/or regulation of the delivery of a burst or bolus of gas and/or liquid to the lens guard **210'**, as described herein.

[0068] FIG. **2**B shows the lens guard **210** and the flow controller **220** of the view optimizer **200** joined together as a unitary construction. It should be understood that the lens guard **210** and the flow controller **220** could be provided as two or more separate pieces that are used remotely from one another and not joined together as a unitary construction. FIG. **2**A shows a side view of another exemplary embodiment of the view optimizer **200** of the present application. In this embodiment, the view optimizer **200** is in two separate pieces (as previously noted, the prime designation, e.g. **210'**, is used to reference features that are common between the embodiments depicted in FIG. **2**A and FIG. **2**B and FIG. **2**C). The lens guard **210'** is attached at its proximal end **214** to the laparoscope **100**, and comprises a vent actuator **280**, and a fluid conduit **270** that is in communication with the flow controller **220'** (connection not shown). The flow controller **220'** is depicted as an ergonomic device to be grasped in an operator's hand, with a flow actuator/regulator **250'** adapted to be depressed by the operator's thumb, and a burst flow actuator/regulator **260'** adapted to be depressed by the flexion of the operator's fingers, to deliver the flow of gas or liquid from one or more inlet sources (not shown) through the fluid conduit **270**, for delivery to the objective lens of the scope through distal end **212** of the lens guard **210**. In the depicted embodiment, the vent actuator **280** is under the control of the scope operator, and may be adjusted as needed to assist in maintaining visualization.

[0069] Of course it will be understood that in yet other alternate embodiments, one or more of the actuators may be eliminated, and their locations may be switched, or all actuators may be located on the flow controller **220'** or may be located at yet another controller, such as a separate foot activated controller (not shown). In yet other embodiments, the lens guard **210** and **210'** and the flow controller **220** and **220'** could be provided as two or more separate pieces that are assembled for use. And it will further be appreciated that the two or more separate pieces that comprise the view optimizer **200** may comprise a lens guard **210/210'** that is separate from the flow controller **220/220'** and the lens guard and flow controllers are interconnected by one or more conduits for providing fluid flow. Once such embodiment is depicted in FIG. **2**C, for example.

[0070] While the lens guard **210** and **210'** and the flow controller **220** and **220'** of the illustrated embodiments are formed from plastic, other suitable materials, such as metal or a composite material, or combinations of these could also be used.

[0071] According to some embodiments, the view optimizer **200** is adapted to deliver a stream of fluid to the objective lens of the laparoscope so as to create a current passing over the face of the lens that transports moisture located on or near the lens away from the lens, thus preventing moisture from adhering to the lens. In additional embodiments, the view optimizer **200** delivers a stream of fluid to the objective lens at a temperature that is adapted to help ensure that the temperature of the objective lens does not fall to a point that is at or below the dew point temperature within the patient's abdominal cavity, thus preventing condensation from forming on the lens. Finally, in yet additional embodiments, the view optimizer **200** is adapted to deliver a stream of generally anhydrous fluid to the objective lens. In such embodiments, the generally anhydrous fluid serves to attract and absorb moisture particles located on or near the lens and carry the moisture away from the lens with the flow of fluid. In some embodiments, the fluid is medical grade CO_2. Medical grade CO_2 for use with conventional insufflators is typically 99% pure, that is, no more than 1% of the gas is other than CO_2, and such medical grade CO_2 generally has a maximum moisture content of 25 parts per million by volume.

[0072] It should be understood that additional embodiments of the view optimizer **200** may perform only one of the above-described functions or any combination of these functions. Based on testing that was conducted in connection with the view optimizer **200** of the illustrated embodiment, when the temperature within the patient's abdomen was approximately 102.9° F. and the relative humidity within the patient's abdomen was 76%, the delivery of a stream of fluid to the objective lens of the laparoscope **100** at a flow rate of equal to or greater than 0.07 liters per minute proved to be effective for defogging the lens (and/or preventing the fogging of the lens). It should be understood, however, that a variety of different flow rates will be effective for defogging the lens depending on the temperature and the moisture content of the gas being supplied by the insufflator and the temperature and relative humidity of the patient's abdomen as well as other variables. As a way of illustrating the defogging effects of the view optimizer **200** according to one embodiment, the information regarding the dew point temperature of the objective lens of the laparoscope was collected when the view optimizer **200** was located within the patient's abdominal cavity.

[0073] According to some embodiments, the view optimizer **200** is adapted to deliver a stream of one or more fluids across the objective lens of the laparoscope **100** to deflect blood, bodily fluids, pieces of tissue, fat or other bodily material that come within the vicinity of the objective lens. The stream of fluid may be either continuous or intermittent. In addition, according to some embodiments, the view optimizer **200** is adapted to deliver a burst or bolus of gas and/or liquid to the objective lens of the laparoscope when the scope operator desires. This burst or bolus of gas and/or liquid serves, at least in part, to facilitate removal of blood, bodily fluids, pieces of tissue, fat or other bodily material on the objective lens. In this manner, the scope operator can deliver a burst of gas or liquid to the objective lens to remove a piece of material or droplet of liquid, which was otherwise unable to be removed from the objective lens. It should be understood that additional embodiments of the view optimizer **200** may perform only one of the above-described functions or any combination of these functions.

[0074] According to various embodiments, the view optimizer **200** delivers gas to the lens of the laparoscope so as to provide a guard or shield to deflect liquid and particulate debris and prevent it from contacting the lens. According to some embodiments, the gas delivery is intermittent. According to other embodiments, such as the embodiment illustrated in any one of FIG. **2**A-**2**C, the flow of gas is essentially continuous. As such, the flow of gas during operation of the view optimizer **200** flows constantly, with delays of flow that are of a duration not greater than 5 seconds. Accordingly, in various embodiments wherein the flow of gas is essentially continuous, delays in flow are of a duration that is not greater than about 0.2, 0.4, 0.6, 0.8, 1.0, 2, 3, 4, or 5 seconds.

[0075] As is further described herein, the embodiment of the view optimizer **200** illustrated in any one of FIG. **2**A-**2**C is supplied with gas by the insufflator comprises one or more of a variety of means to permit an essentially uninterrupted supply of gas to be directed across the objective lens of the laparoscope **100**. Accordingly, the illustrated embodiment includes a leakage or venting of gas from the body cavity so as to ensure continuous gas flow from the insufflator. This leak allows gas to exit the patient's abdominal cavity as necessary to ensure that the insufflator remains substantially in an insufflation state, thus supplying the view optimizer **200** with a generally continuous supply of gas.

[0076] As previously described, the lens guard **210** is an elongated, cylindrical tube. However, it should be understood that that the lens guard **210** is not limited to this shape and configuration and other suitable shapes and configurations could also be used in additional embodiments. Examples of additional constructions have been previously described. Examples of additional cross-sectional shapes that could be used for the lens guard **210** include, but are not limited to, rectangular, triangular, oval, etc. The lens guard **210** can have any shape or configuration which allows it to surround the distal tip **120** of the laparoscope **100**.

[0077] Additional embodiments of the view optimizer **200** may include a lens guard which has an angled portion to correspond with scopes with angled portions, such as 45° or 30° angled scopes. The lens guard **210** of the illustrated embodiment is substantially rigid. However, it should be understood that additional embodiments of the view optimizer may include a flexible lens guard, which is adapted for use with a flexible scope. For example, the lens guard **210** of the embodiment illustrated in FIG. **2**A is fashioned from plastic, but other suitable materials such as metal or a composite material or combinations of these could also be used.

[0078] While the view optimizer **200** of the illustrated embodiment includes a lens guard **210** that surrounds and encloses the entire length of the laparoscope **100**, it should be understood that the lens guard **210** of the view optimizer **200** could have any shape, construction or configuration that allows it to deliver gas and/or liquid to the objective lens of the laparoscope **100**. For example, in alternative embodiments the lens guard **210** could be formed of one or more channels, tubes or conduits adapted to deliver gas and/or liquid to the objective lens of the laparoscope **100**. The channels, tubes or conduits of such embodiments of the lens guard **210** could be supported by a rigid or flexible framework. The channels, tubes or conduits of such embodiments could also be fastened to the laparoscope **100** itself, either removably or permanently, by one or more fasteners, such as straps, ties, adhesives, clips, etc. In such embodiments, additional methods of sealing the interface between the view optimizer **200** and the trocar may be employed. For example, the portion of the view optimizer **200** that interfaces with the trocar may be a member that serves to form a seal with the trocar while the portion of the view optimizer **200** that is inserted into the patient's body cavity and delivers gas and/or liquid to the objective lens of the laparoscope could be one or more channel, tube or conduit and/or a rigid or flexible framework In addition, the lens guard **210** of additional embodiments could be adapted to surround and enclose only portions of the laparoscope **100**, leaving other portions of the laparoscope **100** open and free from enclosure.

View Optimizer Stabilization: Scope Stabilizer

[0079] Referring again to FIG. **2**C, upper panel, the depicted exemplary embodiment of the view optimizer is a two-part design, comprising a lens guard that engages with a scope and a flow controller that is used to control and modulate various functions of the view optimizer. As depicted, the flow controller and the lens guard are in communication with one another via tubing elements that are in turn adapted to be in communication with one or more of water, gas and other sources. FIGS. **10**, **4**J and **4**K, respectively, show perspective views of the flow controller **220** and lens guard **210** components shown in FIG. **2**C. In its various embodiments, the view optimizer **200** is adapted to deliver to the objective lens of the laparoscope at least one fluid selected from, for example, a liquid, such as water or saline or a surfactant or other liquid, and a gas, such as CO_2 or air, to prevent the contact of material with the objective lens of the laparoscope or to defog or clean the objective lens of the laparoscope without the need to remove the laparoscope from the surgical field.

[0080] Referring now to FIG. **4**J, the lens guard **210** of the illustrated embodiment is adapted to receive a portion of the laparoscope **100**, most particularly the distal end **120** thereof, and a portion of the main body **110** of the laparoscope. The lens guard **210** can have any shape or configuration which allows it to surround the distal tip **120** of the laparoscope **100**. Additional embodiments of the view optimizer **200** may include a lens guard which has an angled portion to correspond with scopes with angled portions, such as 45° or 30° angled scopes. For example, the lens guard **210** may be provided in a sheath configuration that has a zero angle or flat distal end **212** that corresponds with a non-angled scope. And in other embodiments, the lens guard **210** may be provided in a sheath configuration that has an angle other than zero at its distal end **212**, where such angle corresponds to angled surgical scopes having standard angles of 45° or 30°, or, as will be appreciated by one of skill in the art, the tip may correspond to some other angle as may exist in the scope art. FIG. **4**D-**4**F shows some embodiments of alternate tip configurations. FIGS. **4**G-**4**I show different views of an embodiment of a lens guard tip. Thus, it will be appreciated that in accordance with the various possible lens guard **210** configurations that can be provided, any angle of scope can be accommodated simply by varying the angle of the distal end **212** of the lens guard **200**.

[0081] With respect to those lens guard **210** embodiments that have an angle other than zero at their distal end **211** for receiving variously angled scopes, proper alignment of the scope with the lens guard **210** is of importance to ensure proper function of the view optimizer **200** and to avoid disruption or fracture of the tip of the lens guard **210**. Accordingly, a scope stabilizer is provided that serves the dual purpose of proper alignment of the scope when inserted into the lens guard **210** and maintenance and stabilization of that alignment during use. Referring again to FIGS. **4**J and **4**K, the scope stabilizer **1000** is shown engaged with the manifold **900** portion of the lens guard **210**. The depicted scope stabilizer **1000** has a generally Y or fork-shaped configuration that has a proximal end for engagement with the lens guard **210** and a distal end for initially receiving and guiding a scope into position. The stabilizer **1000** has with two opposing parallel extension arms that are merged into a central base at the proximal end and extend to their tips a the distal end and form a channel there between that is adapted to receive the illuminator connector **140** portion of the scope. The channel serves to guide the scope as it is inserted into proper engagements with the lens guard **210**, and the arms forming the channel maintain the scope in proper position throughout the use of the view optimizer **200**. FIGS. **15**A-**15**C show various views of the scope stabilizer **1000**, and FIG. **15**C shows the scope stabilizer **1000** engaged with the lens guard **210** and an exemplary scope that is depicted in phantom (broken lines).

[0082] It will be understood that while the depicted embodiment of the scope stabilizer **1000** is constructed as a separate piece that is removably engageable with the manifold **900** of the lens guard **210**, other embodiments are possible. Thus, the scope stabilizer **1000** may be formed in combination with one or more components of the lens guard **210**, and as such, may be integrated with the manifold **900**, or with some other component of the lens guard **210**. It will also be understood that as a separate component, the scope stabilizer **1000** may be removably engageable by a variety of attachment means. As depicted, the scope stabilizer **1000** engages with the manifold **900** via a tab **1022** at its proximal end that inserts into a slot **1024** in the manifold **900**. A variety of other means of attachment that are known in the art may be used, some of which may preclude removable engagement: such attachment or fasteners can include, but are not limited to, any type of screws or bolts, anchors, rivets, cotter pins, clips, snaps, straps, ties, adhesives, weldments, and the like.

[0083] As previously described, engagement of a scope with the lens guard **210** involves insertion of the scope through the lens guard **210** with proper orientation of the scope tip and the lens guard **210** tip. The disclosed scope stabilizer **1000** functions to guide and maintain stable orientation of the scope with the lens guard **210**. Additional features of the lens guard **210** also operate to achieve and maintain stable engagement between an engaged scope and the lens guard **210**. Referring again to FIG. **4**K, the lens guard **210** includes structures that achieve and maintain engagement between the scope and the lens guard **210**.

View Optimizer Construction

[0084] Referring now to FIGS. **3**A-**3**D and FIG. **3**E, the view optimizer **200** will now be described with more particularity. In some embodiments, such as shown in FIG. **2**A and

FIG. 2C, and as shown in FIGS. 3A-3D, the view optimizer 200 is formed of discrete components that are interconnected, typically with tubing for transporting fluid. FIGS. 3A-3D in four panels show an exploded view of the device of FIG. 2C, which includes a hand held flow controller 220 connectable to a lens guard 210 via two or more tubing conduits. The various features and functionalities of devices according to this construction may be resident on one or both of the flow controller 220 and lens guard 210 components. That is, the controls for flow of liquid or gas, and delivery of a bolus or burst, as well as control of venting may be actuated from one or both components according to the various aspects of the disclosure herein. Moreover, the device components may be formed of one or multiple subcomponents as shown and described herein, such components and subcomponents being inter-connectable using connections and fastener means known in the art and as described variously herein.

[0085] In other embodiments, such as shown in FIG. 2B, and as shown in FIG. 3E, the view optimizer 200 is of unitary construction, and the various features and functionalities of devices according to this construction may be resident on one or both of the flow controller 220 and lens guard 210 components. That is, the controls for flow of liquid or gas, and delivery of a bolus or burst, as well as control of venting may be actuated from one or both components according to the various aspects of the disclosure herein. Moreover, the device components may be formed of one or multiple subcomponents as shown and described herein, such components and subcomponents being inter-connectable using connections and fastener means known in the art and as described variously herein.

[0086] The view optimizers illustrated in FIGS. 3A-3D are shown with distal end 212 configurations that are zero angle. In accordance with the description provided herein, the view optimizer 200 could be alternately configured to be provided in one or more of an array of configurations. For example, referring to FIG. 4D-4F, the lens guard 210 may be provided in a sheath configuration that has a zero angle or flat distal end 212 that corresponds with a non-angled scope (FIG. 4D). And in other embodiments, the lens guard 210 may be provided in a sheath configuration that has an angle other than zero at its distal end 212, where such angle corresponds to angled surgical scopes having standard angles of 45° (as shown in FIG. 4E) or 30° (as shown in FIG. 4E), or, as will be appreciated by one of skill in the art, the tip may correspond to some other angle as may exist in the scope art. Thus, it will be appreciated that in accordance with the various possible lens guard 210 configurations that can be provided, any angle of scope can be accommodated simply by varying the angle of the distal end 212 of the lens guard 200.

[0087] It will be further appreciated that the components of the lens guard 210 may be in multiple parts as described with respect to several of the illustrated embodiments as shown in FIG. 3E and FIG. 4A-C herein, or the lens guard 210 may alternatively be formed from fewer pieces such as depicted in FIG. 4D-F, and in FIG. 9, or in a single piece. According to embodiments of the lens guard 210 that are formed of two or multiple pieces, the discrete pieces may be connected by any one or combination of fastening means, such as, for example, tongue and groove, threaded, snap fit, or other fastening means as described herein or more generally known in the art.

[0088] The illustrated embodiments of the view optimizer 200 are adapted to deliver a generally continuous flow of gas to the objective lens of a laparoscope 100 via end ring 308 of the lens guard 210 for the cleaning and/or defogging of the lens and to deliver a flow of liquid to the objective lens of the laparoscope 100 when the operator desires. It should be understood that additional embodiments of the view optimizer 200 may be adapted to deliver a generally continuous flow of only liquid to the objective lens of the laparoscope 200 or both liquid and gas simultaneously. In addition, additional embodiments of the view optimizer 200 may be adapted to not deliver a continuous flow of gas and/or liquid but, rather, be adapted to only deliver a flow of gas and/or liquid upon the activation of an actuation device.

[0089] The illustrated embodiment of the view optimizer 200 is also adapted to deliver a burst or bolus of gas to the objective lens of the laparoscope upon the activation of a burst actuator/regulator 260. It should be understood that additional embodiments of the view optimizer may be adapted to deliver a burst or bolus of liquid to the objective lens of the laparoscope 200. It should also be understood that additional embodiments of the view optimizer may be provided without this burst function.

[0090] Finally, the illustrated embodiment of the view optimizer 200 is adapted to create a controlled leak of the gases from within the patients abdominal cavity to ensure that the insufflator does not turn off during a surgical procedure or to diminish the frequency of such stoppages of the insufflator. It should be understood that all embodiments of the view optimizer do not include such a controlled leak function. In addition, yet additional embodiments of the view optimizer 200 may create a steady leak, which is not controllable by the operator.

View Optimizing Devices—Lens Guard Distal End Construction

[0091] Referring again to FIG. 3E, the lens guard 210 of the illustrated embodiment includes an adapter ring 302, a guard tube 304, an exhaust ring 306, and an end ring 308. FIG. 4A-4C provide additional detail regarding the tip of the lens guard 210. Referring first to FIG. 4A, the guard tube 304 is shown with more particularity (the exhaust ring 306 and end ring 308 of the lens guard 210 are not present in FIG. 4A to better illustrate the construction of the guard tube 304). As shown in FIG. 4A, the guard tube 304 is a hollow, cylindrical tube adapted to surround the laparoscope 100. The guard tube 304 has an outer wall 510 that defines a hollow space. Also as shown in FIG. 4A, channels 512 are defined within the outer wall 510 and extend the length of the guard tube 304. The channels 512 are adapted to allow for the travel of gas and/or fluid along the length of the guard tube 318. The guard tube 304 depicted in the figures includes six channels 512, each having one or more functions. However, it should be understood that additional embodiments of the view optimizer may include any number of channels 512 defined within the guard tube 304, such as, for example, a single channel for multiple functions, or two or more channels each having distinct functions. The channels 512 may have a variety of sizes, shapes and configurations that allow for the passage of gas and/or liquid. The guard tube 318 of the illustrated embodiment shown in FIG. 5 has two channels 512 for the passage of exhaust gas from the interior of the patient's body cavity, and is suitable for providing a controlled leak. The illustrated embodiment also includes two channels dedicated to delivery of gas from the insufflator to the objective lens of the laparoscope 100, and one channel for the passage of the liquid to the objective lens of the laparoscope. Additional embodiments of the view optimizer **200** may include guard tubes **304** that have any number of channels **512** dedicated to any combination of gas for delivery to the objective lens of the laparoscope, liquid for delivery to the objective lens of the laparoscope, and/or exhaust gas. As mentioned previously, various additional embodiments of the view optimizer **200** may utilize both gas and liquid or only one of gas or liquid for delivery to the objective lens of the laparoscope. In some embodiments, the view optimizer may lack exhaust channels. Generally, depending on the intended functionality of the lens guard, the one or multiple channels **512** of the guard tube **304** will be suitably adapted.

[0092] Referring now to FIG. 4B, the guard tube **304** and exhaust ring **306** of the lens guard **210** are shown in use with a laparoscope **100** (the end ring **308** of the lens guard **210** is not shown in FIG. 4B to better illustrate the construction of the exhaust ring **306**). The exhaust ring **306** is a hollow, cylindrical piece adapted to surround and enclose a portion of the laparoscope **100**. As shown in FIG. 4B, the guard tube **304** and the exhaust ring **306** of the view optimizer **200** are attached together. The guard tube **304** and the exhaust ring **306** can be attached together in a variety of different ways, such as by adhesives, screws, tabs and slots, etc. In addition, the guard tube **304** and exhaust ring **306** could be formed together as a unitary construction.

[0093] The exhaust ring **306** has an outer wall **514** which defines a hollow space. Exhaust vents **516** are defined within the outer wall **514** of the exhaust ring **306**. As shown in FIG. 4B, the guard tube **304** and the exhaust ring **306** abut against one another when the lens guard **210** is assembled. The exhaust vents **516** defined within the outer wall **514** of the exhaust ring **306** are adapted to form openings into two of the channels **512** of the guard tube **304** that are dedicated to the passage of exhaust gas from within the patient's body cavity in conjunction with the leak function of the view optimizer **200** of the illustrated embodiment. The pressure within the patient's body cavity is greater than the pressure within the channels **512** of the guard tube **304**. Accordingly, gas from within the patient's body cavity will enter the exhaust vents **516** and travel through the channels **512** defined within the guard tube **304** out of and away from the patient's body cavity. While the embodiment of the exhaust ring **306** illustrated in FIG. 4B includes two exhaust vents **516**, additional embodiments of the view optimizer **200** may include exhaust rings **306** with any number of exhaust vents. The exhaust vents **516** may have any shape, size and configuration which allows gas to enter the guard tube **304** or some other portion of the view optimizer **200**. As discussed above, additional embodiments of the view optimizer **200** may lack a controlled leak function, thus, such embodiments of the view optimizer **200** will not include exhaust vents **516**.

[0094] Referring again to FIG. 4B, channels **518**, **520**, **521** and **522** are defined within the outer wall **514** of the exhaust ring **306** and extend through the length of the exhaust ring **306**. The channels are adapted to allow for the travel of either gas and/or liquid along the length of the exhaust ring **306**. When the lens guard **210** is assembled, each of the channels **518**, **520**, **521** and **522** of the exhaust ring **306** align with a channel **512** of the guard tube **304** to allow for the passage of gas and/or liquid therethrough. While the exhaust ring **306** of the illustrated embodiment includes four channels, additional embodiments of the view optimizer may include exhaust rings **306** with any number of channels.

[0095] As depicted, channel **518** of the exhaust ring **306** of the illustrated embodiment is adapted for the passage of liquid for delivering to the objective lens of the laparoscope **100**. Channels **520**, **521** are adapted for the passage of gas for delivery to the objective lens of the laparoscope **100**. Channel **522** of the exhaust ring **306** of the illustrated embodiments is not operative to allow for the passage of either gas and/or liquid. However, in additional embodiments, channel **522** could be functional. Channel **522** could act as an exhaust channel for both fluid and gas. While the exhaust ring **306** includes four channels, it should be understood that additional embodiments of the exhaust ring **306** may include any number of channels. The channels **518**, **520**, **521** and **522** may have a variety of sizes, shapes and configurations. The channels **518**, **520**, **521** and **522** can have any size, shape and configuration that allows for the passage of gas and/or liquid. As mentioned previously, various additional embodiments of the view optimizer **200** may utilize both gas and liquid or one of gas or liquid for delivery to the objective lens of the laparoscope for cleaning and/or defogging. Accordingly, such factors will determine the usage and number of channels as well as the construction, size, shape and configuration of the end ring **308** of additional embodiments of the view optimizer **200**.

[0096] As shown in FIG. 4B, the exhaust ring **306** includes fastener openings **523** for use in the attachment of the end ring **308**. As shown in FIG. 4C, the exhaust ring **306** and the end ring **308** of the view optimizer **200** are attached together. The exhaust ring **306** and the end ring **308** of the illustrated embodiment are attached together by projections (not shown) which extend from the end ring **308** and are received within the fastener openings **523** of the exhaust ring **306**. However, it should be understood that the end ring **308** and the exhaust ring **306** can be attached together in a variety of different ways, such as by adhesives, screws, tabs and slots, etc. In addition, the end ring **308** and exhaust ring **306** could be formed together as a unitary construction.

[0097] Referring now to FIG. 4C the guard tube **304**, exhaust ring **306** and end ring **308** are shown in use with a laparoscope **100**. The end ring **308** is attached to the exhaust ring **306** and extends beyond the end of the laparoscope **100**. This extension of the end ring **308** beyond the distal end **120** of the laparoscope **100** facilitates delivery of fluid to the lens, as further described herein, and helps to shield the objective lens from contacting objects or tissue, either within the patient's body cavity or outside of it, such as within the passageway within a trocar, that may soil, smudge, smear or adhere to the objective lens of the laparoscope. For example, conventional trocars include a seal assembly that consists of a plurality of flaps that create a seal with objects that are inserted through the trocar. These flaps of the trocar seal can become soiled with blood, bodily fluids, pieces of tissue, fat or other bodily material during an operative procedure. The extension of the end ring **308** beyond the distal end **120** of the laparoscope **100** serves to contact these flaps prior to the laparoscope **100** as the laparoscope **100** and view optimizer **200** are being inserted through the trocar, thereby deflecting the soiled flaps away from contacting the objective lens of the laparoscope **100**, and thus, preventing any blood, bodily material or other matter that is on the flaps from contacting and/or dirtying the objective lens. Likewise, the extension of the end ring **308** beyond the distal end **120** of the laparoscope also serves to deflect objects, such as internal organs or other tissue or fat, from contacting the objective lens of the laparoscope **200** when within the patient's body cavity.

[0098] According to various embodiments, the end ring **308** portion of the view optimizer **200** may extend beyond the end of the laparoscope from about 0 mm to about 7 mm, Accordingly, in various embodiments, the end ring **308** portion of the view optimizer **200** may extend beyond the end of the laparoscope from about 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7 mm or more. It should be understood that additional embodiments of the view optimizer **200** may not include an end ring **308** or other structure that extends beyond the distal end **120** of the laparoscope **100**.

[0099] The end ring **308** is adapted to partially enclose the distal end **120** of the laparoscope **100**. The end ring **308** has a main wall **524**. Passageways **526**, **528**, **530** and **532** are defined within the main wall **524** of the end ring **308**. Passageways **526**, **528**, **530** and **532** are adapted to direct the flow of gas and/or liquid exiting the channels **518**, **520**, **521** of the exhaust ring **306** across the operative lens of the distal end **120** of the laparoscope. The passageways **526**, **528**, **530** and **532** of the illustrated embodiment of the view optimizer **200** direct at least a portion of the flow of gas and/or liquid across the face of the objective lens. In the sheath assembly **200** of the illustrated embodiment, passageway **526** is adapted to direct the flow of liquid from channel **518** of the exhaust ring **306** across the objective lens of the laparoscope **100**. Channels **528**, **530** of the illustrated embodiment are adapted to direct the flow of the gas from channels **520**, **521** of the exhaust ring **306** across the objective lens of the laparoscope **100** to deflect gas and liquid from the lens, defog the objective lens as well as to remove moisture or material from the surface of the objective lens. Channels **528**, **530** are also adapted to direct at least a portion of the gas from channels **520**, **521** in a path that projects forward from the objective lens (as viewed in FIG. 4C) at an angle relative to the objective lens. The flow of the gas that is directed forward from the distal end **120** of the laparoscope further serves to deflect away smoke, particulate, blood, bodily fluid, moisture, tissue, fat, or other material within the patient's body cavity from contacting the objective lens of the laparoscope **100**. Accordingly, as the laparoscope **100** is inserted into the patient's body cavity and/or moved within the cavity, this forwardly projecting flow of gas serves to deflect away blood or other material that approaches the objective lens.

[0100] It should be understood that additional embodiments of the view optimizer **200** could direct all of the gas and/or liquid across the objective lens in a path that is generally parallel to the objective lens or could direct all of the gas and/or liquid in a path projecting forward and away from the distal end **120** of the laparoscope at an angle relative to the objective lens, or could direct all or a portion of the gas and/or liquid in a path projecting toward the distal end **120** of the laparoscope **100** at an angle relative to the objective lens, or any combination of parallel flow and angled flow.

[0101] Embodiments of the view optimizer **200** may provide for the delivery of gas and/or liquid in a path having any angle relative to the objective lens between 0° and 90° or between 0° and −90°, wherein the negative designation refers to paths directed toward the lens. In some embodiments, fins or louvers are provided to direct the flow of the gas and/or liquid in a variety of different paths each having a different angle relative to the objective lens, thereby, creating a fanned out flow of gas and/or liquid. According to various embodiments, the length of extension of the end ring **308** portion of the view optimizer **200** that extends beyond the end of the laparoscope from about 0 mm to about 7 mm may comprise one or more passageways that deliver a fluid stream at one or a range of positions along the length of the end ring **308**. According to such embodiments, the passageways may be positioned at the base of the end ring **308**, near to the lens of the scope, or at the distal end of the end ring **308**, farthest away from the lens, or at one or more locations in between. And according to such various embodiments, the passageways may be configured to direct a narrow stream of fluid, or may be configured to direct a fan of fluid at various angles.

[0102] It will be appreciated then that a stream of fluid may be directed from one or multiple channels, and that each stream may be directed within a range of possible paths from parallel to perpendicular relative to the lens, and that each such flow path may be parallel or perpendicular to or transect at some angle in between the path of another stream, and that in some embodiments each such flow path may be directed towards the channel from which another stream of fluid is emitted. Accordingly, in some embodiments, a stream of fluid in the form of gas may be directed towards the channel from which another stream of gas is emitted, or a stream of fluid in the form of gas may be directed towards the channel from which another stream of liquid is emitted, or a stream of fluid in the form of liquid may be directed towards the channel from which another stream of liquid is emitted, or a stream of fluid in the form of gas may be directed towards the channel from which another stream of gas is emitted.

[0103] The embodiment depicted in FIG. 4C is configured with an end ring **308** that extends about 2 mm from the end of the laparoscope and is configured to deliver a fan of air at an angle of about 30°, thus the distance of the flow path nearest the lens at the point of the passageway is about 0 mm and the distance of the flow path nearest the lens at the opposite side of the lens is about 8 mm from the lens. Variation of the length of the end ring, distance of the passageway from the lens, angle or angles of flow may vary, such that the distance of the nearest flow path from the lens may range from 0 mm to more than 15 mm, and in some embodiments the flow path may be directed at an angle toward the lens.

[0104] The end ring **308** of additional embodiments an have a variety of sizes, shapes and configurations. The end ring **308**, can have any size, shape or configuration that allows it to direct gas and/or liquid across the face of the objective lens of the laparoscope. While the end ring **308** of the illustrated embodiment only partially encircles the distal end **120** of the laparoscope **100**, it should be understood that additional embodiments of the view optimizer **200** may include an end ring **308** that completely encircles the distal end **102** of the laparoscope **100**. As mentioned previously, various additional embodiments of the view optimizer **200** may utilize both gas and liquid or one of gas or liquid for delivery to the objective lens of the laparoscope for cleaning and/or defogging. In addition, additional embodiments of the view optimizer **200** may not include a controlled leak function. Accordingly, such factors will affect the construction, size, shape and configuration of the end ring **308** of additional embodiments of the view optimizer **200**.

[0105] Referring again to FIG. 3E, an adapter ring **302** is located at the proximal end **214** of the lens guard **210** to permit connection of the lens guard **210** to the flow controller **220**. The adapter ring **302** is adapted to mount the lens guard **210** to the main body. The adapter ring **302** can have any size, shape or configuration that allows it to mount the lens guard

210 to the flow controller **220**. In addition, as mentioned previously, the lens guard **210** and flow controller **220** of additional embodiments may be formed as a unitary piece or may also be located remotely from one another and not directly connected to one another. FIG. 5A-C shows greater detail with respect to the attachment of the lens guard **210** and the flow controller **220**. As shown in FIG. **5**A, the adapter ring **302** has a generally cylindrical shape with a guard tube opening **610** defined through it. The guard tube opening **610** is adapted to receive the guard tube **304**. The guard tube opening **610** of the adapter ring has an inner rim **620**. When the guard tube **304** is inserted into the adapter ring, the guard tube **304** abuts against the inner rim **620**. In this manner, the inner rim **620** helps to properly locate the guard tube **304** within the adapter ring **302** and prevents the guard tube **304** from passing completely through the adapter ring **302**. Several channels **630** are defined within the inner rim **620** of the adapter ring and pass through the length of the adapter ring **302**. The adapter ring **302** of the illustrated embodiment of the view optimizer has six channels **630** to coincide with the six channels **512** of the guard tube **304**. When the guard tube **304** is secured within the adapter ring **302**, the channels **512** of the guard tube **304** align with the channels **630** of the adapter ring, to allow for gas and/or liquid to flow from the channels **512** of the guard tube to the coinciding channels **630** of the adapter ring **302** and vice versa.

[0106] While the adapter ring **302** of the illustrated embodiment includes six channels **630**, it should be understood that additional embodiments of the adapter ring **302** may include any number of channels **630**. The channels **630** may have a variety of sizes, shapes and configurations. The channels **630** can have any size, shape and configuration that allows for the passage of gas and/or liquid. As mentioned previously, various additional embodiments of the view optimizer **200** may utilize both gas and liquid or one of gas or liquid for delivery to the objective lens of the laparoscope for cleaning and/or defogging. Accordingly, such factors will determine the usage and number of channels **630** as well as the construction, size, shape and configuration of the adapter ring **302** of additional embodiments of the view optimizer **200**.

[0107] As shown in FIG. **5**A, a laparoscope opening **622** is defined within the inner rim **620** of the adapter ring. The laparoscope opening **622** is adapted to receive the laparoscope **100** and allow for the laparoscope **100** to enter the guard tube **304**. The laparoscope opening **622** may be any size, shape or configuration that allows for the receipt of the laparoscope **100**.

[0108] Referring now to FIG. **5**B, a rear perspective view of the adapter ring **302** is shown. As shown in FIG. **5**B, the laparoscope opening **622** extends through the adapter ring **302**. Also as shown in FIG. **5**B, the channels **630** defined within the adapter ring **302** extend to the rear of the adapter ring **302** and open into arcuate shaped openings **640**, **642**, **644** and **646** defined within the rear surface of the adapter ring **302**. As can be seen in FIG. **5**B, two of the channels **630** connect with opening **640**, one channel **630** connects with opening **642**, two of the channels **630** connect with opening **644** and one of the channels **630** connects with opening **646**. In this manner, one pair of the channels **630** are jointly connected to opening **640** and one pair of the channels are jointly connected to opening **644**. Accordingly, the gas and/or liquid traveling through such channels **630** will jointly flow through openings **640** and **644**. Also, any gas and/or liquid which enters openings **640** or **644**, will flow into the pair of channels **630** connected with opening **640** or **644**. Consequently, this allows for one source of gas and/or liquid to be divided into the flow of gas and/or liquid through a pair of channels **630** of the adapter ring and, consequently, a pair of channels **512** of the guard tube **304**.

[0109] In the illustrated embodiment of the view optimizer **200**, opening **640** is adapted to receive gas for delivery to the objective lens of the laparoscope **100** through the lens guard **210**, opening **642** is adapted to receive liquid for delivery to the objective lens of the laparoscope **100** through the lens guard **210**, and opening **644** is adapted for the passage of the exhaust gases leaving the patient's body cavity via exhaust vents **516** and passing through the lens guard **210**. In the illustrated embodiment of the view optimizer **200**, opening **646** is not operable to receive the flow of either gas or liquid, however in additional embodiments of the view optimizer **200**, opening **646** may be functional. As mentioned previously, various additional embodiments of the view optimizer **200** may utilize both gas and liquid or one of gas or liquid for delivery to the objective lens of the laparoscope for cleaning and/or defogging. In addition, additional embodiments of the view optimizer may not include a controlled leak function. Accordingly, such factors will affect the construction, size, shape, configuration and functionality of the adapter ring **302**, the channels **630** of the adapter ring **302**, and the openings **640**, **642**, **644**, and **646** of the adapter ring **302** of additional embodiments of the view optimizer **200**.

[0110] Referring again to FIG. 3E, the view optimizer **200** includes a connection plate **310** that is adapted to abut the adapter ring **302**. The connection plate **310** of the illustrated embodiment is a generally planar, circular disc with a central opening **311** defined through it, and is adapted to permit the laparoscope **100** to pass through the connection plate **310**. The connection plate **310** also has four openings **312** defined through it radially outward from the central opening **311**. The openings **312** are adapted to receive fluid connectors **313**. While the connection plate **310** of the illustrated embodiment has four fluid connectors **313**, additional embodiments of the connection plate **310** may have any number of fluid connectors **313**. The connection plate **310** is adapted to abut against the adapter ring **302** and seal against the openings **640**, **642**, **644** and **646**. Each of the four fluid connectors **313** mounted within the connection plate **310** coincides with one of the openings **640**, **642**, **644** and **646** of the adapter ring **302** described in connection with FIG. **5**. Thus, fluid flowing through one of the fluid connectors **313** is free to pass through the connection plate **310** into one of the openings **640**, **642**, **644** and **646** of the adapter ring, through the channels **630** of the adapter ring, through one of the channels **512** of the guard tube, through one of the channels of the exhaust ring and through the end ring **308** for delivery to the objective lens. In addition, exhaust gas that enters the exhaust vents **516** may pass up the guard tube **304**, through the adapter ring **302** and into one of the fluid connectors **313**. Additional embodiments of the view optimizer may not include a connector plate **310** or fluid connectors **313**.

[0111] Referring again to FIG. **5**B, projecting outwardly from the adapter ring **302** are three fastener portions **650**, each fastener portion **640** having a fastener opening defined therethrough. As shown in FIG. **6**, the fastener portions **650** are utilized to mount the adapter ring **302** and, consequently, the lens guard **210** to the flow controller **220**. Additional embodiments of the sheath assembly **200** may have any number of fastener portions **650**. The adapter ring **302** of the illustrated embodiment is attached to the flow controller **220** with conventional screws, however, other suitable fasteners, such as adhesives, rivets, tab and slots, etc. could also be used. When the adapter ring **302** and lens guard **210** are mounted to the flow controller **220**, the fluid connectors **313** project into the interior of the flow controller **220**. Also, as mentioned previously, the lens guard **210** and the flow controller **220** may be formed as a one-piece construction in additional embodiments of the view optimizer **200** or may be located remotely from one another and not directly connected to one another. As a result, all embodiments of the view optimizer **200** may not include an adapter ring **302**. It should be understood that additional embodiments of the view optimizer **200** may utilize various methods for mounting the lens guard **210** to the flow controller **220**.

View Optimizing Devices—Flow Controller Construction

[0112] Referring again to FIG. 3E, the flow controller **220** will be described with more particularity. The flow controller **220** of the illustrated embodiment of the view optimizer **200** generally includes a base portion **318**, a handle portion **320** and an end cap **330**. The base portion **318**, handle portion **320** and end cap **330** of the illustrated embodiment are adapted to surround and enclose other portions of the view optimizer **200**. The base portion **318**, handle portion **320** and end cap **330** of the illustrated embodiment are molded from plastic, however, other suitable materials can also be used. It should be understood that the base portion **318**, handle portion **320** and end cap **330** of the view optimizer **200** are not limited to the size, shape or configuration set forth in FIGS. 3A-3D or FIG. 3E. The base portion **318**, handle portion **320** and end cap **330** of the flow controller **220** of the view optimizer **200** can have any size, shape or configuration that can support and/or enclose other components of the view optimizer **200**.

[0113] The base portion **318**, handle portion **320** and end cap **330** are fastened together with a plurality of fasteners **332**. The fasteners **332** of the illustrated embodiment are conventional screws, however, it should be understood that any suitable attachment means could be used. Examples of additional fasteners that can be used include, but are not limited to, any type of screws or bolts, anchors, rivets, cotter pins, clips, snaps, straps, ties, adhesives, weldments, etc. In addition, it should be understood that the flow controller **220** could be formed as one unitary piece in additional embodiments, and need not be provided as multiple pieces that are assembled together.

[0114] The base portion **318** of the flow controller **220** has an outer wall **334** that defines an interior cavity **336**. The configuration of the interior cavity **336** of the base portion **318** is adapted to support and enclose other components of the view optimizer **200**. A scope receiver portion **338** extends from the outer wall **334** of the base portion **318** and opens into the interior cavity **336** of the base portion **318**. The scope receiver portion **338** is adapted to receive the laparoscope **100**. The scope receiver portion **338** of the illustrated embodiment of the view optimizer is a cylindrically shaped, threaded channel. However, the scope receiver portion **338** is not limited to this shape or configuration and can have any shape or configuration that allows it to receive the laparoscope **100**. The scope receiver portion **338** of the illustrated embodiment is adapted to receive a grommet **340** that has a cylindrical shape with a opening defined therethrough. The grommet **340** of the illustrated embodiment is rubber, however other suitable materials may also be used, such as plastic or a composite material. The threads of the scope receiver portion **338** are adapted to mate with the threads of a nut **342** which can be tightened onto the scope receiver portion **338**. The nut **342** of the illustrated embodiment has an opening defined through it. A second opening (not shown in the figures) is defined within the bottom wall of the base portion **318** of the flow controller **220**. This second opening is in communication with the lens guard **210** that is connected to the base portion **318** of the main body (as shown in FIG. **6**).

[0115] When the view optimizer **200** is in use, the distal end **120** of the main body **110** of a laparoscope **100** is inserted, in turn, through the opening defined within the nut **342**, the opening defined within the grommet **340**, and the opening defined within the scope receiver portion **338** by the scope operator. The main body **100** of the laparoscope **100** is then passed through the scope receiver portion **338** and through the base portion **318** of the flow controller **220** into the lens guard **210**. Once the distal end **120** of the laparoscope **100** reaches the desired position within the lens guard **210**, the nut **342** can be tightened down onto the threads of the scope receiver portion **338**. This tightening of the nut **342** forces the grommet **340** to be wedged between the surface of the scope receiver portion **338** and the laparoscope **100**, thereby locating the laparoscope in the desired position relative to the flow controller **220** and the lens guard **210**, and preventing both linear and rotational movement of the laparoscope relative to the flow controller **220** and the lens guard **210**. However, one or both of linear or rotational movement may be allowed in alternative embodiments.

[0116] As illustrated in FIG. 3E, the handle portion **320** of the flow controller **220** has a main wall **350** that defines a partially enclosed space. The configuration of the handle portion **320** is adapted to support and enclose other components of the view optimizer **200**. The partially enclosed space of the handle portion **320** abuts with the interior cavity **336** of the base portion **318** so the partially enclosed space of the handle portion **320** and the interior cavity **336** of the base portion **318** are in communication when the base portion **318** and the handle portion **320** are joined. Referring to the illustrated embodiment of FIG. 3E, a burst actuator compartment **352** and a gas/liquid actuator compartment **354** are defined within the main wall **350** of the handle portion **320**. The burst actuator compartment **352** is adapted to hold the burst actuator **260** and the gas/liquid actuator compartment **354** is adapted to hold the gas/liquid actuator/regulator **250**. The burst actuator compartment **352** and the gas/liquid actuator compartment **354** of the handle portion **320** are in communication with each other as well as being in communication with the interior cavity **336** of the base portion **318**.

[0117] The handle portion **320** of the illustrated embodiment of the view optimizer includes an end cap **330** that is removably attached to the handle portion **320** of the flow controller **220**. The end cap **330** is adapted to fully enclose the gas/liquid actuator compartment **354** of the handle portion **320**. Additional embodiments of the view optimizer **200** are provided without such an end cap **330**. As mentioned previously, additional embodiments of the view optimizer may include a one-piece flow controller **220** as opposed to the multi-piece flow controller **220** of the illustrated embodiment. The main body can have any shape or configuration that allows it to support and/or enclose other portions of the view optimizer **200**.

[0118] The gas inlet **230** and the fluid inlet **240** of the flow controller **220** extend into the gas/liquid actuator compartment **354** of the handle portion **320** of the flow controller **220**. The gas inlet **230** and the liquid inlet **240** of the illustrated embodiment of the view optimizer **200** are cylindrical tubes extending outwardly from the surface of the flow controller **220**. The gas inlet **230** and liquid inlet **240** are formed from plastic, but a variety of suitable materials could also be used. It should be mentioned that additional shapes and configurations could be used for the gas inlet **230** and liquid inlet **240**. The gas inlet **230** and the fluid inlet **240** of the flow controller **220** receive gas and liquid respectively from external sources. The gas inlet **230** and liquid inlet **240** can have any shape or configuration that allows for the connection of the view optimizer **200** to external gas and liquid sources.

[0119] It should be understood that additional embodiments of the view optimizer **200** may include gas and/or liquid sources that are located internally within the view optimizer **200** itself, thus eliminating the need for a means of connecting the view optimizer **200** to external sources of gas and/or liquid. In addition, it should also be understood that additional embodiments of the view optimizer utilize only gas or only liquid. Whether or not the view optimizer **200** utilizes gas, liquid, or both will determine whether a gas or liquid inlet is provided with various additional embodiments of the view optimizer **200**.

[0120] The gas/liquid actuator/regulator **250** of the illustrated embodiment of the view optimizer is housed within the gas/liquid actuator compartment **354** of the handle portion **320** of the flow controller **220**. The gas/liquid actuator/regulator **250** of the view optimizer **200** can be formed of one of a variety of actuation means. The gas/liquid actuator/regulator **250** of the illustrated embodiment of the view optimizer **200** is a control valve, namely, a manually controlled switching valve. It should be understood, however, that additional embodiments of the view optimizer **200** may include a variety of different types of gas/liquid actuator. Additional embodiments of the view optimizer **200** may include a variety of manually or electrically controlled valves or other device. The gas/liquid actuator/regulator **250** may be any valve or similar device that actuates and/or regulates the flow of the gas and/or liquid utilized by the view optimizer **200** for delivery to the objective lens of the laparoscope **100**. The gas/liquid actuator/regulator **250** of the illustrated embodiment is formed from plastic; however, other suitable materials including metals and composites may also be used.

[0121] The gas/liquid actuator/regulator **250** of the embodiment of the view optimizer **200** illustrated in FIG. **3**E includes a gas inlet **358**, a liquid inlet **360**, a gas outlet **362** and a liquid outlet **364**. Referring to FIG. **3**E, the gas inlet **230** of the flow controller **220** is connected to the gas inlet **358** of the gas/liquid actuator/regulator **250** and the liquid inlet **240** is connected to the liquid inlet **360**. The embodiment of the gas/liquid actuator/regulator **250** illustrated in FIG. **3**E includes an actuation switch **366**. The actuation switch **366** of the illustrated embodiment is a push-button that can be selectively operated to actuate the gas/liquid actuator/regulator **250**. However, it should be understood that a variety of different switches or other actuation devices can be utilized to perform this function, and the view optimizer **200** of this application is not limited to a push-button type switch. The actuation switch **366** can be any type of switch or actuation device that can serve to actuate the gas/liquid actuator.

[0122] The gas/liquid actuator/regulator **250** of the illustrated embodiment of the view optimizer **200** is operable to switch between two states, a gas flow state and a liquid flow state. In the gas flow state, gas from an external gas source, such as an insufflator in the case of the illustrated embodiment, flows through the gas inlet **230** of the flow controller **220**, through the gas inlet **358** of the gas/liquid actuator/regulator **250**, through the gas/liquid actuator/regulator **250** and out the gas outlet **362** of the gas/liquid actuator/regulator **250**. When the gas/liquid actuator/regulator **250** is in the gas flow state, liquid is prevented from flowing through the gas/liquid actuator/regulator **250** and out of the liquid outlet **364**. Conversely, when the gas/liquid actuator/regulator **250** is in the liquid flow state, liquid from an external source flows through the liquid inlet **240** of the flow controller **220**, through the liquid inlet **360** of the gas/liquid actuator/regulator **250**, through the gas/liquid actuator/regulator **250** and out the liquid outlet **364** of the gas/liquid actuator/regulator **250**. When the gas/liquid actuator/regulator **250** is in the liquid flow state, gas is prevented from flowing through the gas/liquid actuator/regulator **250** and out of the gas outlet **362**.

[0123] The gas/liquid actuator/regulator **250** of the illustrated embodiment is biased towards the gas flow state and delivers a generally continuous flow of gas when in the gas flow state. In this manner, the view optimizer **200** of the illustrated embodiment delivers a generally continuous flow of gas to the objective lens of the laparoscope **100** when the gas/liquid actuator/regulator **250** is in the gas flow state. The gas/liquid actuator/regulator **250** of the illustrated embodiment remains in the gas flow state with the view optimizer delivering a generally continuous flow of gas to the objective lens of the laparoscope until an operator switches the gas/liquid actuator/regulator **250** to the liquid flow state by pressing the actuation switch **366** of the gas/liquid actuator/regulator **250**. When the gas/liquid actuator/regulator **250** of the illustrated embodiment is switched to the liquid flow state, gas is not permitted to flow through the gas/liquid actuator/regulator **250**. The gas/liquid actuator/regulator **250** of the illustrated embodiment only remains in the liquid flow state for as long as the operator is holding the actuation switch **366**. Once the operator releases the actuation switch **366**, the gas/liquid actuator of the illustrated embodiment returns to the gas flow state. Additional embodiments of the gas actuator/regulator **250** could remain in the liquid flow state until an operator presses on the actuation switch **366**. In additional embodiments of the view optimizer, the actuation switch **366** may allow for the flow of both liquid and gas simultaneously. In yet additional embodiments, the gas/liquid actuator/regulator **250** may be biased towards the liquid flow state. Additionally, some view optimizers contemplated by this detailed description may only utilize gas or liquid and the actuation switch **366** of such embodiments will only activate or deactivate the flow of gas or liquid not both and not switch between the flow of gas or liquid. And in still other embodiments, the apparatuses may include more than one actuation switch, each of which independently activates and deactivates the flow of a liquid or a gas, or combinations thereof.

[0124] The burst actuator/regulator **260** of the illustrated embodiment of the view optimizer **200** is housed within the burst actuator compartment **352** of the handle portion **320** of the flow controller **220**. The burst actuator/regulator **260** of the view optimizer **200** can be formed of one of a variety of actuation means. As shown in FIG. **3**E, the burst actuator/regulator **260** of the embodiment of the view optimizer **200** illustrated in FIG. **3**E is a manually operated, pneumatic bulb. However, it should be understood that the burst actuator/regulator **260** can be a variety of different manually or electrically operated devices. The burst actuator/regulator **260** can be any device that allows for the actuation and/or regulation of the burst function of the view optimizer **200**. The burst actuator/regulator **260** of the illustrated embodiment is formed from rubber, however other suitable materials may be used. The burst actuator/regulator **260** of the illustrated embodiment has an inlet **370** and an outlet **372**. The burst actuator/regulator **260** of the illustrated embodiment is adapted to deliver a burst or bolus of gas and/or liquid to the objective lens of the laparoscope **100** when activated by an operator. It will be understood that in various other embodiments, the apparatuses may include more than one burst actuator, each of which is adapted to work independently to deliver a burs or bolus of a liquid or a gas, or combinations thereof.

[0125] Referring again to FIG. 3E, the gas outlet **362** of the gas/liquid actuator/regulator **250** of the illustrated embodiment of the view optimizer **200** is connected to the inlet **370** of the burst actuator/regulator **260**. In the embodiment of the view optimizer **200** illustrated in FIG. 3E, the gas/liquid actuator/regulator **250** is connected directly to the inlet **370** of the burst actuator/regulator **260**. In other embodiments of the view optimizer **200**, the gas/liquid actuator/regulator **250** and the burst actuator/regulator **260** are connected indirectly with other intermediate parts being located between them, such as tubing or conduit. In addition, it should be understood that the gas/liquid actuator/regulator **250** and the burst actuator/regulator **260** need not be connected with one another in all embodiments of the view optimizer **200**, as they may each receive gas and/or liquid from separate sources. Finally, it should be understood that all embodiments of the view optimizer **200** contemplated by this detailed description do not include both a gas/liquid actuator/regulator **250** and a burst actuator, as additional embodiments may be provided with only a gas/liquid actuator/regulator **250** or burst actuator/regulator **260**.

[0126] The liquid outlet **364** of the gas/liquid actuator/regulator **250** is connected to one of the fluid connectors **313** of the connection plate by tubing (not shown) that travels through the internal cavity defined within the handle portion **220** and base portion **318** of the flow controller **220**. Similarly, the outlet **372** of the burst actuator/regulator **260** is connected to one of the fluid connectors **313** of the connection plate **310** by tubing (not shown) which travels through the internal cavity defined within the handle portion **220** and base portion **318** of the flow controller **220**. While tubing is used in some embodiments of the sheath assembly, other suitable methods could be used, such as any type of piping or conduit or flow channels defined within portions of the flow controller **220**. The view optimizer of this detailed description is not limited with respect to the method which is used to connect the gas and/or liquid source to the lens guard **210** for delivery to the objective lens of the laparoscope **100**.

[0127] When the gas/liquid actuator/regulator **250** is in the gas flow state, gas flows from the gas source into the gas inlet **230** of the flow controller **220**, through the gas/liquid actuator/regulator **250**, through the burst actuator/regulator **260**, through a piece or series of tubing into a fluid connector **313** of the connector plate **310**, through opening **640** of the adapter ring **302**, through a pair of channels **630** of the adapter ring **302**, through a pair of corresponding channels **512** of the guard tube **304**, through channels **520**, **521** of the exhaust ring **306**, and is directed across the lens of the laparoscope **100** by passageways **528**, **530** of the end ring **308**.

[0128] As the illustrated embodiment of the view optimizer **200** is adapted to deliver a generally continuous flow of gas to the objective lens of the laparoscope **100**, this cycling of the insufflator needs to be prevented. For this reason, the view optimizer **200** of the illustrated embodiment is provided with exhaust vents **516** located within the exhaust ring **306**. When the laparoscope **100** and the view optimizer **200** are inserted into a patient's abdominal cavity during a surgical procedure, the exhaust vents **516** of the exhaust ring **306** are located within the patient's abdominal cavity. Insufflated gas present in the patient's abdominal cavity is able to enter the exhaust vents **516** and travel through a pair of the channels **512** of the guard tube **304**, thus exiting the patient's abdominal cavity. Due to the pressure differential between the interior of the lens guard **210** and the patient's abdominal cavity, this exhaust gas travels through the channels **512** of the guard tube **304**, through a pair of the channels **630** of the adapter ring **302**, through opening **644** of the adapter ring and through one of the fluid connectors **313** located in the connection plate **310**. The fluid connector **313** which the exhaust gas travels through projects into the base portion **318** of the flow controller **220**.

[0129] As shown in FIG. **6**, an exhaust valve **710** is mounted within the base portion **318** of the flow controller **220**. The fluid connector **313** through which the exhaust gas from within the patient's abdominal cavity passes is connected to the exhaust valve **710** by a piece of or series of tubing (not shown). The exhaust valve **710** can be a variety of different valves or similar devices. The exhaust valve **710** can be any device that can be used to control the flow of the exhaust gases traveling through the view optimizer **200**. The exhaust valve **710** is in communication with exhaust vent **720** defined within the base portion **318** of the flow controller **220**, which is adapted to allow the exhaust gas to exit the view optimizer to the surroundings. The exhaust valve **710** is operable to adjust the flow rate of the exhaust gas exiting the view optimizer **200** via exhaust vent **720**. The controlled leak created by gas entering the lens guard **210** via the exhaust vents **516** and exiting the view optimizer via exhaust vent **720** into the surroundings helps to ensure that the pressure within the patient's abdominal cavity remains below the pre-determined pressure that the insufflator is set to maintain the patient's abdominal cavity. This ensures that the insufflator will continuously insufflate the patient's abdominal cavity and will not shut off during a surgical procedure. Due to the fact that the insufflator is prevented from shutting off, the view optimizer **200** of the illustrated embodiment will be supplied with a generally continuous supply of gas for delivery to the objective lens of the laparoscope. The flow rate of the gas exiting the patient's abdominal cavity via exhaust vents **516** can be controlled via exhaust valve **710** to allow for the scope operator to create a desired amount of leakage from the patient's abdominal cavity, while not compromising the effectiveness of the insufflation. As stated previously, however, it should be understood that additional embodiments of the view optimizer **200** may not provide a controlled leak function and, thus, may not include exhaust vents **516**, an exhaust ring **306**, exhaust valve **710** or exhaust vent **720**. In addition, the view optimizer **200** of this detailed description is not limited to the configuration set forth above with respect to the exhaust of gases from within the patient's abdominal cavity through the view optimizer, as additional embodiments of the view optimizer may include exhaust systems that are constructed differently.

View Optimizing Devices—Alternate Construction

[0130] Referring to FIG. **9**, an alternate embodiment of a lens guard is depicted and corresponds to the lens guard shown in FIG. 2C, FIGS. **3**A-3D, and FIGS. **10**, **12**, **13** and **14**. Referring to FIG. **10**, an alternate embodiment of a flow controller is depicted and corresponds to the flow controller shown in FIG. 2C, FIGS. **3**A-3D, and FIGS. **10**, **12**, **13** and **14**. The device components shown in these various figures provide the same functionalities, namely delivery of continuous or intermittent fluid flow at the distal end of a surgical scope, venting, and delivery of actuated liquid and gas flow. The flow controller and lens guard components according to these illustrated and pictured embodiments are connected via one or more fluid flow conduits, as illustrated in the embodiments shown in FIG. **9**, with engagement between the flow controller and lens guard achieved using tubing connections to a flow manifold structure on the lens guard. The manifold is adapted to receive fluid flow from one or more of liquid and gas sources that are interconnected with the flow controller through tubing and in fluid connection with actuators on the flow controller. FIG. **10** shows the attachment positions for liquid and gas conduits. FIG. **10** further illustrates an embodiment of an actuating mechanism for control of liquid (saline) flow and a pin and spring construction that prevents line crimping when liquid flow is blocked. FIG. **10** further illustrates an embodiment of a gas burst mechanism which is formed of a bulb chamber that permits either a burst of gas or continuous gas feed to offset lag in gas flow during insufflator cycling.

[0131] Referring to FIG. **11**, a schematic shows one possible configuration for interconnection of the flow optimizer components with the saline, gas, trocar and surgical scope devices in a conventional surgical suite. Of course it will be appreciated that other possible configurations may be achieved using the inventive devices and methods described herein.

[0132] Referring to FIG. **12-14**, view optimizer devices corresponding with FIG. **2**C and FIGS. **3**A-**3**D are shown. FIG. **12** shows alternate photographic images of the lens guard and flow controllers connected via tubing as packaged for use. FIG. **13** shows the coiled device as it is packaged. FIG. **14** is a photograph of the device of FIG. **2** and FIGS. **3**A-3D annotated to show the various connections between the view optimizer components and to conventional surgical equipment.

View Optimizer Stabilization: Scope Grip

[0133] Referring now to FIG. **16**, an exploded perspective view of several components of the lens guard **210** of FIGS. **4**J and 4K is shown. As depicted, the locking knob **2000**, cam grip **2200**, manifold cap **2400**, manifold **900** and sheath are shown substantially along the axis of their orientation in the assembled lens guard **210**. It will be appreciated that the locking components as depicted represent one embodiment of the components of the lens guard **210**, and that the specific device components and features may vary as otherwise described in connection with the invention, and are not intended to be limited to the depicted embodiment. The locking knob **2000** is located at the proximal end **214** of the lens guard **210** and functions in part to mount the lens guard **210** to the main body of the scope.

[0134] Referring now to FIGS. **17**A and **17**B, the cam grip **2200** of FIG. **16** is shown in an enlarged side perspective view. FIG. **17**B shows a collet **2210** associated with a manifold cap **2400** and a grommet **2250** displaced from the collet **2210**; FIG. **17**A shows the collet **2210** associated with the grommet **2250** and the manifold cap **2400** dissociated therefrom. While the collet **2210** serves to enhance and fix the contact between the lens guard **210** and the scope, the manifold cap **2400** serves to fix the cam grip **2200** relative to the body of the lens guard **210** so as to prevent its rotation around the axis shared by the scope and the lens guard **210**. Thus, the upper surface of the manifold cap **2400** includes means for engagement with the collet **2210** so as to prevent its axial rotation. In the embodiment depicted in FIGS. **17**A and **17**B, the manifold cap **2400** includes a plurality tabs **2410**, in this case three, that engage with slots **2216** formed between adjacent collet lobes **2212**. The tabs **2410** serve to prevent axial rotation of the collet **2210** and also serve to limit the extent to which the collet **2210** is compressed when in use, as further described herein. The manifold cap **2400** includes engagement means on its lower surface (see FIG. **178**A for engagement with and positional fixation relative to the manifold **900**.)

[0135] Referring again to FIG. **17**B, as depicted, the cam grip **2200** includes a plurality, in this case three, collet lobes **2212** that are attached to form the substantially ring-shaped collet **2210**, the collet lobes **2212** are connected by three living hinges **2214**. Each collet lobe **2212** is attached to an adjacent collet lobe **2212** via a living hinge **2214** attachment means. As depicted, the collet lobes **2212** have a generally crescent-shaped profile and when interconnected form an internal channel that is substantially cylindrical and an outer surface that is contoured. And as depicted, the living hinges **2214** have a generally "U" shaped profile. The collet lobes **2212** and hinges **2214** may be shaped differently. It will be appreciated that the number of collet lobes **2212** and the number of living hinges **2214** may vary, and that in some embodiments there may be as few as two collet lobes **2210** and two living hinges **2214**, and in other embodiments a greater number of each may be used, and that they may vary in size, shape and spacing.

[0136] As will be further described herein, the assembled collet **2210** is actuated by interaction with the locking knob **2000**, which has a receiving means that interferes with the collet lobes **2212** when the locking knob **2000** and the cam grip **2200** are engaged so as to compress the collet lobes **2212**, which in turn flexes the living hinges **2214**, causing the adjacent collet lobes **2212** to move towards one another and to translate radially inward toward the center of the channel such that the circumference of the substantially circular channel through the collet **2210** is reduced. Engagement between the tabs **2410** on the manifold cap **2400** and the collet **2210** limit the extent to which the collet **2210** is compressed. Thus, actuation of the cam lobes **2212** leads to flexion of the living hinges **2214** and reduction of the diameter of the central channel, which serves to compress the grommet **2250**, which thereby grips a scope body that it is inserted therethrough. FIG. **17**C shows the cam grip **2200** and manifold cap **2400** in association with a surgical scope with the grommet **2250** axially displaced from the collet **2210** to illustrate the relative positioning of the collet **2210** components relative to the scope.

[0137] According to the device embodiment depicted in FIGS. **16**, and **17**A-**17**C, the collet **2210** components are of unitary construction and each component is formed of the same materials. The materials of construction may be selected from plastics or other composite materials described with respect to other components of the devices disclosed herein. Of course, in other embodiments, the collet **2210** components may be formed as a plurality of pieces that are connected using one or more appropriate means know in the art, such as by snap fit, sonic welding, glue or other adhesive, or other means Likewise, the collet **2210** components may each be formed of different materials. For example, the living hinge **2214** components may be formed of a less rigid and more flexible material as compared with the material of the collet lobes **2212**. Thus, in some alternate embodiments the collet **2210** may be of unitary construction but comprise different materials for various subcomponents, and the construction may be achieved by various known methods such as in the molding and injection molding arts. And in other embodiments, the components may be discretely manufactured of the same or different materials having the same or varying properties.

[0138] Referring again to FIG. **17**B, the grommet **2250** is formed as a cylinder sized to fit within the circular channel through the collet **2210**. In some embodiments the grommet **2250** may be formed of the same material as one or more of the collet **2210** parts. In some embodiments the grommet **2250** is formed of a flexible rubber or other elastomeric material. As described above, the grommet **2250** functions to enhance the contact between the collet **2210** and the scope. In some embodiments, the grommet **2250** includes one or more channels that are parallel to the channel and are formed on the inner face of the grommet **2250**. As depicted, the grommet **2250** has a plurality of channels, in this case three, that are arrayed at equally spaced intervals on the inner surface of the grommet **2250**. The purpose of the channels is to provide a buckling or hinge point for the grommet **2250** to collapse as it is radially compressed by actuation of the collet **2210**.

[0139] Referring now to FIGS. **18**A-**18**C, various views and configurations of the locking knob **2000** and the cam grip **2200** are shown. FIG. **18**A shows a lower perspective view of the locking knob **2000** and the cam grip **2200** engaged with the manifold cap **2400**, detailing the features of the underside of the manifold cap **2400** that are engageable with the manifold **900**, and the features on the underside of the locking knob **2000**. FIG. **18**B shows a top perspective view of the locking knob **2000** and the cam grip **2200** engaged with the manifold cap **2400**, detailing the features of the grip portion of the locking knob **2000** and the components of the cam grip **2200**. As previously described, the locking knob **2000** engages with the collet **2210** to compress the cam grip **2200** and thus grip the lens guard **210** to the surgical scope. Referring to FIG. **18**A, the underside of the locking knob **2000** includes a cam engagement cavity **2020** that is contoured so as to interfere with the collet lobes **2212**. Thus. when the locking knob **2000** is advanced along the length of the scope body into contact with the cam grip **2200** the collet lobes **2212** are radially displaced inwardly to effectively close the collet channel against the grommet **2250** and thereby grip the scope. Referring again to FIG. **18**A, the rim of the cam engagement **2020** cavity of the locking knob **2000** includes snap tabs **2040** that project radially into the cavity and are arrayed to engage with the manifold cap **2400** which is in turn coupled with the manifold **900**. FIG. **18**C shows the cam grip **2200** engaged with the locking knob **2000**.

[0140] Referring now to FIGS. **19**A, **19**B and **19**C, these figures depict embodiments of the lens guard **210** manifold **900** that interfaces on its upper surface with the manifold cap **2400** and receives and distributes the flow of fluids from external sources through the lens guard **210** and to its tip. The device components shown in these various figures provide the same functionalities as described in connection with alternate unitary construction devices, namely delivery of continuous or intermittent fluid flow at the distal end of a surgical scope, venting, and delivery of user actuated liquid and gas flow. The flow controller **220** and lens guard **210** components according to these illustrated and pictured embodiments are connected via one or more fluid flow conduits **270**, as illustrated in the drawings, with engagement between the flow controller and lens guard **210** achieved using tubing connections to the flow manifold **900** on the lens guard. The manifold **900** is adapted to receive fluid flow from one or more of liquid and gas sources that are interconnected with the flow controller **220** through tubing and in fluid connection with actuators on the flow controller **220**.

Function of the View Optimizer

[0141] As mentioned previously, the gas/liquid actuator/regulator **250** of the illustrated embodiment is biased towards the gas flow state and delivers a generally continuous flow of gas from the insufflator when in this state. Accordingly, when the view optimizer **200** of the illustrated embodiment is in the normal operation state, a generally continuous flow of gas is directed across the face of the objective lens of the laparoscope **100** through passageways **528**, **530** of the end ring **308**. As set forth above, this gas flows in a path that is generally parallel to the objective lens of the laparoscope.

[0142] This generally continuous flow of gas across the face of the objective lens of the laparoscope **100** serves to prevent the objective lens from fogging, particularly under circumstances when there is a significant temperature and/or humidity differential between the operating room environment and the body cavity of the patient. The generally continuous flow of gas across the objective lens of the laparoscope also serves to deflect away from the objective lens any blood, bodily fluids, pieces of tissue, fat or other bodily material that may be encountered by the objective lens of the laparoscope **100** during an operative procedure. If blood, bodily fluids, pieces of tissue, fat or other bodily material is contacted by and sticks to the objective lens of the laparoscope **100**, the gas flow from passageways **528**, **530** serves to remove the material from the objective lens of the laparoscope **100** and to prevent the material from obstructing the view of the surgeon or medical technician through the scope.

[0143] The view optimizer **200** of the illustrated embodiment is adapted for use with conventional insufflators that typically provide gas at a flow rate of between zero (0) and fifteen (15) liters per minute when cycling during normal operation. Of course, other insufflators may deliver gas at flow rates that are considerably higher or lower, and may still be useful with the view optimizers disclosed herein. Thus, the view optimizer **200** of this detailed description can be adapted to be used with insufflators having a variety of flow rates. When in the gas flow state during normal operation, the view optimizer **200** of the illustrated embodiment is adapted to divert approximately 9% to 18% of this gas provided from the insufflator for delivery to the objective lens of the laparoscope **100** through the lens guard **210**. Accordingly, the remainder of the gas provided by the insufflator continues to be delivered to the patient's body cavity through one or more of the trocars and not pass through the view optimizer **200**. For example, if the insufflator produces 1 liter per minute (L/min), then 0.1 L/min (10%) would go through the view optimizer **200** to the patient and 0.9 L/min would go through the insufflator trocar to the patient Additional embodiments of the view optimizer **200** may divert more or less of the flow from the insufflator to the view optimizer **200**. Accordingly, in various embodiments, the view optimizer **200** may divert about 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, or 18,% of the gas provided from the insufflator. However it should be understood that additional embodiments of the view optimizer **200** may divert gas from the insufflator in excess of 19, 20, 25, 30, 40, 50, 60, 70, 80, 90% or more. And it will be appreciated that in yet other embodiments, the source of the gas may be from other than the insufflator, in which case there is no diversion of gas from direct delivery to the patient's body cavity.

[0144] When in the gas flow state during normal operation, the view optimizer **200** of the illustrated embodiment delivers a generally continuous flow of gas across the objective lens of the laparoscope **100** at a flow rate between zero (0) and ten (10) liters per minute. In some embodiments, the view optimizer **200** delivers a flow of gas at a flow rate between 0.01 and five (5) liters per minute, and in yet other embodiments the view optimizer **200** delivers a flow of gas at a flow rate between two and a half (2.5) and five (5) liters per minute. This generally continuous flow of gas across the objective lens of the laparoscope **100** forms a gas "screen," or "shield." This gas "screen" or "shield" of continuous gas flow across the objective lens of the laparoscope **100** is delivered at a velocity of between zero (0) and about forty (40) meters per second. In some embodiments, the velocity of gas is from about nineteen (19) to thirty eight (38) meters per second. Accordingly, in various embodiments, the flow rate of the gas across the lens is about 0, 0.01, 00.2, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 3, 4, 5, 6, 7, 8, 9 or 10 L/min, or increments thereof. And the velocity of the gas screen is about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 18, 19, 20, 21, 22, 23, 24, or 25 m/s. However it should be understood that additional embodiments of the view optimizer **200** may deliver gas to the objective lens of the laparoscope at a variety of different flow rates and velocities, in which case such flow rates may exceed 10 L/min or greater and the velocities may exceed 25, 30, 40, 50, 60, 70, 80, 90 or 100 m/s or greater.

[0145] During a surgical procedure, blood, bodily fluids, pieces of tissue, fat or other bodily material may become lodged upon the objective lens of the laparoscope and effectively resist deflection or removal by the gas flow provided by the view optimizer in normal operation state. To help facilitate the removal of such adherent material, the view optimizer **200** of the illustrated embodiment provides a burst flow feature. An operator may activate the burst flow feature of the illustrated embodiment of the view optimizer **200** through the use of the burst actuator/regulator **260**. As mentioned previously, the burst actuator/regulator **260** of the illustrated embodiment is a manually operated, pneumatic bulb. To activate the burst flow feature of the illustrated embodiment of the view optimizer **200**, an operator squeezed the pneumatic bulb of the burst actuator/regulator **260**. When the burst actuator/regulator **260** is activated, the view optimizer **200** of the illustrated embodiment delivers a burst or bolus of gas from the insufflator to the objective lens of the laparoscope **100**. During the burst flow state, the view optimizer **200** of the illustrated embodiment delivers a burst or bolus of gas at a flow rate between zero (0) and twenty (20) liters per minute at a velocity of between zero (0) and one hundred and forty five (145) meters per second. Accordingly, in various embodiments, the gas burst flow rate of the gas across the lens is about 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20 L/min, or increments thereof. And the velocity of the gas burst flow is about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 18, 19, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 115, 130, or 145 m/s, or increments thereof. However it should be understood that additional embodiments of the view optimizer **200** may deliver gas burst flow to the objective lens of the laparoscope at a variety of different flow rates and velocities, in which case such flow rates may exceed 20, 25, 30, 35, 40, 45, 50 L/min or greater and such velocities may exceed 150, 155, 160, 165, 170 m/s or greater. The burst or bolus of gas serves to remove blood, bodily fluids, pieces of tissue, fat or other bodily material lodged upon the objective lens of the laparoscope that is resistant to the gas flow provided by the view optimizer in the normal operation state.

[0146] As mentioned previously, when the gas/liquid actuator/regulator **250** of the view optimizer **200** of the illustrated embodiment is in the liquid flow state, liquid is delivered to the objective lens of the laparoscope **100** and the delivery of gas ceases. When the gas/liquid actuator/regulator **250** is in the liquid flow state, liquid flows from the liquid source into the liquid inlet **240** of the flow controller **220**, through the gas/liquid actuator/regulator **250**, through a piece or series of tubing into a fluid connector **313** of the connector plate **310**, through opening **642** of the adapter ring **302**, through a channel **630** of the adapter ring **302**, through a corresponding channel **512** of the guard tube **304**, through channel **518** of the exhaust ring **306**, and is directed across the lens of the laparoscope **100** by passageway **526** of the end ring **308**. Accordingly, when the view optimizer **200** of the illustrated embodiment is in the liquid flow state, a generally continuous flow of liquid is directed across the face of the objective lens of the laparoscope **100** through passageway **526** in a path that is generally parallel to the objective lens. As shown in FIG. **4**C, the passageway **526** of the end ring **308** that delivers the fluid to the objective lens is located in a position which directs the flow of the liquid in a path which is generally perpendicular to the flow of the gas provided by channels **528**, **530** of the end ring **308**. However, it should be understood that the view optimizer **200** of the illustrated embodiment is not limited to this configuration of the flow of liquid and gas and additional embodiments of the view optimizer **200** may provide a different configuration of gas and/or liquid flow. In addition, the gas and/or liquid flow of additional embodiments of the view optimizer may be angled towards or away from the objective lens of the laparoscope **100**.

[0147] When the gas/liquid actuator is in the liquid flow state, the view optimizer **200** of the illustrated embodiment delivers liquid at a volume of generally between zero (0) and 0.4 liters per minute at a velocity of generally between zero (0) to 0.0075 meters per second. However, it should be understood that additional embodiments of the view optimizer **200** may deliver liquid at various other flow rate and velocities. Accordingly, in various embodiments, the flow rate of the liquid across the lens is about 0, 0.1, 0.2, 0.3, or 0.4 L/min. And the velocity of the liquid flow is about 0 to about 0.0075 m/s. However it should be understood that additional embodiments of the view optimizer **200** may deliver liquid to the objective lens of the laparoscope at a variety of different flow rates and velocities, in which case such flow rates may exceed

0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0 or greater and such velocities may exceed 0.0075 m/s or greater. This delivery of liquid to the objective lens of the laparoscope **100** serves to defog or clean the objective lens.

[0148] The burst actuator/regulator **260** of the additional embodiments of the view optimizer **200** may be adapted to serve as a gas accumulator (not shown) that accumulates pressurized gas from the insufflator, or from one or more other or additional gas sources. In the event that the insufflator cycles into the static, non insufflating state, the gas within the gas accumulator of such additional embodiments is delivered to the objective lens of the laparoscope via the view optimizer **200**. This delivery of gas from the gas accumulator ensures that the view optimizer **200** is supplied with a generally steady supply of gas even when the insufflator cycles into the static state. In this manner, the gas accumulator would act as a damping mechanism to smooth out the cyclic on/off of the insufflator and ensure that a generally steady, continuous flow of gas is delivered to the objective lens of the laparoscope **100**.

[0149] As an example, the burst actuator/regulator **260** of some additional embodiments may be an elastic, compliant chamber that expands to accumulate gas from the insufflator. In this manner, the burst actuator/regulator **260** could be used to actuate the delivery of a burst or bolus of gas and or liquid to the objective lens as well as serving as a gas accumulator. A backflow valve may be provided with such burst actuators **260** of additional embodiments to prevent gas from returning to the insufflator from the burst actuator/regulator **260**. Such gas accumulators are adapted to accumulate gas from the insufflator until a predetermined, threshold pressure of gas within the gas accumulator is reached. Once the threshold pressure is reached, the gas accumulator would not accumulate any additional gas from the insufflator. This threshold pressure could be maintained within the accumulator either by the use of a valve or similar control mechanism or simply be maintained by the pressure of the flow of gas supplied by the insufflator.

[0150] The gas accumulator of such embodiments is adapted to maintain a pressure that is equal to or greater than the predetermined pressure at which the patient's body cavity is desired to be maintained. Once the pressure within the patient's body cavity drops below the predetermined pressure, due to the cycling off of the insufflator or some other reason, the gas accumulator would deliver gas to the objective lens of the laparoscope **100**, thereby, also delivering gas to the patient's body cavity. In instances where an elastic, compliant chamber is supplied as the gas accumulator, the chamber will elastically contract in response to a pressure differential between the gas accumulator and the patient's body cavity. This contraction of the gas accumulator would serve to deliver gas to the objective lens of the laparoscope **100** and the patient's body cavity. The delivery of gas by such a gas accumulator could be controlled by the utilization of a valve or similar control mechanism. The delivery of such gas could also be delivered in a manner that is not capable of being controlled by the user.

[0151] It should be understood that the gas accumulator described above could be provided as a single chamber or multiple chambers. The gas accumulator could be incorporated with the burst actuator/regulator **260** as described above or could be provided separately from the burst actuator/regulator **260**. In embodiments in which the burst actuator/regulator **260** and the accumulator function are provided separately from one another, they could each be connected to the insufflator in series or in parallel with respect to one another. Once all or a portion of the gas contained within the gas accumulator has been delivered to the objective lens of the laparoscope, the gas accumulator must be refilled with gas. If the gas accumulator is connected in series with the burst actuator/regulator **260**, or other component of the view optimizer **200** that delivers gas to the objective lens, all or a portion of the flow of gas from the insufflator will first fill the gas accumulator to capacity prior to being delivered to the objective lens of the laparoscope. Due to this phenomenon, a decreased amount of flow will be delivered to the objective lens during the filling of the gas accumulator. Upon the initial startup of the insufflator or the cycling of the insufflator to an insufflation state from a static state, this can result in a time period during which little or no gas is delivered to the objective lens of the laparoscope during the filling of the gas accumulator. To prevent this from occurring, in some embodiments of the view optimizer, the gas accumulator is connected to the insufflator in parallel with relation to the burst actuator/regulator **260** or other components of the view optimizer **200** that deliver gas to the objective lens of the laparoscope to ensure that an effective flow of gas to the objective lens is maintained while the gas accumulator is being filled. In such embodiments, a portion of the gas from the insufflator can be diverted to refill the accumulator only if this diverted flow will not cause the flow of gas that is being delivered to the objective lens to drop below an effective amount. In various embodiments, the flow being diverted to the accumulator can be controlled by a valve or other similar control means.

[0152] It should be understood that the gas accumulator of additional embodiments could be adapted to accommodate a variety of different volumes of pressurized gas. In yet additional embodiments, the gas accumulator could be a non-compliant chamber that is activated by a control switch or other actuation means to deliver gas to the objective lens of the laparoscope **100** when the insufflator ceases insufflating. Such a gas accumulator could be electronically controlled and connected to the insufflator via electronic circuitry so as to be responsive to the cycling of the insufflator. Finally, it should be understood that additional embodiments of the view optimizer **200** may not be supplied with gas from an insufflator, but, rather, may include a gas supplying device incorporated within the view optimizer **200** that is comparable to the insufflator.

[0153] According to some embodiments, vibration of the objective lens of the laparoscope is utilized as an additional means for removing moisture and debris from the objective lens and/or preventing moisture and debris from adhering to the objective lens. According to some such embodiments, the view optimizer **200** is adapted to utilize the flow of gas from the insufflator to vibrate the objective lens. For example, the end ring **308** is structured in such embodiments in such a way that the flow of gas over or through the end ring **308** vibrates the end ring **308** and, thus, vibrate the objective lens as well. One such embodiment includes an end ring **308** including flexible flaps that are adapted to vibrate the end ring **308** as gas from the insufflator flows over the flaps. Additional embodiments of the view optimizer **200** include mechanical means for vibrating the objective lens that do not utilize the flow of gas from the insufflator. For example, some embodiments utilize a piezoelectric end ring **308** or one or more eccentric weights to vibrate the objective lens. It should be understood that in additional embodiments of the view optimizer **200**, vibration of the objective lens may be provided in combination with one or more of the cleaning and/or defogging methods previously described or may be provided alone.

[0154] The leak of the illustrated embodiment is created by a vent or vents defined within the lens guard **210**. The leak of the illustrated embodiment of the view optimizer **200** is a controlled leak that can be controlled by a user of the scope through the use of a valve or other control mechanism. The valve provided to control the leak could be a simple two-state, on/off valve or it could be a multi-state, variable valve that allows the flow rate of the leak to be adjusted. The valve or other control mechanism could be either manually operated or automated, or under electronic control. Thus, it should be understood that the leak created by the view optimizer **200** could provided in a manner that is not controlled by a user.

[0155] The view optimizer **200** of the illustrated embodiment provides a leak that has a flow rate that is generally between zero (0) and eight (8) liters per minute, and approximately 7.8 liters per minute, wherein two of the six channels are for exhaust venting (as discussed further herein in connection with FIG. **4**. Accordingly, in various embodiments, the flow rate of the leak is about 0, 0.5, 1, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0 liters per minute. However it should be understood that additional embodiments of the view optimizer **200** may provide a leak having a variety of different flow rates, in which case such flow rates may exceed 8, 9, 10, 12, 14, 16, 18, or more liters per minute, or increments thereof. As a way of illustrating the effect of the leak provided by the view optimizer **200** of the illustrated embodiment on the insufflator, the following information was collected regarding the cycling intervals of a conventional insufflator during an operative procedure when a leak was provided by the view optimizer as compared to the insufflator operating without a leak being provided.

[0156] In addition, while the leak created by the view optimizer **200** of the illustrated embodiment is a passive leak that relies on the pressure within the patient's body cavity to expel gas from within the cavity, alternative embodiments of the view optimizer could be augmented by the utilization of a vacuum or other suction means to create a suction force that actively draws gas out from within the patient's body cavity. In such embodiments, the leak could likewise be under the control of the user, or otherwise under the control of an automated source or an electronic control.

[0157] Such embodiments that provide a vacuum or other suction means, may provide a suction force between zero (0) inches of mercury (in. Hg) and twenty six (26) inches of mercury (in. Hg). Accordingly, in various embodiments, the suction force provided is about 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25 or 26 inches of mercury (in. Hg). In some embodiments the suction force provided by the vacuum or other suction means of such embodiments is between twelve (12) inches of mercury (in. Hg) and fourteen (14) inches of mercury (in. Hg). However it should be understood that additional embodiments of the view optimizer **200** may provide a suction force having a variety of values that exceed 26 inches of mercury.

[0158] In additional embodiments of the view optimizer **200**, the controlled leak could be created in alternative ways other than vents defined within the lens guard **210**. For example, the leak could be created by a vent defined within the interface between the view optimizer **200** and the trocar that receives the view optimizer **200**. For instance, the outer diameter of the lens guard **210** could be adapted to create a gap between the outer diameter of the lens guard **210** and the inner diameter of the trocar opening, thus, creating a leak. In addition, one or more notches, indentations or other openings could be defined within the portion of the view optimizer **200** that interfaces with the trocar, or, alternatively, within a portion of the trocar that interfaces with the view optimizer **200**, to create a gap through which gas could escape. Additional embodiments may include one or more notches, indentations or openings that extend along the entire length of the lens guard **210**, thereby, creating a leak between the lens guard **210** and the trocar. As discussed previously, it should be understood that this leak located at the interface between the view optimizer **200** or lens guard **210** and the trocar could be controlled with the use of a valve or other control mechanism. Thus, in one example, referring to FIG. **1**B, the leak may be achieved using the stopcock valve **810** of a conventional trocar, whereby an operator opens or "cracks" the vacuum within the surgical system by actuating the valve. In addition, this leak could be a passive leak or could utilize a vacuum or other pumping means to actively draw gas out from within the patient's body cavity. It will be appreciated that the construction of the lens guard **210** may be adapted such that whether it is formed as continuous sheath, or is formed of two or more portions, it is nevertheless adapted to allow for the introduction and control of a leak according to the various embodiments described herein, whether relying on conventional venting means in the trocar system, or other structures or features of the trocar or the inventive devices herein.

[0159] While the creation of a leak helps to ensure that the insufflator provides the view optimizer **200** with a generally continuous supply of gas, the leak can also serve to remove moisture from within the patient's body cavity, thereby, decreasing the humidity within the cavity. Humidity levels in a laparoscopic surgical field can range from below 50% to close to 100% relative humidity; in most cases, the range is from about 75% to 99%, and most typically from about 85% to about 95%. Thus, the humidity within the abdomen can exist from less than 50%, to 55, 60, 65, 70, 75, 80, 85, 90, 95 and 100%, and increments thereof. Reduction of the humidity within the patient's body cavity serves to diminish the likelihood that the objective lens of the laparoscope **100** will become fogged when it is within the patient's body cavity. In addition, the leak can also help to remove smoke and mist generated from the use of a harmonic scalpel, and/or other particulate matter that is suspended in the gas within the patient's body cavity. This removal of airborne matter from within the patient's body cavity serves to ensure that the visibility through the objective lens of the laparoscope **100** is maintained.

[0160] It should be understood that the gas exiting the patient's body cavity via the leak created by the view optimizer **200** could be filtered in various embodiments. This filtering process could serve to remove blood, bodily fluids, or other matter from the gas exiting the patients body cavity, thus, preventing these potential contaminants from entering the air within the operating room. It is beneficial to remove such matter from the escaping gas to prevent anyone in the operating room from inhaling such matter. It should also be understood that the gas exiting the patient's body cavity via the leak could be recycled for re-delivery into the patient's body cavity by the insufflator or the view optimizer **200**. In addition, baffles or other muffling means could be incorporated with the vents provided by additional embodiments to muffle the sound of gas exiting the vents. Finally, it will be understood that in other embodiments, wherein the supply of fluid is to be intermittent, that there is not a need for a leak.

EXAMPLES

Example 1

[0161] Effect of Venting and Incidence of Scope Removal

[0162] Evaluation of effect of venting on insufflator function was evaluated during a laparoscopic surgical procedure. The ambient surgical room temperature was 67° F., the temperature of the carbon dioxide supply was 60° F., and the room humidity was 74%. The following general observations of insufflator function were recorded: after establishing constant pressure in the abdomen sufficient to shut off insufflator operation, followed by a sudden pressure drop in the surgical cavity, there was a 2-3 sec lag before the insufflator restarted. During the standard laparoscopic procedure, the insufflator was in inflation mode about 60% of time, and cycled off for a maximum time of about 11 sec.

[0163] During a hand assisted laparoscopic procedure, the insufflator was in inflation mode about 75% of time, and cycled off for a maximum time of about 5 sec. During the standard laparoscopic procedure, with a slow continuous leak at the stop cock, with the insufflator set at a flow of 5-6 liters per minute and 12-13 mm HG, the insufflator remained in inflation mode 100% of time. During the standard laparoscopic procedure, with a slow continuous leak through a 16 G angiocath, with the insufflator set at a flow of 5 liters per minute and 12-17 mm HG, the insufflator remained in inflation mode 100% of time.

[0164] During the standard surgical procedure, without hand assist, the scope was removed from the patient several times, for the reasons and durations as follows: Fog 40 sec; Fog 40 sec; Blood 40 sec; Fog 30 sec; Cautery 25 sec; Cautery 30 sec; Fog 30 sec; and Fog 25 sec. During the standard surgical procedure, with hand assist, the scope was removed from the patient several times, for the reasons and durations as follows: Fog 30 sec; Fog 60 sec; Cautery 25 sec; Cautery 25 sec; Debris 25 sec; Fog 60 sec; Fog 45 sec; Fog 30 sec; and Fog 30 sec.

Example 2

Evaluation of Fogging

[0165] In a device that simulates the humidity and temperature conditions of an animal abdominal cavity during a laparoscopic procedure, the effects of fogging on a laparoscopic lens was evaluated. Chamber temperature of 99.4-99.7° F., and an initial scope lens temperature of 70.1-72.1° F., humidity was 75-77% RH. FIG. **8** shows the change in scope temperature at the lens and various locations along its length at various times at the chambers humidity.

[0166] Relative humidity is understood as the Ratio of water vapor (dew point). Above the line corresponding to the relative humidity in the chamber, no condensation is observed; below the line, condensation is observed. The principle was observed in the study, wherein, upon initial insertion of the scope into the chamber, fogging immediately occurred and visualization of an object in the chamber was obscured. It was observed that visualization of the object improved as the scope heated up above dew point temperature, and condensation dissipated.

Example 3

Evaluation of Accumulator Reservoir Function

[0167] Testing was performed in a simulator as described in EXAMPLE 2 to compare insufflator function with and without an accumulator. The conditions of testing were similar for each trial, with chamber temperature of 99.4-99.7° F., and an initial scope lens temperature of 70.1-72.1° F., humidity was 75-77% RH.

[0168] The defogging threshold was determined in later testing. A valve was placed inline with an embodiment of the view optimizer described herein and attached to a compliant reservoir. This valve was slowly closed until the airflow was restricted to the point where defogging did not occur. Two trials were performed with the chamber temperature being 102.9-103.9° F. with an initial scope lens temperature of 70.5-70.9° F., humidity was 75-76% RH. Observation of the data recorder showed that at steady state, the maximum peak flow was registered at 1.3V during this time. The voltage of the sensor at 0 flow was measured pretest at 1.228V. FIG. **8** shows the resulting data, wherein the use of an accumulator reservoir compensated for the insufflator to deliver a continuous stream of air when the insufflator was shut-off, and a shift in flow was observed upon re-initiation of insufflator function until the complaint reservoir was replenished with gas.

Example 4

Use of the View Optimizer

[0169] SET UP. In use, the view optimizer is removed from packaging (example of one embodiment of packaged device is shown in FIG. **12**, and as removed from the package as shown in FIG. **13**).

[0170] Referring now to FIG. **14**, the view optimizer is uncoiled for connection to the systems in the operating suite. The sequence of the following steps 2-6 may be modified to suit operating room practice.

[0171] Spike the view optimizer's Saline Line which is tagged & labeled (see FIG. **14**) into the port of a pressurized irrigation bag. Insure that a proper connection is made and that no leaks are visible. If desired, spike the water line of a suction/irrigation system into the view optimizer's Auxiliary Irrigation Port provided via the Y-connector (see FIG. **14**). If connection cannot be made, use an additional irrigation bag. Connect the view optimizer's Insufflator Line which is tagged & labeled (see FIG. **14**) to the insufflator output or to the line that would formerly have been connected to the stopcock on the insufflation trocar. The Insufflator Line comes with an attached luer connector. This can be removed to accommodate a different style connection if desired. Connect the view optimizer's Trocar Line (tagged & labeled) to the stopcock on the insufflation trocar once the trocar has been properly introduced through the abdominal wall. It is recommended that the optical trocar NOT be used as the insufflation trocar. (Note: The Trocar Line remains on the sterile field after the connection is made.) Clip the view optimizer's Rinse Pistol assembly (also referred to as flow controller) to an accessible place on the sterile field of the surgical table. Use the attached Pistol Clamp (see FIG. **14**) to properly secure it to the surgical drape to prevent it from inadvertently falling off the sterile field. The Rinse Pistol only needs to be accessed when a saline flush to the laparoscopic lens is needed. There is no need to constantly grasp or otherwise tend to the Rinse Pistol throughout the course of surgery.

[0172] While gently pressing the Tip of the view optimizer's Sheath assembly (also referred to as lens guard) against one hand or finger-tip, carefully insert the laparoscope down into the Sheath until the lens and distal rim of the scope is seated on the back of the view optimizer's Tip. The scope will "bottom out" inside the device. Caution: Do not use excessive force when inserting the scope into the sheath, or "slam" the laparoscope into the back of the view optimizer's Tip. The scope should slide smoothly through the shaft of the device.

[0173] While holding the laparoscope fully inserted into the Sheath, and supporting the Manifold of the Sheath by hand (see FIG. **14**), rotate the Locking Collar on the Sheath assembly clockwise approximately one-third (⅓) of a turn until a firm stop is felt (see FIG. **14**). This locks the scope to the view optimizer device. Note: Once locked, any rotation or up/down movement of the laparoscope inside the Sheath will not be possible without potentially stripping the locking mechanism. Be certain to unlock the scope before attempting to rotate or otherwise move it within the sheath. Before locking, check to see if any part of the Tip is present in the view of the scope (as projected on the monitor). If so, simply rotate the shaft of the scope inside the Sheath and Manifold assembly until the image of the Tip is eliminated. It may be considered useful to align the view optimizer's Manifold Tubing (air & saline line, see FIG. **14**) in parallel with the cord of the laparoscope's light source before locking. Use the supplied Tubing Clip to attach the tubing to the cord and maintain this alignment. Once locked into place, examine the tip end of the view optimizer and scope assembly. To ensure proper function, the view optimizer's Tip should be securely fastened to its Sheath and no space or visible gap should be observed between the distal rim of the scope's shaft and the Tip of the device.

[0174] Operating the Device

[0175] With the insufflating trocar in place and the Trocar Line properly connected, switch on the insufflator to inflate the abdominal cavity as usual. Insert the scope and the attached the view optimizer Sheath through a 12 mm optical trocar and acquire visualization of the surgical site as usual. Caution: Do not use excessive force when inserting the Sheath and scope assembly into the trocar. The assembly should slide smoothly down the trocar. During the normal course of surgery, the view optimizer device will operate automatically to prevent fogging. Operate the laparoscope as normal. No user intervention is required.

[0176] As intra-operative visualization may be impaired due to the adherence of blood or surgical debris on the laparoscopic lens, depress the Flow Button (see FIG. **14**) on the Rinse Pistol to activate a pressurized flow of saline across the lens. The saline flow will continue as long as the Flow Button is depressed, and will stop when the Flow Button is released. Typically, only a momentary flow (2-3 seconds) of saline will be sufficient to effectively rinse the lens of the laparoscope. Multiple rinses may be necessary.

[0177] To blow off any residual saline which may be present on the lens after rinsing, squeeze the Bulb (see FIG. **14**) on the Rinse Pistol with a firm, sudden force creating an air burst. Several bursts may be required to remove all droplets of saline. Another flush of saline, followed by another burst from the Bulb may also prove useful in the case of a stubborn water droplet interfering with visualization. Due to the continuous laminar flow across the lens, small droplets will disappear spontaneously after a few seconds. For fatty substances, external cleaning of the lens may sometimes be required. In this case, carefully withdraw the scope/Sheath assembly from the trocar and clean the lens with a wet 4×4 gauze pad. Before re-insertion, re-examine the assembly to ensure that there is no visible gap between the end of the scope and the Tip of the device. Excessive movement of the Rinse Pistol and/or tubing lines may cause a small droplet of saline to appear on the lens without depressing the Flow Button. Should this occur, squeeze the Bulb to remove this droplet.

[0178] Removal/Disassembly

[0179] At the conclusion of surgery, withdraw the scope/the view optimizer assembly from the trocar. Unlock the assembly by rotating the Locking Collar counterclockwise approximately ⅓ of a turn. Slide the laparoscope out of the Sheath. Caution: Care should be taken not to inadvertently drop and damage the laparoscope once the assembly has been unlocked. Disconnect the tubing set from the insufflating trocar, the insufflator output circuit, and the saline reservoir. Dispose of the entire the view optimizer device and ancillary tubing set. Caution: The used view optimizer device should be treated as bio-hazardous waste and disposal should be in accordance with established institutional protocols.

[0180] Troubleshooting

[0181] If insufflation of the abdomen has been achieved and the laparoscopic view fogs and fails to clear within several seconds after insertion of the scope/the view optimizer assembly, try one or more of the following: Withdraw the scope/the view optimizer assembly from the trocar and examine the Tip. No visible gap should exist between the Tip and the lens/distal rim of the scope. If a gap does exist, unlock the assembly by rotating the Locking Collar counter-clockwise, pull the scope back several inches within the view optimizer Sheath, and reseat it by repeating steps above. Check to make sure there are no kinks or obstructions in the CO_2 line from the insufflator to the view optimizer device. Add additional venting to the system by slightly opening the stopcock of an adjacent trocar so as to create an air leak. Withdraw the assembly from the trocar and wipe the lens. If operation of the Rinse Pistol and depression of the Flow Button fails to produce a flow of saline across the laparoscope's lens, try one or more of the following: Check that the spike connection to the saline reservoir/bag is made properly. Check that there are no apparent leaks in the water circuit. Check that the tubing is not kinked or obstructed. Check that the saline reservoir/bag is adequately pressurized. Ensure that the laparoscope's lens is properly seated behind the Tip of the device, per the description herein above.

[0182] If insufflation of the abdomen cannot be achieved and the insufflator is operating properly, check to make sure there that the proper connection has been made between the Insufflator Line and the insufflator, that there are no kinks or obstructions in the CO_2 line from the insufflator to the view optimizer device, and that the proper connection has been made between the Trocar Line and the insufflating trocar.

[0183] The embodiments and examples of the view optimizer **200** described herein are representative of aspects of the invention and are provided as examples and not an exhaustive description of implementations of an aspect of the invention. While various aspects of the view optimizer **200** are described and illustrated herein as embodied in combination in the exemplary embodiments, these various aspects may be realized in many alternative embodiments, either individually or in various combinations and sub-combinations thereof. Unless expressly excluded herein all such combinations and sub-combinations are intended to be within the scope of the present application. Still further, while various alternative embodiments as to the various aspects and features of the invention, such as alternative materials, structures, configurations, methods, devices, such descriptions are not intended to be a complete or exhaustive list of available alternative embodiments, whether presently known or later developed. Those skilled in the art may readily adopt one or more of the aspects, concepts or features of the invention into additional embodiments within the scope of the present invention even if such embodiments are not expressly disclosed herein. Additionally, even though some features, concepts or aspects of the invention may be described herein as being a preferred arrangement or method, such description is not intended to suggest that such feature is required or necessary unless expressly so stated.

What is claimed is:

1. A method of defogging a lens of a laparoscope, comprising:

inserting the laparoscope into a sheath;

engaging a fork stabilizing feature of the sheath with a light post of the laparoscope to prevent rotational movement of the sheath relative to the scope;

activating a locking mechanism on the sheath to longitudinally fix a distal end of the laparoscope relative to a distal end of the sheath; and

providing gas to a plurality of gas lumens within a wall of the sheath such that the gas flows through the gas lumens and over the lens of the laparoscope to defog the lens.

2. The method of claim **1**, wherein activating a locking mechanism comprises rotating the locking mechanism.

3. The method of claim **2**, wherein rotating the locking mechanism comprises rotating until a firm stop is felt.

4. The method of claim **2**, wherein rotating the locking mechanism comprises rotating approximately ⅓ of a turn.

5. The method of claim **1**, wherein inserting the laparoscope into a sheath comprises inserting the laparoscope such that no space or gap is visible between the distal end of the sheath and the lens.

6. The method of claim **1**, wherein the locking mechanism is a cam lock.

7. The method of claim **1**, wherein the fork stabilizing feature includes one extension that engages the sheath and two opposing extensions that are parallel to one another and are configured to engage the light post.

8. The method of claim **1**, wherein the locking mechanism includes a locking knob and collet, and wherein engaging the locking mechanism comprises rotating the locking knob such that the collet radially compresses.

9. The method of claim **1**, wherein a longitudinal axis of the fork stabilizing feature extends substantially parallel with a longitudinal axis of the sheath.

10. The method of claim **1**, wherein inserting the laparoscope into a sheath comprises inserting a laparoscope having an angled lens, the angled lens positioned an angle that is greater than 90 degrees relative to a longitudinal axis of the sheath.

11. The method of claim **10**, wherein the distal end of the sheath is angled, and wherein inserting the laparoscope into a sheath comprises inserting the laparoscope such that the angled lens is aligned with the angled distal end of the sheath.

12. The method of claim **10**, wherein the angled lens is positioned at an angle of approximately 120 degrees relative to the longitudinal axis.

13. The method of claim **10**, wherein the angled lens is positioned at an angle of approximately 135 degrees relative to the longitudinal axis.

14. The method of claim **1**, wherein the collet includes a plurality of collet lobes connected together by living hinges.

15. The method of claim **1**, wherein providing gas comprises providing gas from an insufflator.

16. The method of claim **15**, wherein providing gas comprises continuously providing gas from the insufflator.

17. The method of claim **1**, further comprising providing fluid to another lumen within a wall of the sheath such that the fluid flows through the lumen and over the lens of the laparoscope.

18. The method of claim **17**, wherein the fluid is a surfactant.

19. The method of claim **1**, further comprising providing a burst of gas through the plurality of lumens to clear debris or fluid from the lens of the laparoscope.

20. The method of claim **1**, wherein inserting the laparoscope into a sheath comprises inserting the laparoscope until the lens or a distal rim of the laparoscope is seated against a proximal face of the distal end of the sheath.

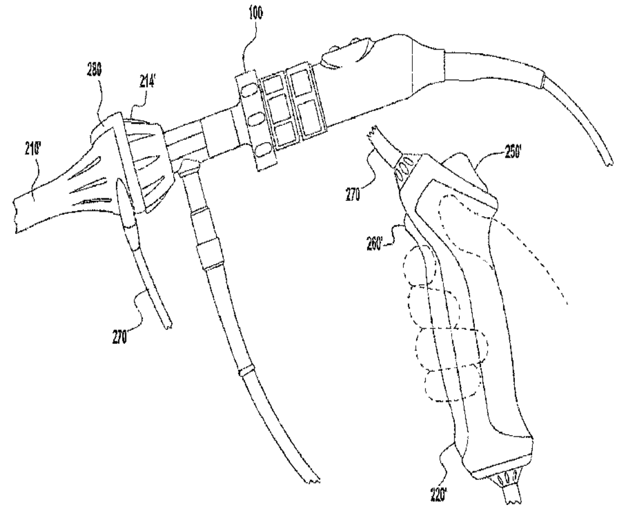
* * * * *

patsnap

专利名称(译)	查看优化器和稳定器，以便与外科手术一起使用		
公开(公告)号	US20150342449A1	公开(公告)日	2015-12-03
申请号	US14/733752	申请日	2015-06-08
[标]申请(专利权)人(译)	投票WAYNE大号 赫德尔斯顿MATTHEWĴ CRISAFULLI CAROLINE中号 LANDIS ADAM 德劳奇GREGORY P		
申请(专利权)人(译)	民意调查显示，WAYNE L. 赫德尔斯顿，MATTHEW J. CRISAFULLI，CAROLINE M. LANDIS，ADAM 德劳奇，GREGORY P.		
当前申请(专利权)人(译)	民意调查显示，WAYNE L. 赫德尔斯顿，MATTHEW J. CRISAFULLI，CAROLINE M. LANDIS，ADAM 德劳奇，GREGORY P.		
[标]发明人	POLL WAYNE L HUDDLESTON MATTHEW J CRISAFULLI CAROLINE M LANDIS ADAM DRACH GREGORY P		
发明人	POLL, WAYNE L. HUDDLESTON, MATTHEW J. CRISAFULLI, CAROLINE M. LANDIS, ADAM DRACH, GREGORY P.		
IPC分类号	A61B1/12 A61B1/313 A61B1/00		
CPC分类号	A61B1/126 A61B1/313 A61B1/00135 A61B1/127 A61B1/00091 A61B1/3132 A61B17/3474 A61B2017/347 A61M13/003 A61M2202/0225 A61M2205/3344 A61B1/00142 A61B1/015		
优先权	61/121514 2008-12-10 US 61/170864 2009-04-20 US		
外部链接	Espacenet USPTO		

摘要(译)

一种除雾腹腔镜镜片的方法，包括：（1）将腹腔镜插入护套中;（2）使护套的叉稳定特征与腹腔镜的灯柱接合，以防止护套相对于窥镜的旋转运动;（3）启动护套上的锁定机构，以相对于护套的远端纵向固定腹腔镜的远端;（4）向护套壁内的多个气体腔提供气体，使得气体流过气体腔和腹腔镜的镜片，以在腹腔镜处于体腔内时使镜片除雾。



100
280
214'
210'
270'
270
250'
260'
220'