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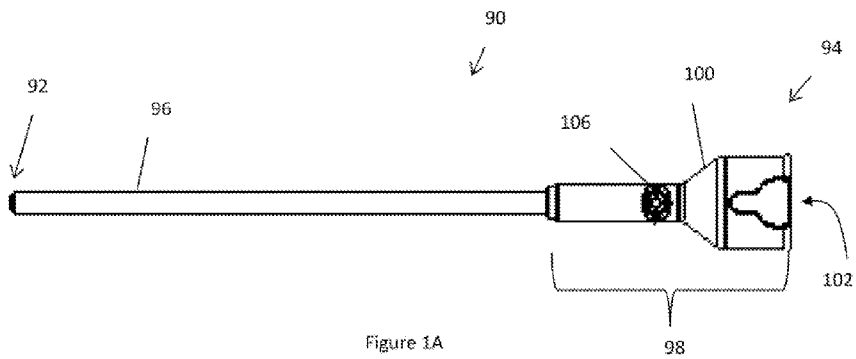


Figure 1A

(57) Abstract: An endoscope sheath comprising: (a) a tube configured to receive all or a portion of a shaft of an endoscope, the endoscope including a fight post in a proximal end region of the endoscope; and (b) an arm attached to and extending from a proximal end region of the sheath; wherein the arm has one or more features that are in communication with the light post to orient the sheath axially and rotationally with respect to the endoscope.

# ENDOSCOPE SHEATH ARM

## FIELD

**[0001]** The present teachings generally relate to an endoscope sheath that receives all or a portion of an endoscope and more specifically to an arm of an endoscope sheath that is used to locate the endoscope sheath relative to an endoscope.

## BACKGROUND

**[0002]** Endoscopes are typically used for minimally invasive surgery or to provide access to an internal location of a patient so that a doctor is provided with visual access. Endoscopes, during use, may be inserted into a location that may include debris that may cover the end of the endoscope and especially cover an imaging device located at the end of the endoscope. For example, an endoscope being used for surgery may become covered by blood and the blood may impair the vision of a surgeon so that surgery becomes increasingly difficult. Attempts have been made to provide various devices to assist a surgeon in clearing the debris from the imaging device of the endoscope and restore vision. These devices may remove some of the debris from the imaging device of the endoscope, however, these devices may not remove all of the debris and/or may leave spots on the imaging device, which may result in continued impairment. Further, movement of the endoscope during use may cause axial or rotational movement of the device relative to the endoscope so that the devices become less effective and/or impairs imaging using the imaging device.

**[0003]** Examples of some endoscope cleaning devices may be found in U.S. Patent Nos. 4,646,722; 5,170,774; 5,419,309; 5,575,756; 6,110,103; 6,126,592; 6,447,446; and 7,811,228. all of which are incorporated by reference in their entirety herein for all purposes. It would be attractive to have an endoscope sheath having an arm that aligns a tip of an endoscope sheath with endoscope tips of various viewing angles. It would be attractive to have an endoscope sheath that directs fluid and/or suction across a distal end of the endoscope so that debris and other imagine blocking substances are removed from the distal tip of the endoscope. It would be attractive to have an endoscope sheath with an alignment device (i.e., an arm) that rotationally and axially immobilizes the endoscope sheath with regard to the endoscope. What is needed is an endoscope sheath that is configured to receive fluid, suction, one or more functional devices, or a combination thereof so that the fluid, suction, one or more functional devices, or a combination thereof that extend from a proximal end to a distal end.

## SUMMARY

**[0004]** The present teachings meet one or more of the present needs by providing: an endoscope sheath comprising: (a) a tube configured to receive all or a portion of a shaft of an endoscope, the endoscope including a light post in a proximal end region of the endoscope; and (b) an arm attached to and extending from a proximal end region of the sheath; wherein the arm has one or more features that are in communication with the light post to orient the sheath axially and rotationally with respect to the endoscope.

**[0005]** Another possible embodiment of the present teachings comprises: an endoscope sheath comprising: a tube configured to receive all or a portion of an endoscope having: a distal end, a proximal end, a shaft having a cylindrical body, a light post extending from a proximal end region of the endoscope; and an arm attached to and extending from a proximal end region of the sheath; wherein the arm has a socket with an undercut that is configured to secure the endoscope sheath to the light post and prevent axial movement of the sheath towards the proximal end and the distal end with respect to the endoscope.

**[0006]** The teachings herein provide an endoscope sheath having an arm that aligns a tip of an endoscope sheath with endoscope tips of various angles. The teachings provide an endoscope sheath that directs fluid and/or suction across a distal end of the endoscope so that debris and other imagine blocking substances are removed from the distal tip of the endoscope. The teachings provide an endoscope sheath with an arm that rotationally and axially immobilizes the endoscope sheath with regard to the endoscope. The teachings provide an endoscope sheath that is configured to receive fluid, suction, one or more functional devices, or a combination thereof so that the fluid, suction, one or more functional devices, or a combination thereof extend from a proximal end to a distal end.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0007]** FIG. 1A illustrates a top view of an endoscope sheath;

**[0008]** FIG. 1B illustrates a proximal end view of an endoscope sheath of FIG. 1A;

**[0009]** FIG. 1C illustrates a distal end view of an endoscope sheath of FIG. 1A;

**[0010]** FIG. 2 illustrates a cross sectional view of FIG 1C along lines A-A;

**[0011]** FIG. 3A illustrates a side view of an endoscope inserted in the endoscope sheath of FIG. 1A;

**[0012]** FIG. 3B illustrates a distal end view of FIG. 3A;

**[0013]** FIG. 4A illustrates an example of an endoscope with an imaging device at a 0 degree angle;

**[0014]** FIG. 4B illustrates an example of an endoscope with an imaging device at a 70 degree angle;

**[0015]** FIG. 5 illustrates a perspective view of an endoscope sheath and arm;

**[0016]** FIG 6 illustrates a cross-sectional view of an arm extending from an endoscope sheath;

**[0017]** FIG. 7A illustrates a side view of an example of an endoscope sheath including an arm;

**[0018]** FIG. 7B illustrates a side view of another example of an endoscope sheath including an arm;

**[0019]** FIG. 8 illustrates an example of a system including the endoscope sheath of the teachings herein; and

**[0020]** FIG. 9 illustrates another example of a system including the endoscope sheath of the teachings herein.

## DETAILED DESCRIPTION

**[0021]** The explanations and illustrations presented herein are intended to acquaint others skilled in the art with the teachings, its principles, and its practical application. Those skilled in the art may adapt and apply the teachings in its numerous forms, as may be best suited to the requirements of a particular use. Accordingly, the specific embodiments of the present teachings as set forth are not intended as being exhaustive or limiting of the teachings. The scope of the teachings should, therefore, be determined not with reference to the above description, but should instead be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes. Other combinations are also possible as will be gleaned from the following claims, which are also hereby incorporated by reference into this written description.

**[0022]** The present application claims priority to U.S. Provisional Patent Application Serial No. 61/882,652, filed on September 26, 2013, the contents of which are both incorporated by reference herein in their entirety for all reasons. The present teachings provide an endoscope sheath for use in a system. The system of the teachings herein includes an irrigation source and a suction source that are both connected to an endoscope sheath that is in communication

with an endoscope. The system may include one or more control modules. The system may function to clean an endoscope. Preferably, the system functions to clean a distal tip of an endoscope. More preferably, the system functions to clean an imaging device of an endoscope. The system may include one or more functional components that may extend proximate to a distal end of an endoscope or beyond a distal end of an endoscope. The system may provide one or more conduits relative to the endoscope. The system may protect the endoscope. The system may include one or more sources of irrigation fluid for use with the system and the one or more sources of irrigation fluid, suction, or both may be controlled by one or more control modules.

**[0023]** The one or more control modules may function to control the amount of fluid, suction or both applied to a predetermined area, an area of interest, the endoscope, or a combination thereof. The one or more control modules may be powered by electricity, battery powered, or both. The one or more control modules may include one or more pumps, one or more valves, one or more user interfaces, or a combination thereof. The one or more user interfaces may be one or more control knobs, one or more selectors, one or more indicators, one or more user controls, one or more devices for changing a parameter, or a combination thereof. The one or more control modules may include any of the pumps discussed herein and based upon feedback from the user interface may control the pump to perform the selected parameter. The control module may include a microprocessor, a computer, a control algorithm, or a combination thereof. The control module may control one more valves located within the system, connected to the control module, or both. The one or more control modules may perform a suction function, an irrigation function, or a combination of both upon a selection by the user as is indicated by the user interface. The control module may control the running speed, pumping duration, or both of the pump so that irrigation fluid is moved to the sheath.

**[0024]** The irrigation fluid may function to clean an endoscope, irrigate a surgical site, clear debris from a location proximate to the endoscope, be bioabsorbable, or a combination thereof. The irrigation fluid may function to move solid particles, move opaque fluids, or both. The irrigation fluid may be applied with a pressure. The pressure of the irrigation fluid may be varied by changing the height of the irrigation source relative to the sheath so that the head of the irrigation fluid is increased or decreased. The irrigation fluid may be applied with a pressure of about 0.10 MPa or more, about 0.20 MPa or more, about 0.30 MPa or more, or even about 0.50 MPa or more. The irrigation fluid may be applied with a pressure of about 3 MPa or less, about 2 MPa or less, about 1 MPa or less, or even about 0.75 MPa or less. The irrigation fluid may be applied with a sufficient amount of pressure that the surface tension of the irrigation fluid wicks

the irrigation fluid across the distal end, the imaging portion, or both of the endoscope (e.g., the pressure may be low enough that the irrigation fluid remains in contact with the endoscope, the sheath, or both). The irrigation fluid may be applied with a gravity feed, thus, the pressure of the irrigation fluid may be determined by the height of an irrigation source. For example, the irrigation source may be an IV bag and the height of the IV bag may determine the amount of pressure and/or force generated at the distal tip of the sheath, endoscope, or both. The irrigation fluid may be applied by a pump that pumps the fluid at a predetermined pressure. The irrigation fluid may be continuously applied, intermittently applied, or both during an application cycle. The pressure of the irrigation fluid may change when the irrigation fluid reaches the end of an endoscope sheath so that the fluid cleans the endoscope, creates turbulence at the end of the endoscope, or both. Preferably, the pressure is sufficiently low so that the flow across the endoscope is laminar. The pressure of the irrigation fluid may be varied based upon the size, length, or both of an irrigation line extending between an irrigation source and the sheath. The irrigation source may be a reservoir that fluid is drawn from by a fluid movement mechanism (e.g., a pump) and moved through the sheath to provide irrigation to a distal end of an endoscope, to clean an endoscope, or both.

**[0025]** The pump may function to circulate irrigation fluid, move irrigation fluid through one or more lines, move fluid through a sheath, or a combination thereof. The pump may function to create a negative pressure (e.g., suction or vacuum). The pump may move fluid with an impeller. The pump may be a lobe pump, a centrifugal pump, a positive displacement pump, a rotary positive displacement pump, a diaphragm pump, peristaltic pump, rope pump, a gear pump, a screw pump, a progressing cavity pump, a roots-type pump, a plunger pump, or a combination thereof. Preferably, the pump moves a constant amount of fluid upon being activated, a constant amount of fluid may be varied from application to application, or both. More preferably, the pump is a peristaltic pump. The peristaltic pump may provide irrigation fluid a point of interest and preferably to a distal end of an endoscope within a surgical site.

**[0026]** The one or more irrigation lines may function to connect the sheath to an irrigation source. The irrigation line may function to create a head so that the irrigation fluid is applied with a pressure. The irrigation line may be flexible, movable, or both. The irrigation line may be made of any material that is compatible with the irrigation fluid, a patient, use in a surgical procedure, or a combination thereof. The irrigation line may connect the sheath to an irrigation source, a suction source, or both (i.e., suction may be applied through the irrigation line).

**[0027]** The suction source may function to remove fluid, debris, opaque fluids, unwanted material, or a combination thereof from a point of interest, from a distal end of the sheath, a

distal end of the endoscope, or a combination thereof. The suction source may function to perform a drying function, remove fluid spots, fluid droplets, or a combination thereof. The suction source may be a pump, reversal of a motor, a common suction source, a hospital suction source, or a combination thereof. The suction source may apply a sufficient amount of vacuum to remove a predetermined amount of fluid in a predetermined amount of time. For example, the suction source may apply suction so that 10 ml of fluid may be removed in 1 to 2 seconds. The suction source may apply continuous suction, intermittent suction, or both.

**[0028]** The suction line may function to connect to the sheath so that suction may be pulled through the sheath. The suction line may function to connect the sheath to a suction source. The suction line may assist is moving fluids, removing fluids, removing debris, removing opaque fluids, removing particles, or a combination thereof. The suction line may be any line that may assist in creating a vacuum at a distal tip of the endoscope, the sheath, or both. The suction line and the irrigation line may be the same line. The suction line and the irrigation line may be connected to a common line. The suction line and the irrigation line may be connected by one or more fittings, one or more valves or both.

**[0029]** The one or more valves may function to allow only one function to work at a time (e.g., irrigation or suction). The one or more valves may function to block the irrigation line, the suction line, or both. The one or more valves may only allow suction or irrigation to be applied at a given time. The one or more valves may be a check valve, a back flow preventer, a pinch valve, or a combination thereof. The one or more valves may be located proximate to the sheath, proximate to the irrigation source, proximate to the suction source, or a location therebetween. Each of the lines may include a valve. If more than one valve is present the valves may be electrically connected, hydraulically connected, fluidly connected, or a combination thereof so that if one valve is opened another valve is closed. The two or more valves (e.g., a first valve and a second valve) may be electrically connected, electrically controlled, or both. The two or more valves may be operated in a sequence (e.g., one opened and then one closed), operated simultaneously, operated on a delay, or a combination thereof. For example, only one valve may be open at a time. In another example, one may close and after a time delay another may open. The one or more valves may be part of a common fitting, located proximate to a common fitting, or both.

**[0030]** The one or more common fittings may function to connect two or more lines into a common line. The one or more common fittings may function to connect a suction line and an irrigation line to a common port. The one or more common fittings may connect a single line to multiple devices so that multiple devices may be used simultaneously, in series, in parallel, or a

combination thereof. For example, the common fitting may connect a suction line and an irrigation line to a common line that is connected to a sheath and during operation an irrigation fluid may be applied and then after a delay and/or immediately when the irrigation fluid ceases to be applied, suction may be applied to the suction line so that irrigation fluid, excess irrigation fluid, debris, particles, opaque fluids, or a combination thereof are removed from the distal end of the endoscope. The one or more common fittings may have two or more openings, three or more openings, four or more openings, or even five or more openings. Each opening may receive at least one line and fluidly connect the one or more lines together. More than one common fitting may be used to connect multiple lines together. For example, a first common fitting with three openings may be connected to another common line with three openings so that two tubes are connected to one opening of a common fitting and one tube is connected to each of the other two openings. Preferably, the common fitting is generally "Y" shaped and two of the openings lead into a third opening that is connected to a common line and/or a delivery line.

**[0031]** The common line may function to deliver irrigation fluid, suction, or both to a sheath. The common line may function to provide a combination of multiple different fluids, devices, suction level, fluid pressures, or a combination thereof. The common line may provide a single access point between the irrigation source, the suction source, or both and the sheath. The common line may have an increased cross-sectional area (e.g., diameter) relative to the cross-sectional area of the irrigation line, the suction line, or both. The common line may be the same size as one or both of the irrigation line, the suction line, or both. The common line may extend between the common fitting and a port of the sheath. The common line may be a delivery line.

**[0032]** The delivery line may function to deliver fluids to a sheath. The delivery line may function to deliver suction to the sheath. The delivery line and the common line are preferably the same line. The delivery line, common line, or both may be used during an application cycle.

**[0033]** The application cycle may be any cycle where an endoscope is cleaned. The application cycle may be a cycle where a combination of different items are applied. The application cycle may be a cycle where an irrigation fluid and suction are applied in a sequence to clean an endoscope. The application cycle may be a combination of one or more applications of fluid, one or more applications of suction, or both. The application cycle may be an application of fluid an immediately thereafter an application of suction to remove excess fluid form a point of interest, the distal end of the endoscope, the distal end of the sheath, or a combination thereof. The application cycle may have no delay between an end of the application of an irrigation fluid and the beginning of the application of suction. For example,

upon completion of the irrigation fluid being applied the suction may immediately begin. The application cycle may be varied by a user. The application cycle may include only an application of fluid (i.e., a flushing cycle, a washing manner) with no suction. The application cycle may be user activated for a predetermined amount of time. The application cycle may be activated based upon a duration a user activates a switch. For example, a user may pre-set the activation cycle so that one touch of the switch causes the irrigation fluid to run for 5 seconds. The user may pre-set the activation cycle so that no suction is used. The application cycle may concurrent application of fluid and suction. For example, suction may begin being applied before the irrigation fluid is turned off. The application cycle of the irrigation fluid, the suction, or both may be changed by a user changing a selector, actuating a control longer, changing an input, or a combination thereof. The application cycle may be sufficiently long so that an image sensor of an endoscope is clear and good images may be taken.

**[0034]** The endoscope may function to provide an image to a surgeon, a doctor, a mechanic, a technician, a nurse, any other person who desires visual access to a remote location, or a combination thereof. The endoscope may be used for non-invasive surgery. The endoscope may be used for orthoscopic surgery. The endoscope may be used for insertion into an orifice including an ear, nose, throat, rectum, urethra, or a combination thereof. The endoscope may have a generally circular cross-section. The endoscope may have a tubular section that is generally cylindrical. The endoscope may have a tubular section extending to the distal end and a handpiece connected to the tube and extending to the proximal end. The endoscope may include one or more image sensors in a distal end region. The endoscope may include two or more image sensors. The endoscope may include an image sensor at the most distal point of the endoscope. The endoscope may include an image sensor that is located on an angle. The angle of the image sensor may be about 0°, 20°, 30°, 45°, 60°, 70°, or a combination thereof. The image sensor may provide black and white images, color images, thermal images, or a combination thereof. Preferably, the image sensor, imaging device, or both are located substantially at the distal end. The angle of the image sensor, the viewing face, or both may dictate the angle, shape, viewing cone, or a combination thereof of the endoscope.

**[0035]** The viewing cone may be an area that of visibility of the endoscope. The viewing cone may be variable, adjustable, or both. The angle of the viewing cone may be movable. The angle of the viewing cone may be predetermined based upon the type of endoscope selected. The angle of the viewing cone may not be affected by the flow director, lumen, sheath, or a combination thereof. The viewing cone may extend outward from the distal end of the endoscope in a cone shape.

**[0036]** The distal end of the endoscope may function to be inserted into a patient so that a feature of interest may be viewed through minimally invasive means. The distal end of the endoscope may be the leading portion of the endoscope (i.e., the first portion hat enters a patient). The distal end may function to provide washing functions, suction functions, irrigating functions, or a combination thereof that directs irrigation fluid and/or suction across the viewing face of the endoscope, the lens, or both. The distal end of the endoscope may be on an opposing end of the endoscope as a proximal end. The proximal end may function to be gripped by a user. The proximal end may function to provide controls to a user. The proximal end may provide an interface for connecting other functional components such as an imaging device (e.g., a camera). The proximal end may function to provide power, sensing, suction, fluid, control, or a combination thereof to the distal end of the endoscope. The proximal end may be retained out of the patient and the distal end may be inserted in the patent. A shoulder may be located between the distal end and the proximal end.

**[0037]** The shoulder may function to prevent the proximal end from entering a patient. The shoulder may function to form a connection point with a tube of the endoscope. The shoulder may be a terminal portion of a proximal end of the endoscope. The shoulder may prevent a sheath from axially moving towards the proximal end of the endoscope. The shoulder may be a distal end of the proximal end portion of the endoscope. The shoulder may be generally vertical, generally flat, generally orthogonal to the longitudinal axis of the tubular section of the sheath, or a combination thereof. One or more light posts may be located in a distal end region of the endoscope in a proximal direction relative to the shoulder (e.g., closer to the shoulder end then a visual port end).

**[0038]** The light post may function to provide light into the endoscope. The light post may direct light into the endoscope and out of the tube of the endoscope so that a feature of interest is illuminated. The light post may provide light so that a user can see features of interests that are located in low light conditions. The light post may be rigid. The light post may be immobile and/or fixedly connected to the endoscope so that the light post has a fixed position on the endoscope. The light post may be made of metal. The light post may be integral with a main portion of the proximal end. The light post may be made of metal or some other biocompatible material. The one or more light posts may assist in providing light through the endoscope, so that the visual port may be used for observing a feature of interest at a distal end of the endoscope.

**[0039]** The visual port may function to provide a viewing window for a user. The visual port may function to allow a user to observe a feature of interest. The visual port may function to

provide an output so that an image is displayed on a monitor. The visual port may provide visual access through the endoscope to a user. The visual port may provide a connection point to a camera that displays the image on a larger image device such as a television or a monitor. The visual port may be an optical window at the proximal end that provides visual access to a viewing lens at the distal end.

**[0040]** The viewing lens may function to provide a window that an image sensor views through. The viewing lens may be a cover over an image sensor. The viewing lens may have a cross-sectional length (e.g., diameter) that is less than the cross-sectional length of the endoscope. The viewing lens may have a largest dimension that is larger than the cross-sectional thickness of the endoscope. For example, when the endoscope has an imaging device at a 70° angle the viewing lens may be greater than the cross-sectional length of the endoscope. The viewing lens may protect the imaging device (e.g., camera) from fluid, damage, corrosion, or a combination thereof. The viewing lens may cover one or more imaging devices or even two or more imaging devices. The viewing lens when in use may become covered with debris, fluid, blood, opaque fluids, or a combination thereof. The viewing lens may be inhibited from allowing a clear image, an undistorted image, or both to be formed. The viewing lens may be partially of fully covered by a sheath, be partially or fully surrounded by a sheath, or both. Preferably, the sheath is located proximate to the viewing lens without interfering with the range of vision created by the viewing lens.

**[0041]** The sheath may function to provide one or more conduits for a fluid, suction, a functional device, or a combination thereof to extend out of a distal end region. The sheath may provide a conduit that extends from a proximal end to a distal end. The sheath may be open at both ends. The sheath may be open at the distal end and the proximal end so that an endoscope may be inserted into the proximal end and extend through the sheath and view a feature of interested located near the distal end. The distal end of the sheath may have a stop that located the distal end of the endoscope relative to the distal end of the sheath. The sheath may include one or more lumen, create one or more lumen, or both. The sheath may include one or more parts that when connected together create a conduit that provides irrigation fluid, suction, or both to a distal end of the endoscope. The sheath may substantially mirror the shape of the endoscope. Thus, for example, if the endoscope has a circular cross-section then then sheath has a circular cross section. The sheath may function as an endoscope cleaner. The sheath may have a distal end and a proximal end with a longitudinal axis that extends therebetween.

**[0042]** The distal end of the sheath may function to direct irrigation fluid, suction, or both across the viewing lens of the endoscope. The distal end may function to open, be open, or both so that irrigation fluid may exit the sheath. The distal end region may include one or more annular gaps (e.g., ring shaped gaps). The distal end may function to not interfere with the imaging capabilities of the endoscope. The distal end may open out so that velocity of the irrigation fluid drops as the irrigation fluid reaches the distal end. The distal end may include one or more distal end locating features. The distal end locating features may include a hooking portion, a projecting portion, or both. The hooking portion, the projecting portion or both may extend from the distal end of the sheath. The hooking portion may extend out from the distal end and down towards an opening in the sheath. The hooking portion may extend in a direction so that irrigation fluid as it exits the sheath is directed across the distal end of the endoscope. The hooking portion may extend at an angle, in an arcuate manner, have one or more linear segments connected by an angular portion, or a combination thereof. The hooking portion may have a tapered tip. The hooking portion may extend generally downward from the distal end. The distal end may include a projecting portion that functions to direct irrigation fluid downward, across a viewing lens of the endoscope, or both. The projecting portion may be linear along its entire length. The projecting portion may have a tapered tip portion. The projecting portion, the hooking portion, or both may extend axially away from the proximal end of the sheath.

**[0043]** The proximal end of the sheath may function to create a connection with the endoscope. The proximal end may align the sheath relative to the endoscope. The proximal end of the sheath may axially align the sheath relative to the endoscope, radially align the sheath relative to the endoscope, axially align the distal ends of the sheath and the endoscope, the sheath axially relative to a light post of the endoscope, the sheath rotationally relative to a light post of the endoscope, or a combination thereof. The proximal end may receive all or a portion of the endoscope. The proximal end may contact a shoulder of the endoscope. A longitudinal axis may extend between the proximal end and the distal end of the sheath. The longitudinal axis may extend through a through hole that extends the length of the sheath. The endoscope may extend within the sheath along the longitudinal axis. The longitudinal axis may extend from a connection point between the endoscope and the sheath and through a tube of the sheath.

**[0044]** The tube may function to receive the imaging device of the endoscope. The tube may be located at the distal end of the endoscope. The tube may be generally the same size and shape as the endoscope. For example, if the endoscope has a generally circular cross-section then the tube may have a generally circular cross-section. The tube may have a shape

that is different than the endoscope. The tube may be any shape so that the tube is configured to receive the endoscope. The tube may be connected to: a hub, integrally formed with a hub, in fluid communication with a port, connected to a port, include a through hole that is in communication with a port, or a combination thereof. The tube may be connected to a handpiece at the proximal end. The tube may be integrally formed with a handpiece. The tube may have a uniform wall thickness, a variable wall thickness, or both. The wall thickness may vary along the length of the tube. The wall thickness may vary along the circumference of the tube. For example, the tube may have a wall that is twice as thick on a bottom half of the tube than a top half of a tube when viewing the tube in a cross-section. The tube may include one or more positioning devices along its length. The one or more positioning devices may be one or more dimples. The tube may be any shape so that the tube is configured to receive the endoscope. The tube may be connected to a hub, integrally formed with a hub, in fluid communication with a port, connected to a port, include a through hole that is in communication with a port, or a combination thereof.

**[0045]** The port may function to provide access into the tube of the sheath. The port may function to provide a fluid connection, a suction connection with one or more irrigation sources, one or more suction sources, one or more common lines, one or more delivery lines, or a combination thereof. The port may form a fixed connection with one or more lines so that suction, irrigation fluid, or both may be provided through the port. The port may provide direct access to the inside of the tube. The port may be configured so that one or more functional elements (e.g., a cutting tool, a cauterizing tool, or both) may gain access to the inside of the tube of the sheath, may extend out of the distal end of the sheath, or both. For example, the port may receive items that do not flow. The port may be part of the tube, the hub, or both.

**[0046]** The hub may function to connect the sheath to the endoscope. The hub may function to seal the sheath to the endoscope. The hub may surround a portion of the endoscope. The hub may function to create a fluid seal with the endoscope so that the irrigation fluid, suction, or both do not leak. The hub may receive a shoulder of the endoscope so that the shoulder and the hub form a fluidly sealed connection. The hub may have a circular cross section. The hub may taper as it extends towards the distal end of the sheath. The hub may be large enough to receive all or a portion of the endoscope. The hub may partially extend around the endoscope, fully extend around the endoscope, or a combination of both. The hub may have a thicker section that connects to the tube. The hub may be fastened to the tube. The hub may be connected to the tube by a mechanical fastener such as threads, a snap, a one way connection system, a series of ribs, or a combination thereof. The hub may connect to the tube

by one or more adhesives. The hub may include a collar, an arm, or both that receive all or a portion of the endoscope.

**[0047]** The collar and the arm may perform the same functions. The collar and the arm may include the same elements. The collar may be an integral part of the hub. The collar may form a majority of the hub (e.g., 50 percent or more, 60 percent or more, or 70 percent or more). The collar may function to prevent rotational movement. The collar may function to prevent axial movement. The collar may function to receive all or a portion of the endoscope. The collar may function to receive a light post of the endoscope. The collar may surround the light post. The collar may extend partially around the light post. The collar may include a socket that receives all or a portion of the light post.

**[0048]** The socket may function to contact the light post so that the sheath and endoscope are axially aligned, rotationally aligned, or both. The socket may function to receive all or a portion of the endoscope. The socket may receive all or a portion of the light post without locking the sheath to the light post. The socket may function to lock the sheath to the endoscope. The socket may function to rotationally lock the sheath to the endoscope, axially lock the sheath to the endoscope, or both. The socket may prevent all axial movement of the sheath relative to the endoscope. For example, the socket may prevent axial movement of the sheath in the proximal direction and the distal direction relative to the endoscope, light post, the distal end of the of the endoscope, or a combination thereof. The socket once connected to the light post may constrain all axial movement of the sheath so that the distal end of the sheath and the distal end of the endoscope are axially aligned. The socket may be a positive feature that forms a connection with the endoscope. The socket may be a negative feature, an absence of material, a lack of material, a section free of material, or a combination thereof. The socket may include an opening that receives all or a portion of an endoscope and preferably receives a light post of an endoscope. The socket may be part of the collar, the arm, or both. The size of the opening in the socket may be variable in size so that the socket may be able accommodate endoscopes, light posts, or both of different sizes. The socket may have an opening that is semicircular, rectangular, "V" shaped, hexagonal, a geometric shape, or a combination thereof that is configured to receive a light post or another component of the endoscope. The socket may include a hinge that allows for the socket size to be varied. The material characteristics of the socket may allow for the socket size, the opening in the socket, or both to be varied. The material of the socket may be elastically deformable so that the socket receives the light post and forms an interfere fit with the light post. The socket may mirror the shape of one or more portions of the endoscope. The socket may mirror the shape of the light

post. The socket may extend partially and/or fully around the light post. The socket may include one or more fingers that extend around an opening in the socket. The socket may include one or more fingers with one or more undercuts.

**[0049]** The one or more fingers may function to extend around an opening. The one or more fingers may create an opening between adjacent fingers. The one or more fingers may function to be movable during attachment. The one or more fingers may function to form an interference fit. The one or more fingers may function to prevent rotational movement, axial movement, or both of the sheath. The one or more fingers may be elastically deformable. The one or more fingers may be laterally translatable (e.g., extend within their own plane). The one or more fingers may create a gripping force on the endoscope, the light post, or both. The one or more fingers may each form a gripping force of about 2 N or more, about 5 N or more, about 7 N or more, or even about 10 N or more. The one or more fingers may each include one or more undercuts and may move the one or more undercuts into contact with a light post, around a light post, or both.

**[0050]** The one or more undercuts may prevent axial movement, rotational movement, or both. Preferably, the one or more undercuts may prevent axial movement towards the distal end of the endoscope, the sheath, or both. The undercuts and a distal end of the socket may work in conjunction to constrain axial movement (e.g., both proximally and distally) of the sheath relative to the endoscope. The one or more undercuts may assist in forming a fixed connection with the endoscope, form a fixed connection with the endoscope, or both. The one or more undercuts may grip a portion of the endoscope. Preferably, the undercuts extend at least partially around the endoscope or a portion of the endoscope so that the endoscope and sheath are fixedly connected. More preferably, the undercuts extends at least partially around the light post of the endoscope or into a portion of the light post to form a fixed connection. The one or more undercuts may form an interference fit, a friction fit, a snap fit, or a combination thereof with the endoscope and preferably with the light post of the endoscope. The one or more undercuts may be two opposing undercuts that are located on opposing fingers of the socket. The undercuts may angle towards each other, extend towards an inside of the socket, reduce the diameter of the socket, or both. The undercuts, the socket, the fingers, or a combination there of may be part of a collar, a hub, an arm, or a combination thereof.

**[0051]** The arm may function to axially extend from the hub. The arm may function to axially align the sheath and the endoscope. The arm may include a socket, fingers, an undercut, or a combination thereof as discussed herein. The arm may function to contact the endoscope so that the sheath is positioned at a standard position, a predetermined position, or

both relative to the endoscope. The arm may function to align the distal end of the sheath with the distal end of the endoscope. The arm may function to extend the sheath towards the proximal end of the endoscope. The arm may mirror the shape of the endoscope. The arm may axially extend so that the arm does not interfere with the visual port. The arm may have an "L" shape. The arm may extend down towards the endoscope and then turn and extend axially along the endoscope. The arm may be tapered. The arm may be widest at its proximal end and thinnest at its distal end. The arm may have a continuous width along its length. The arm may include one or more hinges so that the angle of the arm relative to the endoscope may be varied. The arm may include one or more flexible regions so that the angle of the arm relative to the endoscope may be varied. The arm may be variable in length. The arm may include a telescoping feature so that the endoscope may be lengthened and shortened. The arm may include one or more locking features that allow for the length of the arm to be changed and then locked into position. The arm may locate the sheath relative to the endoscope so that a flare, a facing surface, or both of the sheath align with the endoscope.

**[0052]** The flare may function to create a sealed connection with the endoscope. The flare may create a fluid seal with the endoscope so that irrigation fluid, suction, or both cannot escape between the endoscope and the flare. The flare may create a thrust seal. The thrust seal may be formed by the flare compressing. The flare may create a thrust seal, a circumferential seal, or both. The flare may be axially compressed, radially compressed, radially expanded, or a combination thereof. The thrust seal may be formed between the shoulder of the endoscope and the flare of the sheath. The flare may substantially encircle a portion of the endoscope so that when a thrust seal is created a fluid seal is created between the endoscope and the sheath and fluid is prevented from exiting the sheath proximate to the endoscope. The flare may be flexible so that the flare forms a seal. The flare may be elastically deformable so that the flare forms a compression fitting with the endoscope. The flare may be partially deformable, include a deformable region, include rubber, include an elastomer, include elastic, or a combination thereof. The flare may be axially compressed when the endoscope is inserted in the sheath. The flare may form a circumferential seal about a shoulder of the endoscope, an end of the proximal end region, around the tube, or a combination thereof. The flare may axially extend from the hub of sheath. The flare may radially extend from the hub. The flare may be located partially within the hub and partially out of the hub. The flare may have a facing surface that contacts an endoscope.

**[0053]** The facing surface may function to create a seal with an endoscope. The facing surface may contact a shoulder of the endoscope. The facing surface may create a seal with

the endoscope, the shoulder of the endoscope, or both. The facing surface may surround a portion of the endoscope. For example, the facing surface may extend around the tube, the shoulder, or both to create a seal. The facing surface may be made of a pliable material that forms a seal. The facing surface may be made of an elastomer, may include an elastomer, or both. The facing surface may elastically deform. The facing surface may extend from the hub. The facing surface may have a portion that extends radially outward. The hub may include one or more spacers.

**[0054]** The one or more spacers may function to axially align the endoscope within the sheath. The one or more spacers may contact a shoulder of the endoscope and align the endoscope within the sheath. The spacer may contact a tube so that the tube is axially aligned within the tube. The one or more spacers may be optional. The spacer may be located proximate to one or more O-rings.

**[0055]** The one or more O-rings may function to form a seal between the sheath and a tube of the endoscope. The one or more O-rings may function to prevent fluid from traveling towards the proximal end of the endoscope. The one or more O-rings may function to create a seal. The one or more O-rings may be located within the hub, proximate to a collar of the hub, or both. The one or more O-rings may be made of any material that forms a seal. The one or more O-rings may create a circumferential seal, a thrust seal, or both. The one or more O-rings may be axially compressed, radially compressed, radially expanded, or a combination thereof. The one or more O-rings may include one or more through holes. The one or more O-rings may elastically deform. The one or more O-rings may be made of an elastomer, include elastic, include rubber, include a deformable material, include a deformation region, or a combination thereof. The one or more O-rings may be located proximate to a locking ring.

**[0056]** The one or more locking rings may lock the O-ring to the sheath, the endoscope, or both. The one or more locking rings may function to lock two or more components together. The one or more locking rings may include a through hole so that the endoscope extends through the tube and the locking ring.

**[0057]** A through hole may extend from a proximal end to a distal end of the sheath. A through hole may be sufficiently large so that the endoscope and fluid may pass from the distal end to the proximal end of the sheath. The tube may include one or more through holes in the sheath.

**[0058]** Figure 1A illustrates a top view of sheath 90 for use with an endoscope cleaner system (not shown). The sheath 90 includes a distal end 92 and a proximal end 94. A tube 96 and hub 98 extend between the distal end 92 and the proximal end 94. The hub 98 includes a

port 106 for receiving suction, an irrigation fluid, or both. The hub 98 also includes a collar 100 that includes a socket 102 for receiving a light post 72 (not shown) of a corresponding device (not shown).

**[0059]** Figure 1B illustrates an end view of the sheath 90 from the proximal end 94. The port 106 is shown extending from the hub 98 and a through hole 152 is shown extending through the tube 96 and hub 98. The socket 102 is illustrated extending through the hub 98 towards the port 106.

**[0060]** Figure 1C illustrates a view of the sheath 90 from the distal end 92. A through hole 152 is shown extending through the sheath 90.

**[0061]** Figure 2 illustrates a cross sectional view of the sheath 90 of Figure 1C cut along lines A-A of Figure 1C. The sheath 90 includes a tube 96 connected to a hub 98. The hub 98 includes a spacer 128 between an end of the tube 96 and a mating surface of the hub 98. An O-ring 130 is located in the hub proximate to a locking ring 132 for securing the O-ring to the hub 98

**[0062]** Figure 3A illustrates an endoscope 60 extending into a sheath 90. The endoscope 60 includes a proximal end 64 including a visual port 74. The endoscope 60 includes a distal end 92 that extends to a distal end 62 of a sheath 90. The sheath 90 includes a tube 96 extending from a distal end 92 to a hub 98. A viewing cone 78 is shown extending at an angle (e.g., 0 degree angle) from the end of the endoscope 60 and sheath 90. The hub 98 includes a port 106 for receiving suction, an irrigation fluid, or both. The hub 98 terminates at a proximal end 94 by the hub 98 contacting a shoulder 70 of the endoscope 60 and the socket 102 of the sheath 90 receiving a light port 72 of the endoscope 60.

**[0063]** Figure 3B illustrates an end view of the sheath 90 and endoscope 60 from a distal end view 62, 92. The visual port 74 and light post 72 of the endoscope 60 extend outward from the endoscope 60.

**[0064]** Figure 4A illustrates an endoscope 60. The endoscope 60 includes a visual port 74 for providing an image. The visual port 74 provides an image that is located within the viewing cone 78 at the distal end 62 of the endoscope 60 which extends at a 0 degree angle. . The endoscope 60 also includes a light port 72 for providing light to the distal end 62 of the endoscope. The endoscope 60 also includes a shoulder 70 to prevent the endoscope 60 from entering a patient.

**[0065]** Figure 4B illustrates an endoscope 60 having visual port 74 for viewing an image within the viewing cone 78 that is located at the distal end 62. The viewing cone 78 extends at

a 70 degree angle from the distal end 62. A light post 72 and shoulder 70 are located proximate to the visual port 74.

**[0066]** Figure 5 illustrates a perspective view of the sheath 90. The sheath 90 has a longitudinal axis 95 that extends through the hub 98 and tube 96 that are connected. The hub 98 is connected to an arm 108 that includes a socket 102, a pair of fingers 109, and an undercut 104 on each finger 109. The socket 102 has an opening for receiving a light post of an endoscope (not shown) for aligning the sheath 90 on the endoscope and the undercuts 104 retain the light post within the opening of the socket 102. A flange 110 and socket 112 are located on the proximal end 94 near the arm 108 and are configured to receive a portion of an endoscope. A port 106 extends from the tube 96 from a location adjacent to and on a distal side of the arm 108.

**[0067]** Figure 6 illustrates a cross-sectional view of a sheath 90. The sheath 90 includes a hub 98 that is connected to a tube (not shown) with a longitudinal axis 95 extending through the tube and hub 98. A port 106 and an arm 108 extend from a same side of the hub 98 and the arm 108 is located proximal of the port 106. The tube 96 has a proximal end 94 with a flare 110 and facing surface 112 at the proximal end 94. The arm 108 includes a socket 102 for receiving a light post of an endoscope (not shown). The socket 102 includes fingers 109 that extend around an opening in the socket 102 and an undercut 104 at the end of the fingers 109. The opening of the socket 102 receives a light post (not shown) and the undercut 104 retains the light post within the opening.

**[0068]** Figure 7A illustrates a side view of another possible sheath 90. The sheath 90 includes a hooking portion 156 at a distal end 92 and an arm 108 extending from the sheath 90. The arm 108 is located so that the arm 108 aligns the hooking portion 156 on an endoscope (not shown) so that the hooking portion 156 directs a cleaning fluid across the endoscope and cleans the endoscope. The arm 108 includes a socket 102 that is configured to receive a portion of an endoscope such as a light post. The socket 102 includes a rear wall that is located a distance (**D**) from the hooking portion 156.

**[0069]** Figure 7B illustrates a sheath 90 including a hooking portion 156 at the distal end 92. An arm 108 extends from the sheath 90 and aligns the hooking portion 156 with an end of an endoscope (not shown) so that a cleaning fluid is directed across a lens of the endoscope by the hooking portion 156. The hooking portion 156 extends further out than the hooking portion of Figure 7A. The hooking portion 156 is located a distance **(D2)** from the rear wall of the socket 102.

**[0070]** Figure 8 illustrates an endoscope cleaning system 2. The endoscope cleaning system 2 includes an irrigation source 4 connected to an irrigation line 6 that is connected to a control module 30 that includes a pump 14 for controlling flow of irrigation fluid between the irrigation source 4 and a sheath 90. The control module 30 includes a power source 20 and a controller and/or microprocessor (not shown) that is in communication with a user interface 31 for controlling the control module 30. The system 2 includes a suction source 10 that is connected to the control module 30. The control module 30 includes a valve 8 in the suction line that is connected to a sheath 90, which receives a portion of an endoscope. The valve 8 for controls suction between the suction source 10 and the sheath 90 so that suction may be turned off during all or portion of the application cycle of the irrigation fluid. The irrigation line 6 and the suction line 12 are connected together at a common fitting 16 that connects the irrigation line 6 and the suction line 12 to a common line 18/delivery line 42 for supplying a fluid or suction to the sheath 90 for cleaning an endoscope (not shown).

**[0071]** Figure 9 illustrates a control module 30 that includes a pump 14, a power source 20, a user interface 31, and one or more valves 8. The irrigation source 4 is gravity fed into the pump 14 and then the pump 14 sends fluid through the irrigation line 6 to the sheath 90 so that the sheath 90 washes the endoscope 60. The suction source 10 is connected to a valve 8 of the control module 30 that controls suction being drawn through the suction lines 12. Both the irrigation lines 6 and the suction lines 12 are connected to a common fitting 16 and a single common line 18/delivery line 42 extend from the common fitting 16 to the sheath 90. The suction line 12 may include a valve 8 that is a passive check valve to prevent irrigation fluid from being forced into the suction line.

**[0072]** Any numerical values recited herein include all values from the lower value to the upper value in increments of one unit provided that there is a separation of at least 2 units between any lower value and any higher value. As an example, if it is stated that the amount of a component or a value of a process variable such as, for example, temperature, pressure, time and the like is, for example, from 1 to 90, preferably from 20 to 80, more preferably from 30 to 70, it is intended that values such as 15 to 85, 22 to 68, 43 to 51, 30 to 32 etc. are expressly enumerated in this specification. For values which are less than one, one unit is considered to be 0.0001, 0.001, 0.01 or 0.1 as appropriate. These are only examples of what is specifically intended and all possible combinations of numerical values between the lowest value and the highest value enumerated are to be considered to be expressly stated in this application in a similar manner.

**[0073]** Unless otherwise stated, all ranges include both endpoints and all numbers between the endpoints. The use of "about" or "approximately" in connection with a range applies to both ends of the range. Thus, "about 20 to 30" is intended to cover "about 20 to about 30", inclusive of at least the specified endpoints.

**[0074]** The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes. The term "consisting essentially of" to describe a combination shall include the elements, ingredients, components or steps identified, and such other elements ingredients, components or steps that do not materially affect the basic and novel characteristics of the combination. The use of the terms "comprising" or "including" to describe combinations of elements, ingredients, components or steps herein also contemplates embodiments that consist essentially of the elements, ingredients, components or steps. By use of the term "may" herein, it is intended that any described attributes that "may" be included are optional.

**[0075]** Plural elements, ingredients, components or steps can be provided by a single integrated element, ingredient, component or step. Alternatively, a single integrated element, ingredient, component or step might be divided into separate plural elements, ingredients, components or steps. The disclosure of "a" or "one" to describe an element, ingredient, component or step is not intended to foreclose additional elements, ingredients, components or steps.

**[0076]** It is understood that the above description is intended to be illustrative and not restrictive. Many embodiments as well as many applications besides the examples provided will be apparent to those of skill in the art upon reading the above description. The scope of the teachings should, therefore, be determined not with reference to the above description, but should instead be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes. The omission in the following claims of any aspect of subject matter that is disclosed herein is not a disclaimer of such subject matter, nor should it be regarded that the inventors did not consider such subject matter to be part of the disclosed inventive subject matter.

CLAIMS

We claim:

1) An endoscope sheath comprising:

a. a tube configured to receive all or a portion of a shaft of an endoscope, the endoscope including a light post in a proximal end region of the endoscope; and

b. an arm attached to and extending from a proximal end region of the sheath;

wherein the arm has one or more features that are in communication with the light post to orient the sheath axially and rotationally with respect to the endoscope.

2) The endoscope sheath of claim 1, wherein the one or more features are a socket that extends at least partially around the light post of the endoscope so that rotational movement of the sheath is prevented.

3) The endoscope sheath of any of the preceding claims, wherein the arm extends a predetermined distance from a proximal end of the sheath so that the sheath is axially aligned with the endoscope.

4) The endoscope sheath of any of the preceding claims, wherein the arm axially aligns a distal end of the sheath with a distal end of the endoscope so that the distal end and the proximal end are positioned in a predetermined axial position relative to each other.

5) The endoscope sheath of any of claims 2 through 4, wherein the socket includes an undercut that contacts the light post and connects the endoscope sheath to the light post so that the endoscope sheath is prevented from axial movement and rotational movement relative to the endoscope.

6) The endoscope sheath of any of the preceding claims, wherein a proximal end of the endoscope sheath includes a facing surface that the endoscope extends through, and the facing surface includes a flare that forms a seal with a shoulder of an endoscope.

7) The endoscope sheath of claim 6, wherein the facing surface is elastically deformable so that the facing surface forms a sealed connection with a shoulder of the endoscope.

8) The endoscope sheath of any of the preceding claims, wherein the arm is configured as a collar that receives a portion of the endoscope, and the collar includes a socket that extends into the collar and is configured to receive all or a portion of a light post.

9) The endoscope sheath of claim 8, wherein the collar includes an O-ring that forms a seal between the endoscope sheath and the endoscope, between the endoscope sheath and a shoulder of the endoscope, or both.

10) The endoscope sheath of any of the preceding claims, wherein the endoscope sheath includes a hub and the arm and the tube are connected to and extend from the hub, and the hub includes a port provides ingress and egress of fluids through the endoscope sheath.

11) An endoscope sheath comprising:

a tube configured to receive all or a portion of an endoscope having:

a distal end,

a proximal end,

a shaft having a cylindrical body,

a light post extending from a proximal end region of the endoscope; and

an arm attached to and extending from a proximal end region of the sheath;

wherein the arm has a socket with an undercut that is configured to secure the endoscope sheath to the light post and prevent axial movement of the sheath towards the proximal end and the distal end with respect to the endoscope .

12) The endoscope sheath of claim 11, wherein the one or more features are a socket that extends at least partially around the light post of the endoscope so that rotational movement of the sheath is prevented.

13) The endoscope sheath of claim 11 or claim 12, wherein the arm axially aligns a distal end of the sheath with a distal end of the endoscope so that the distal end and the proximal end are positioned in a predetermined axial position relative to each other.

14) The endoscope sheath any of claims 11 through 13, wherein a proximal end of the endoscope sheath includes a facing surface that the endoscope extends through, wherein the facing surface of the endoscope sheath is free of a gasket, a seal, or both to form a fluidly sealed connection between the endoscope sheath and the endoscope.

15) The endoscope sheath of claim 14, wherein the facing surface is elastically deformable so that the facing surface forms a sealed connection with a shoulder of the endoscope.

16) The endoscope sheath of any of claims 11 through 15, wherein the arm is configured as a collar that receives a portion of the endoscope, and the collar includes a socket that extends into the collar and is configured to receive all or a portion of a light post.

17) The endoscope sheath of claim 16, wherein the collar includes an O-ring that forms a seal between the endoscope sheath and the endoscope, between the endoscope sheath and a shoulder of the endoscope, or both.

18) The endoscope sheath any of claims 11 through 17, wherein the endoscope sheath includes a hub and the arm and the tube are connected to and extend from the hub, and the hub includes a port that provides ingress and egress of fluids through the endoscope sheath.

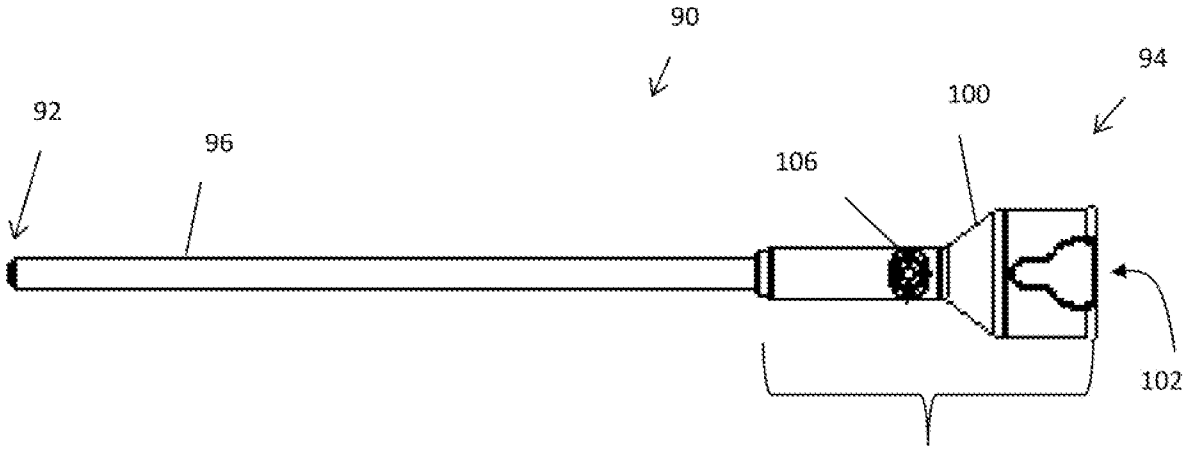


Figure 1A

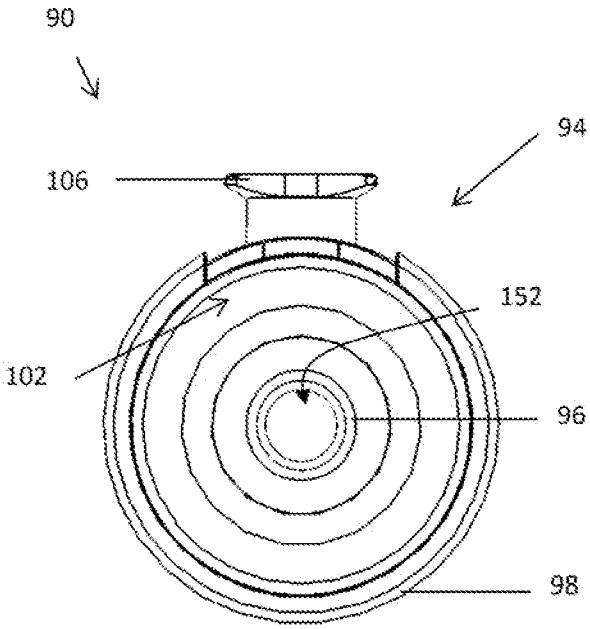


Figure 1B

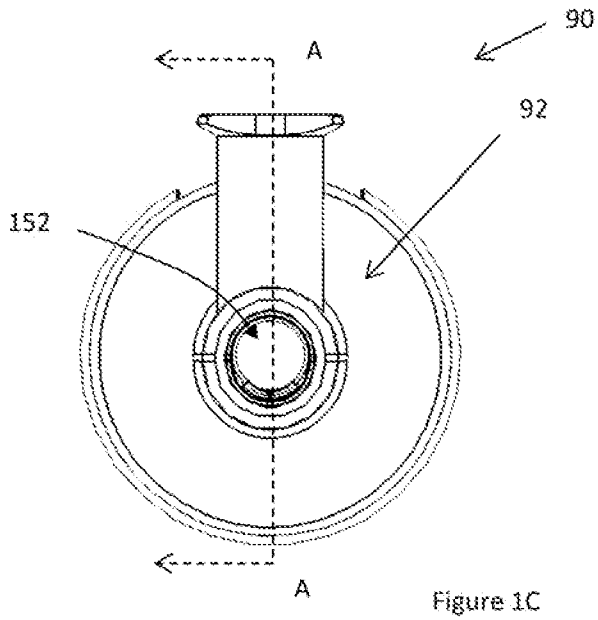


Figure 1C

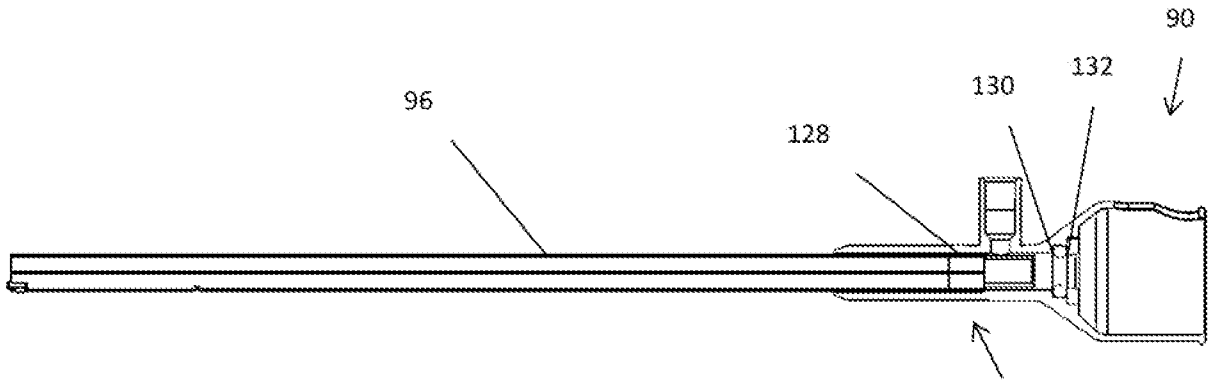


Figure 2

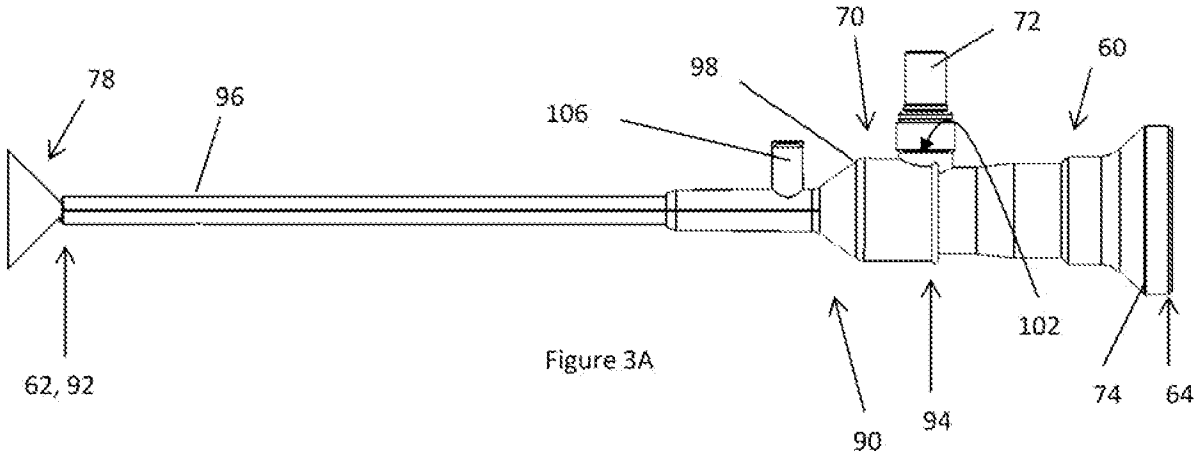


Figure 3A

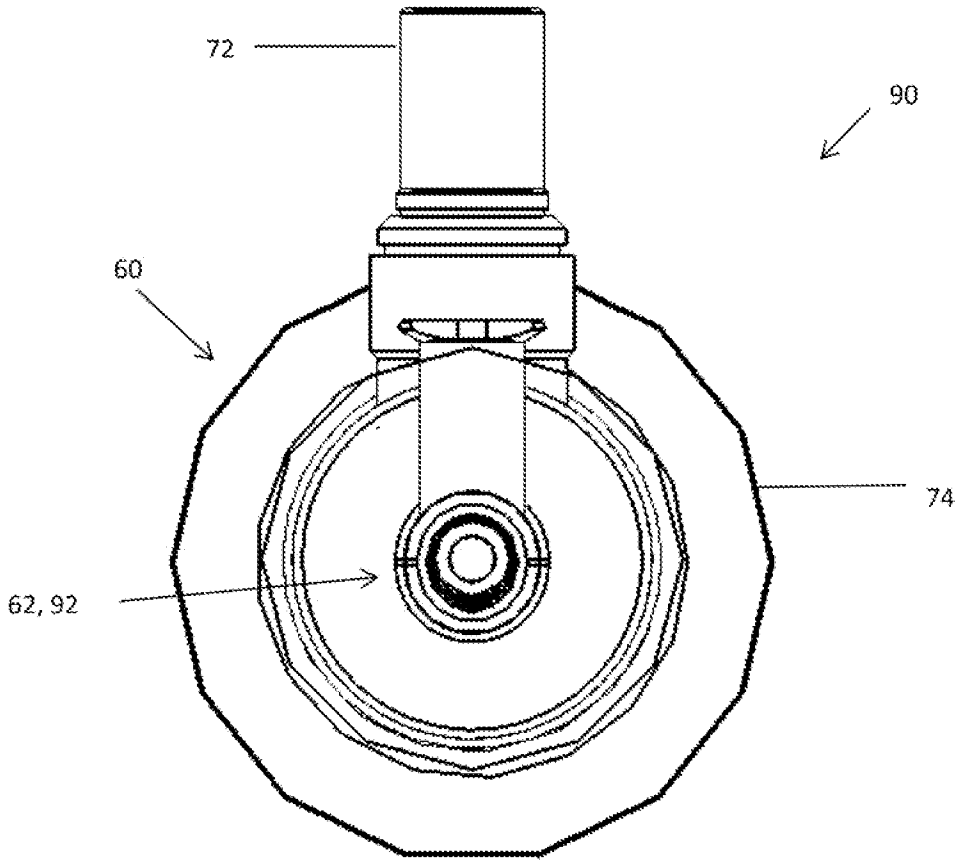


Figure 3B

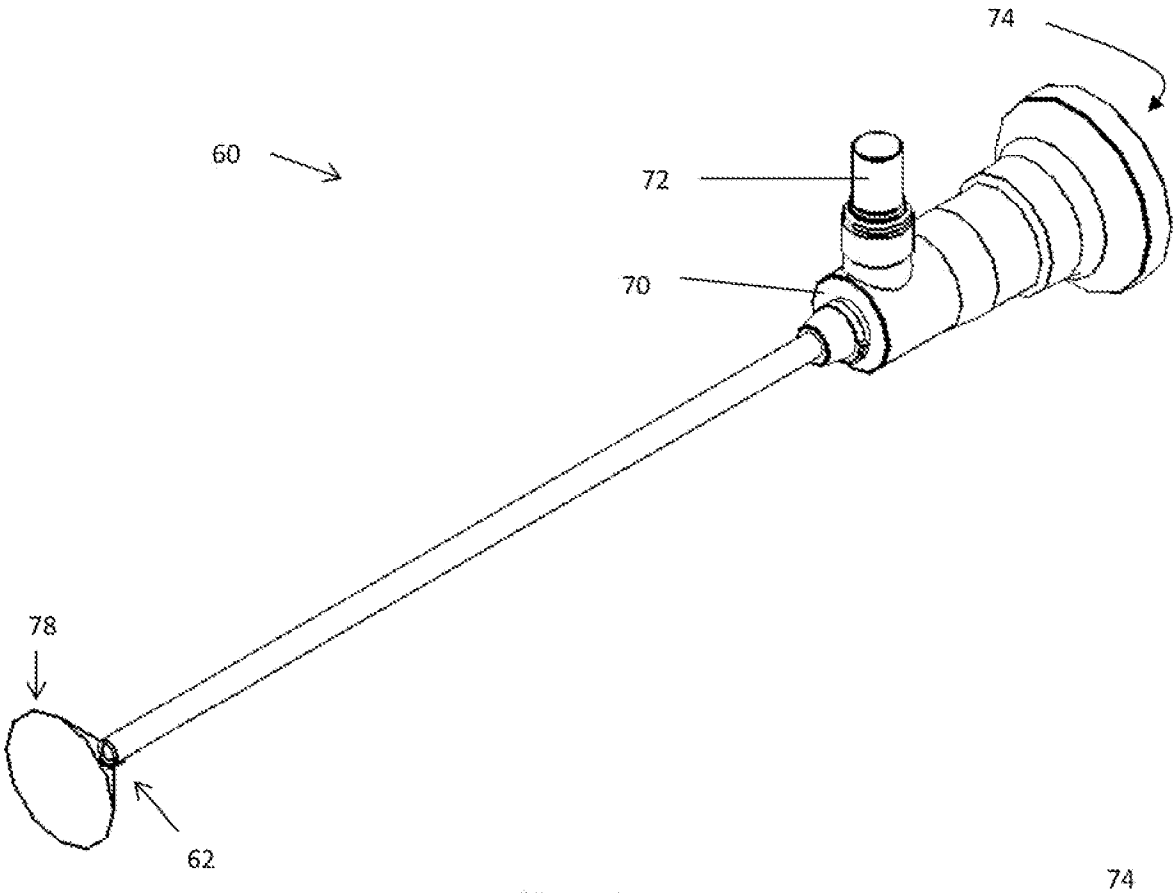


Figure 4A

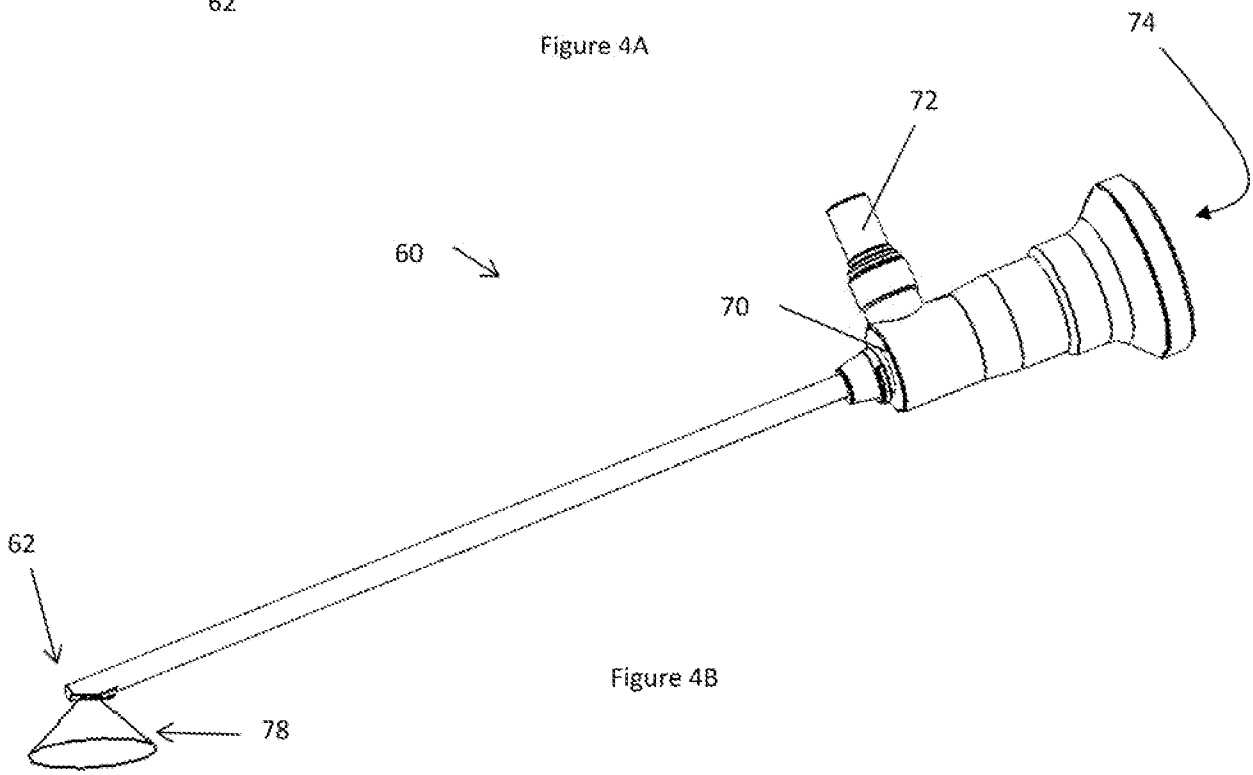


Figure 4B

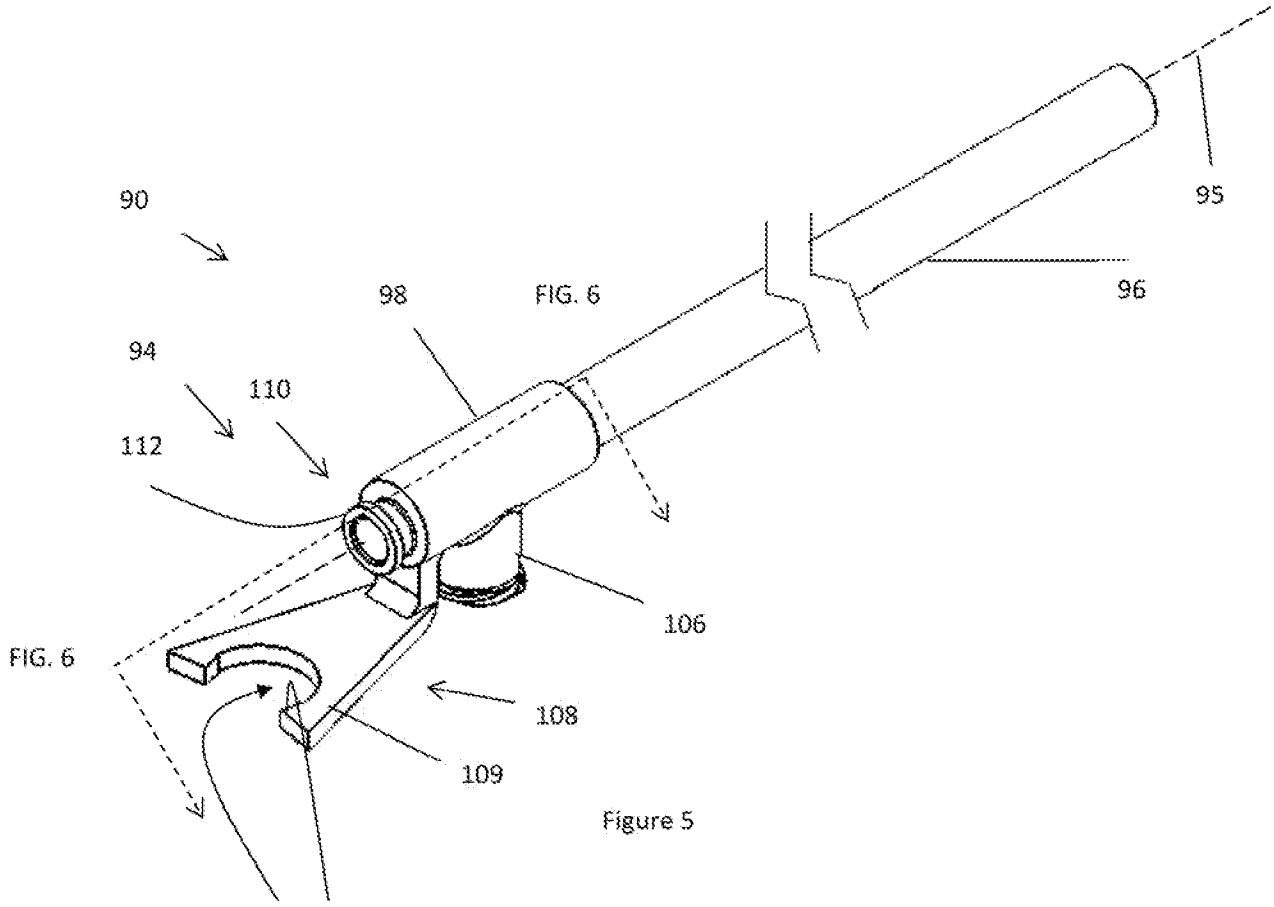


FIG. 6

Figure 5

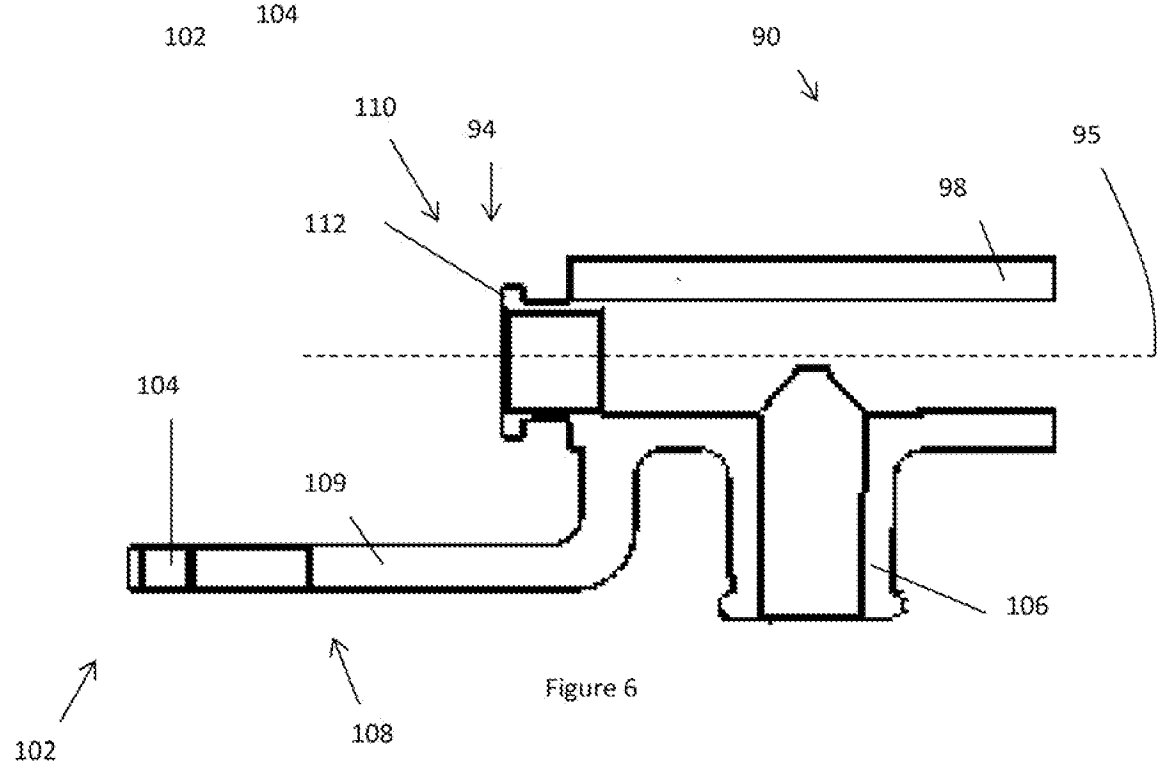


Figure 6

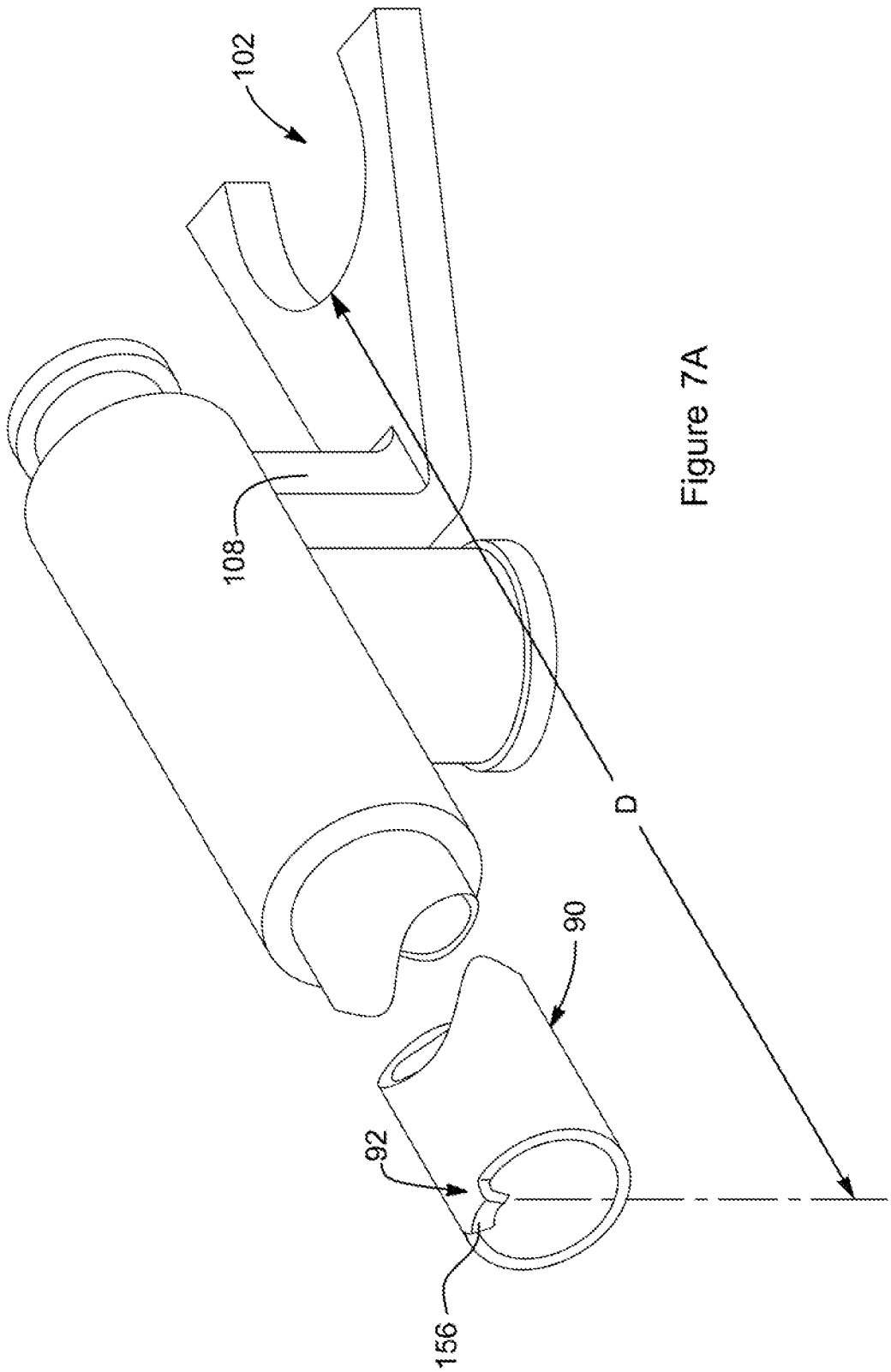


Figure 7A

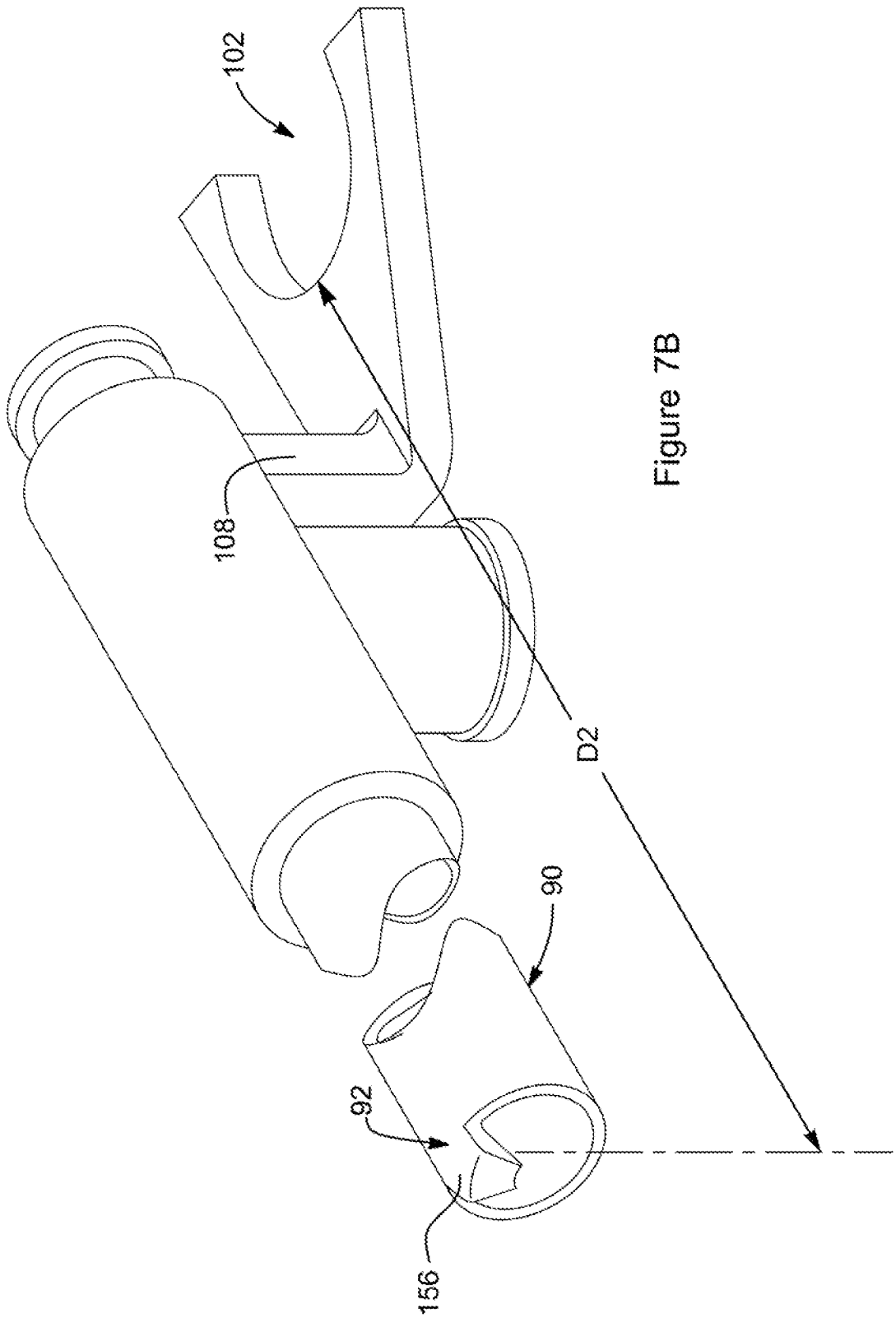


Figure 7B



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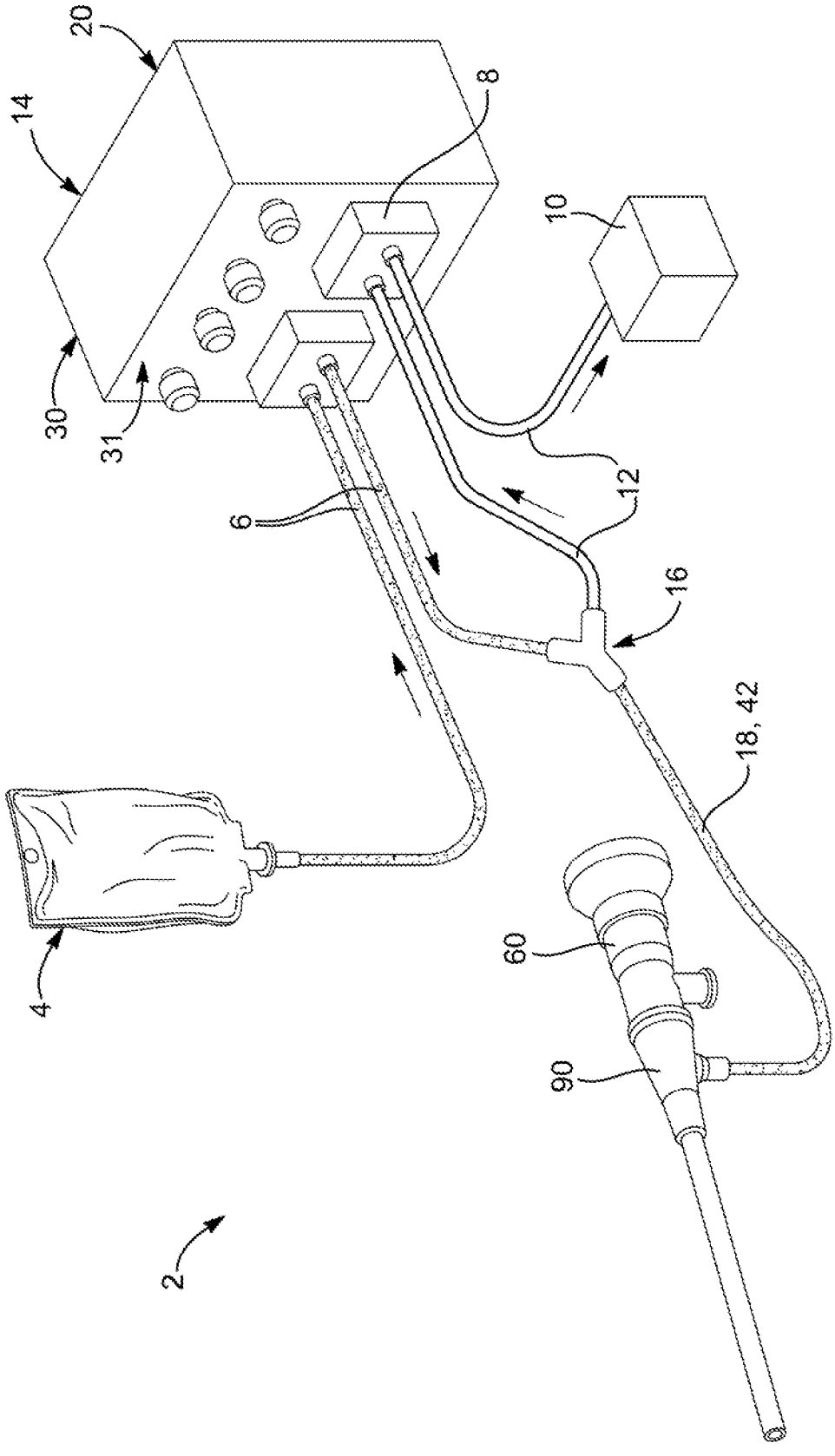


Figure 8



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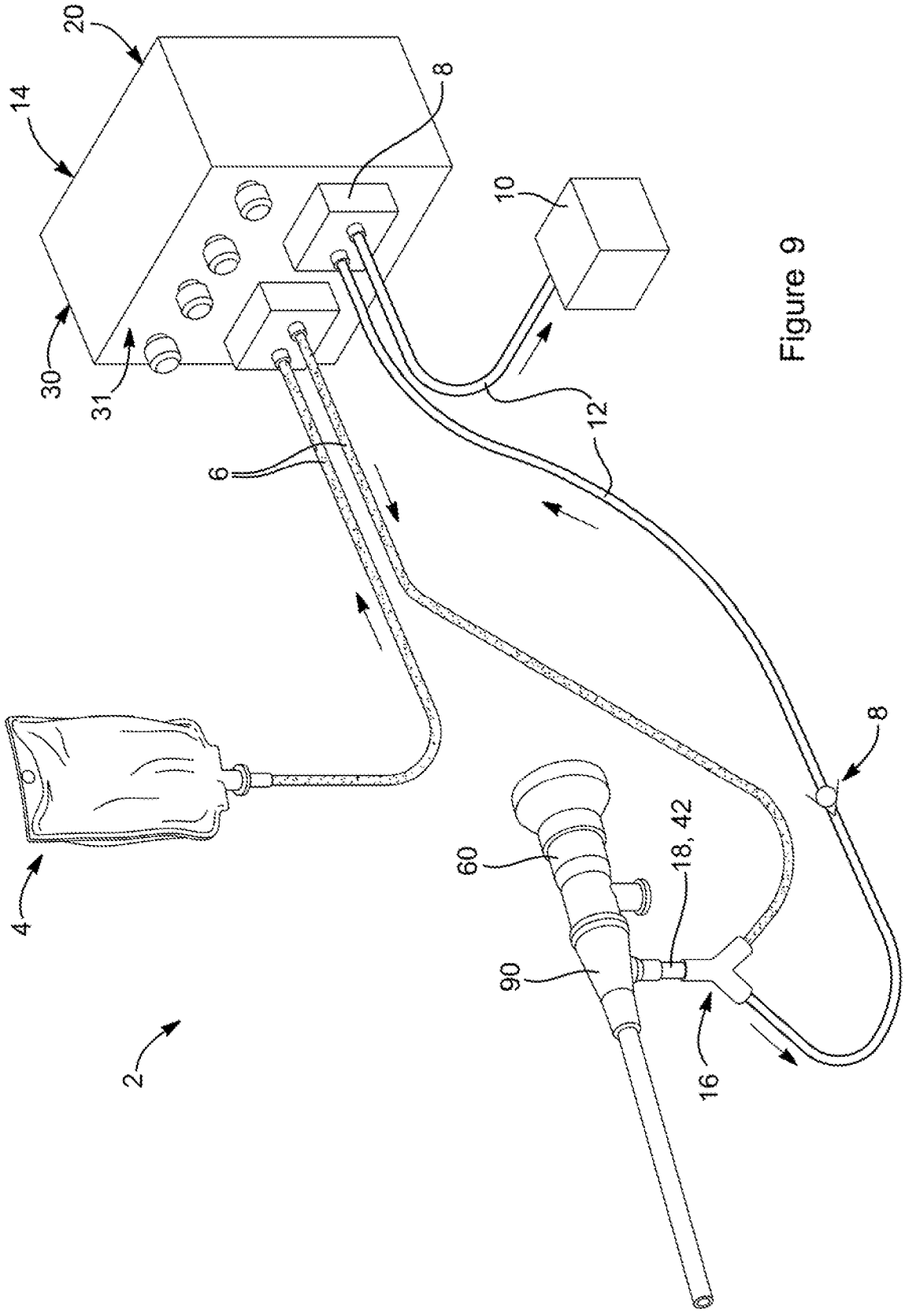


Figure 9

# INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/056911

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B1/07 A61B1/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | US 7 811 228 B2 (ADAMS KENNETH M [US]) 12 October 2010 (2010-10-12) cited in the application column 2, line 55 - column 3, line 27 column 5, line 39 - column 6, line 13; figures 1-5 | 1-5, 8-14, 16-18 |
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 4 December 2014 | 12/12/2014 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Rick, Kai |

# INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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| X | JP 2005 040184 A (OLYMPUS CORP) 17 February 2005 (2005-02-17) paragraph [0020]; figure 1 | 1-5,8, 11-14,16 |
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