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(54) APPARATUS FOR KEEPING CLEAN A DISTAL SCOPE END OF A MEDICAL VIEWING SCOPE

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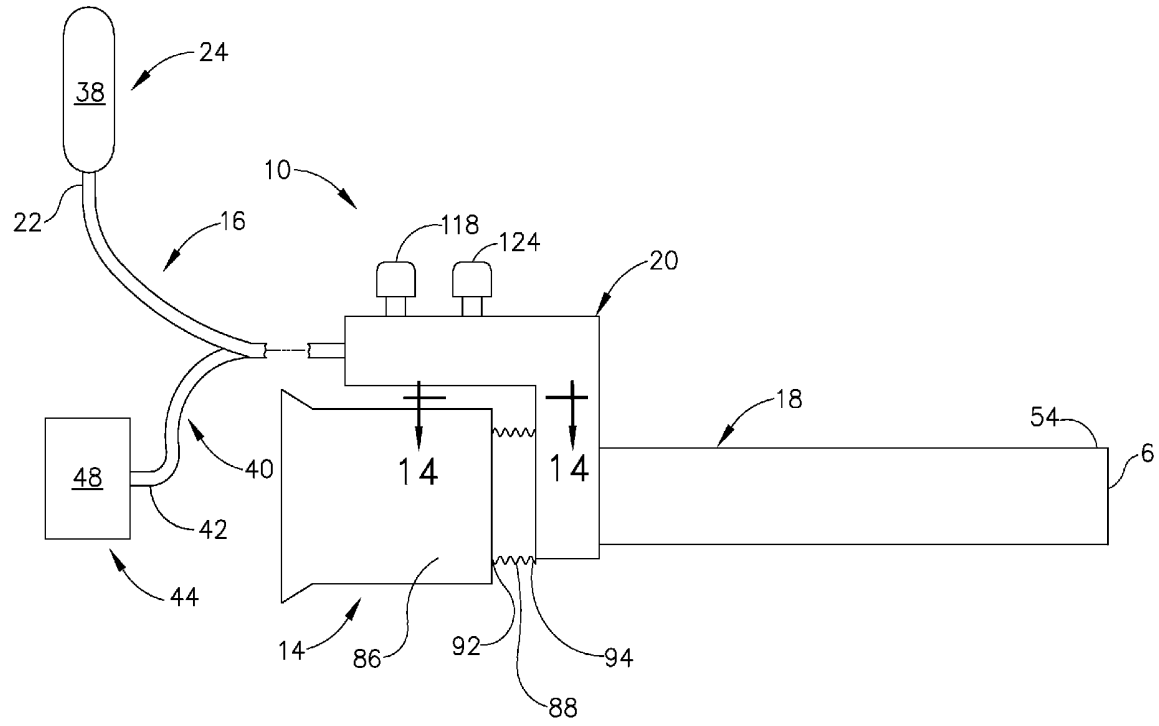
(52) **U.S. Cl.** ..... **600/157**

(57) **ABSTRACT**

A first expression of apparatus for keeping clean a medical viewing scope's distal scope end includes a tube, an annular sheath, and a handpiece. The tube has a proximal end fluidly connectable to irrigation fluid and has a distal end fluidly connected to the handpiece. The sheath is surroundingly attachable to the scope and includes a lumen between the sheath's inside and outside diameters. The lumen has a substantially constant cross-sectional flow area which is substantially equal in area to the tube's cross-sectional flow area. The handpiece is in fluid communication with the proximal lumen end. The distal scope end is positioned proximate the attached sheath's distal lumen end. A second expression of the apparatus has the lumen with a substantially crescent shape without any limitation on its cross-sectional flow area. In an alternate embodiment, the lumen substantially continuously varies in cross-sectional flow area and/or irrigation flow path direction.



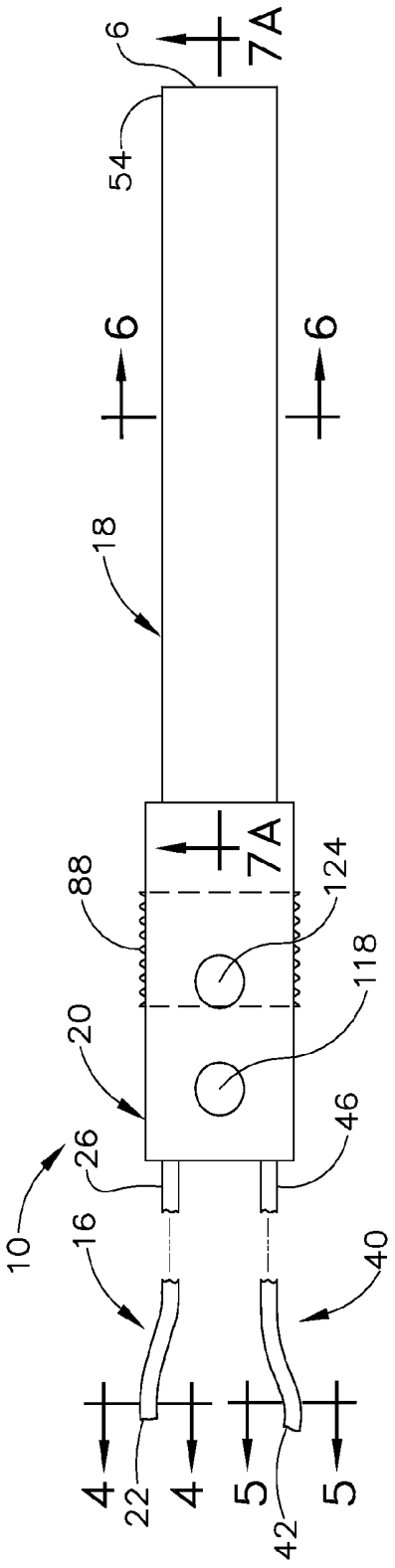

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FIG. 1

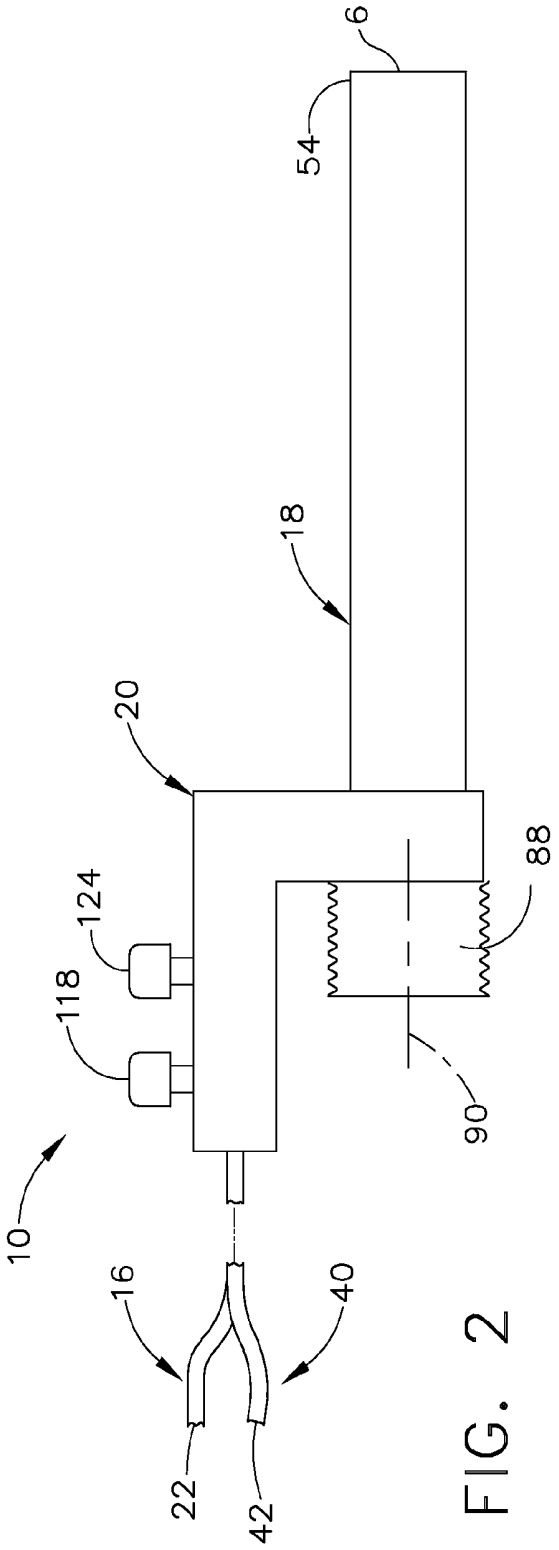
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FIG. 2

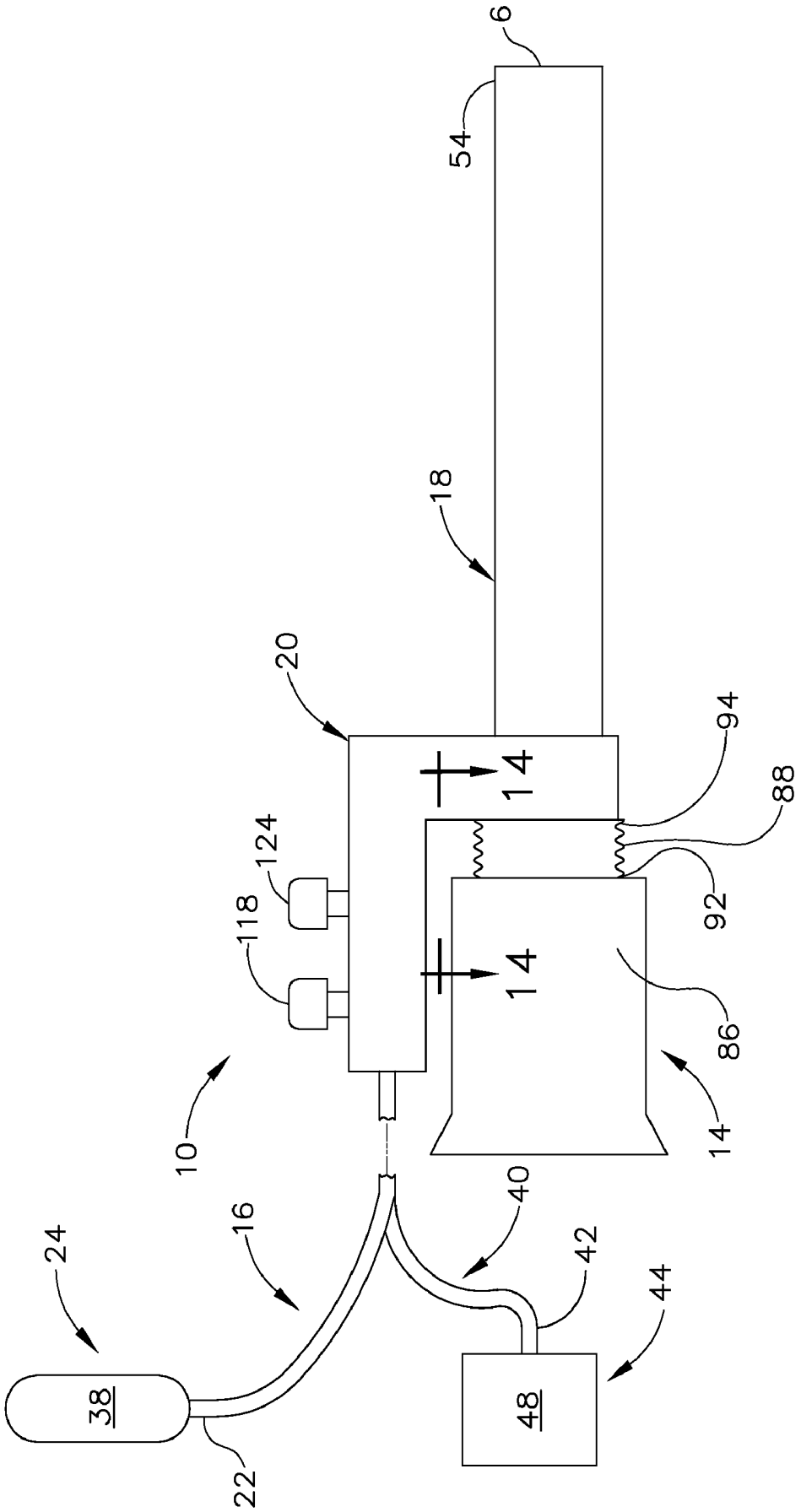


FIG. 3

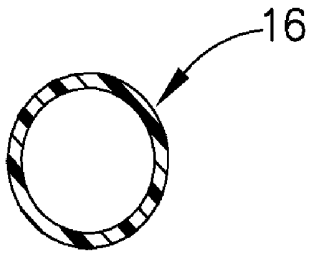


FIG. 4

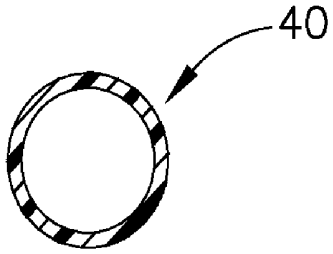


FIG. 5

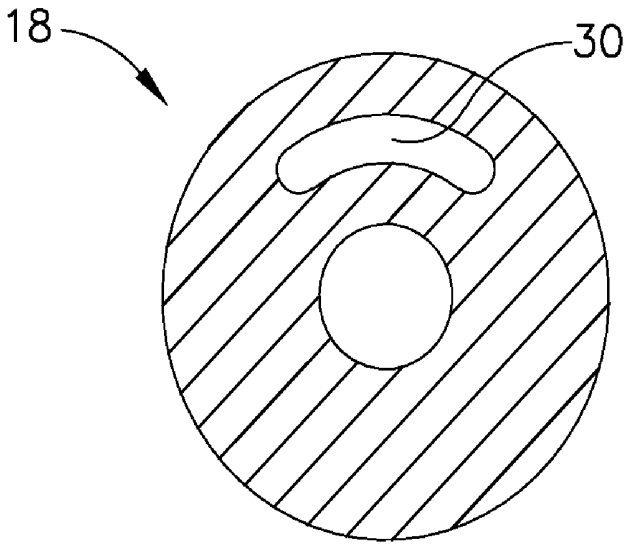


FIG. 6

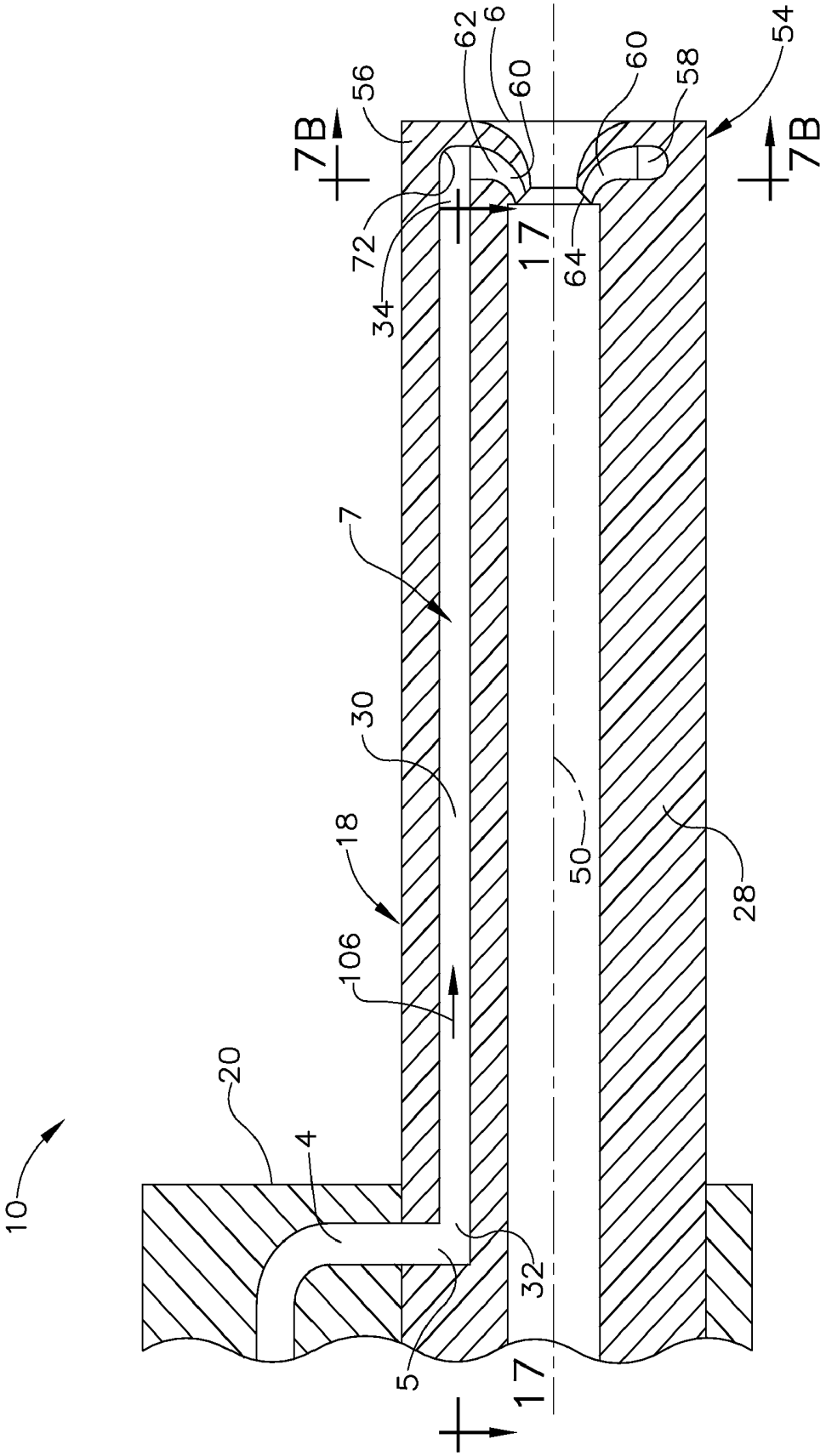


FIG. 7A

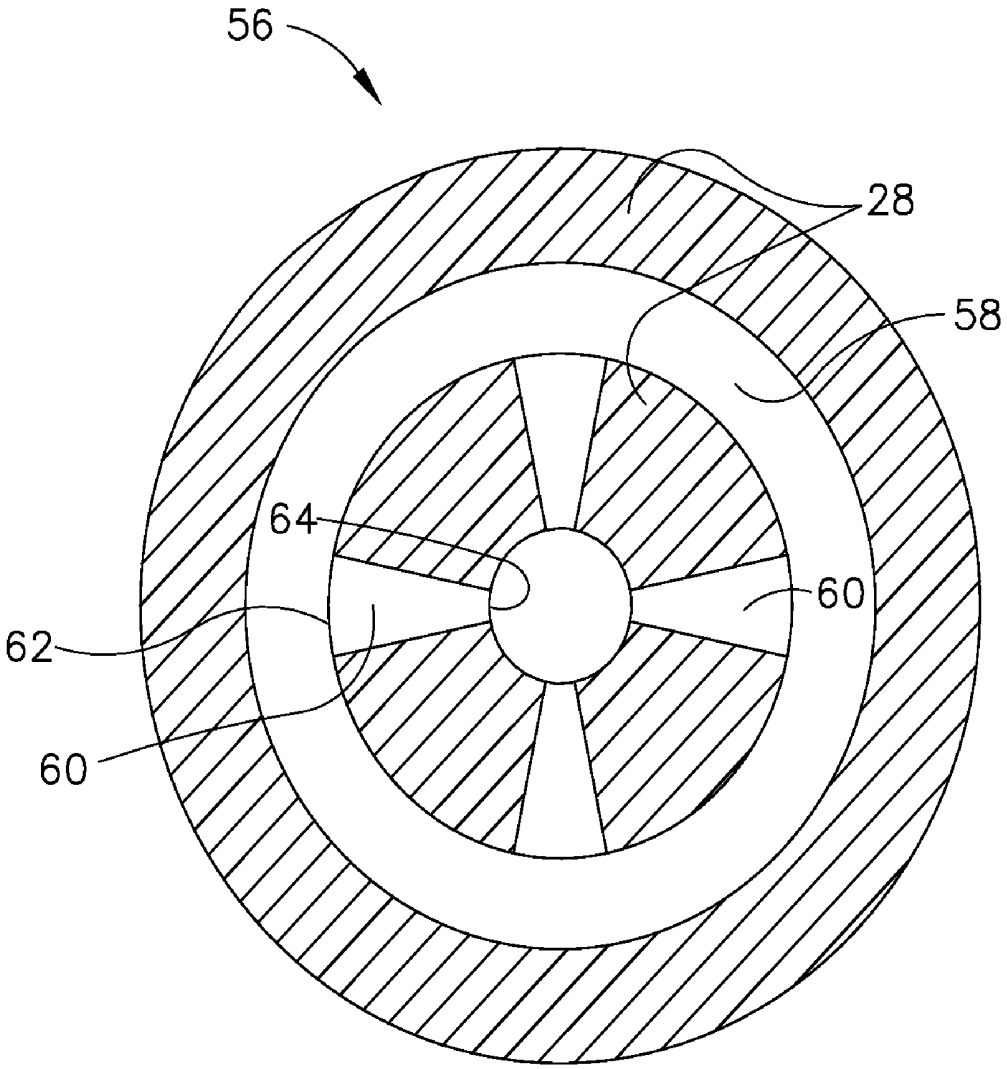


FIG. 7B

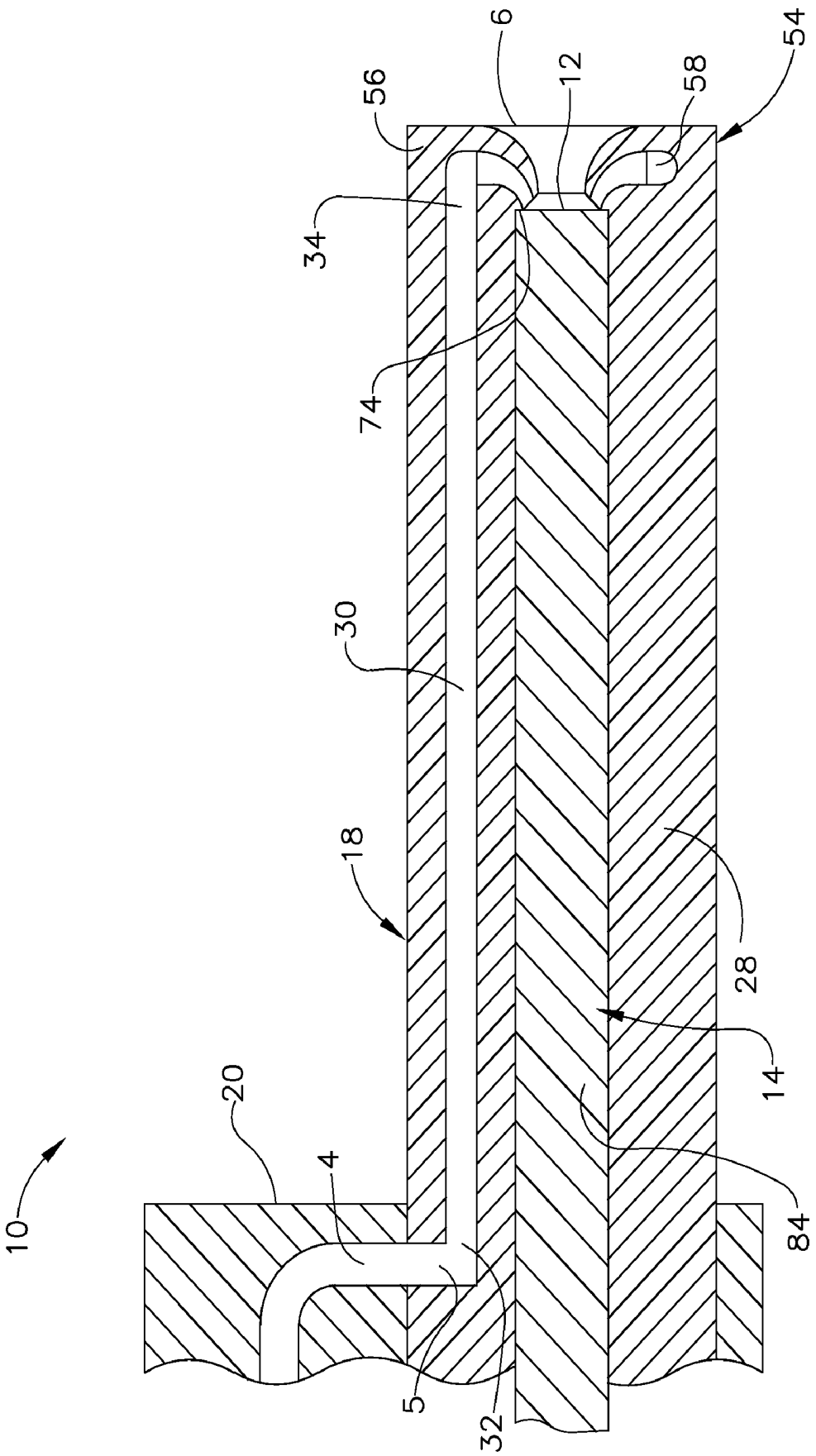


FIG. 8

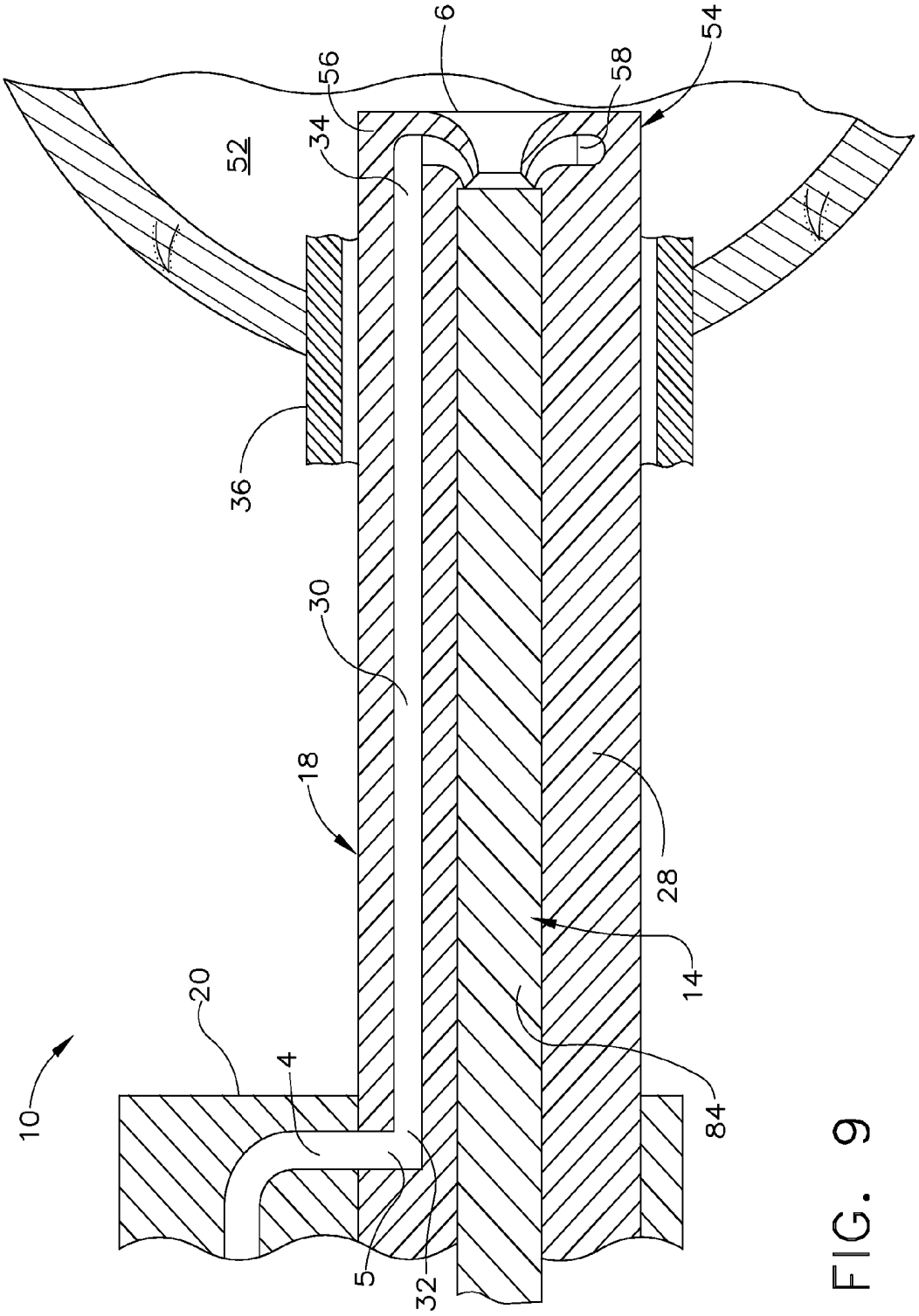


FIG. 9

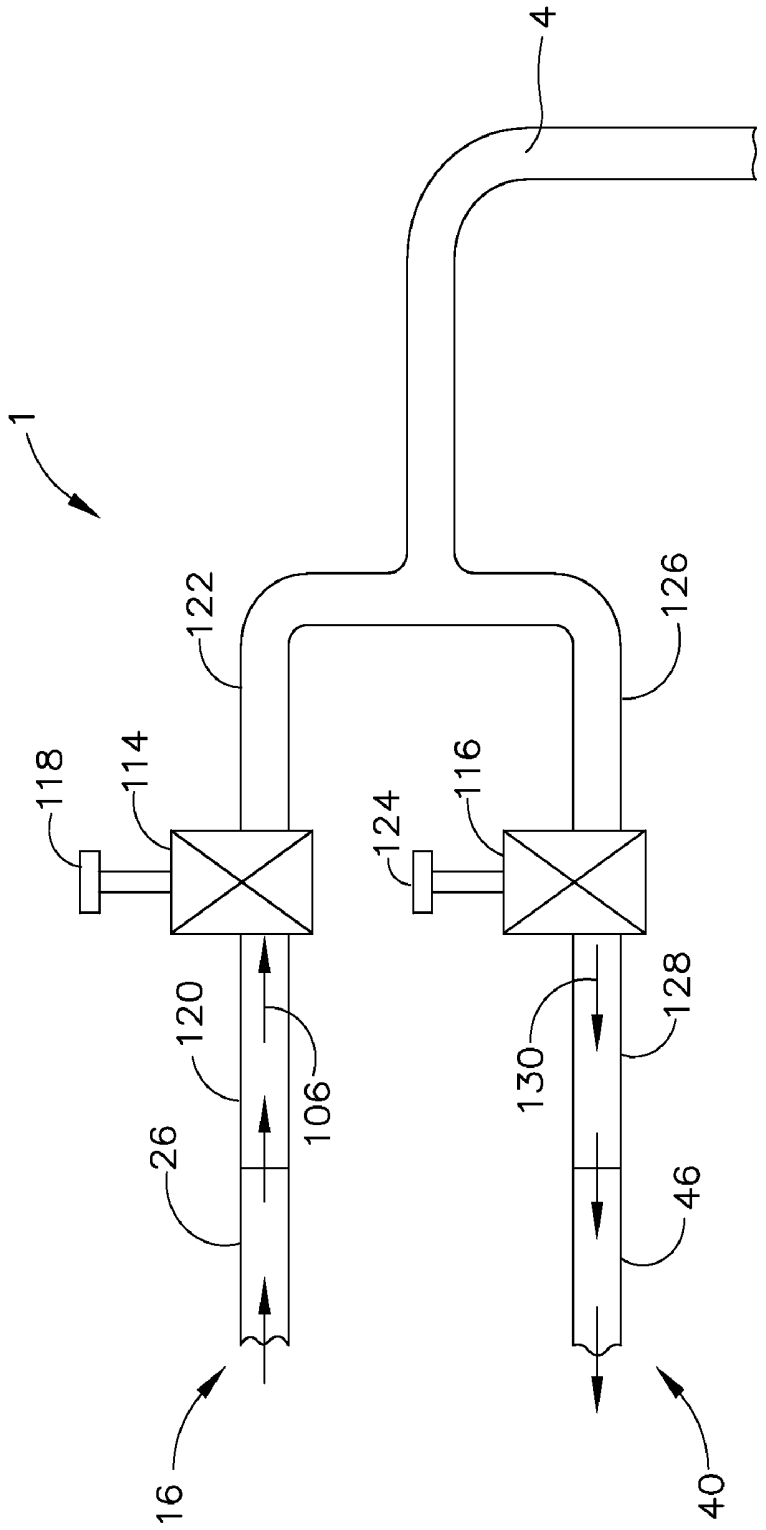


FIG. 10

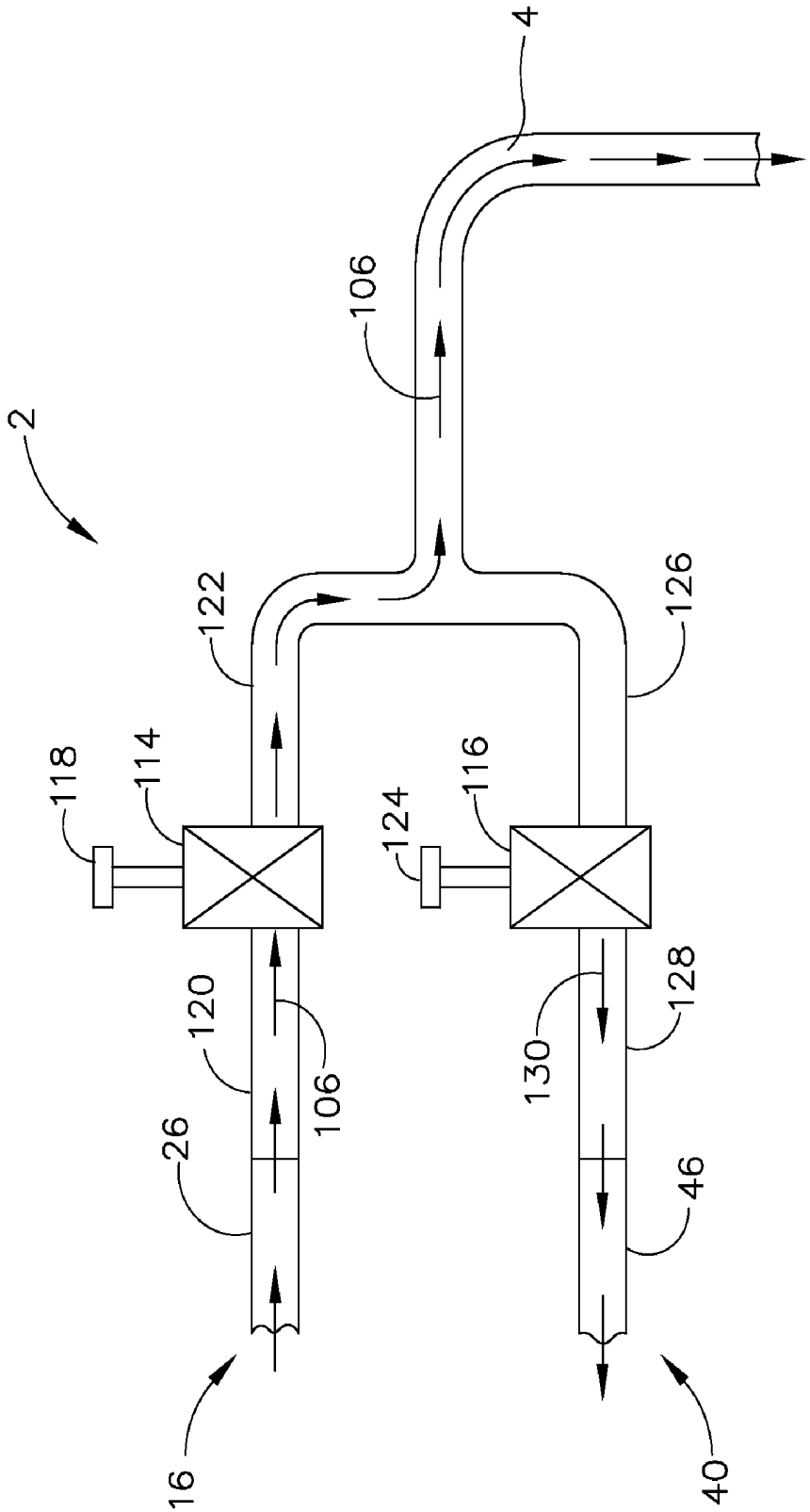


FIG. 11

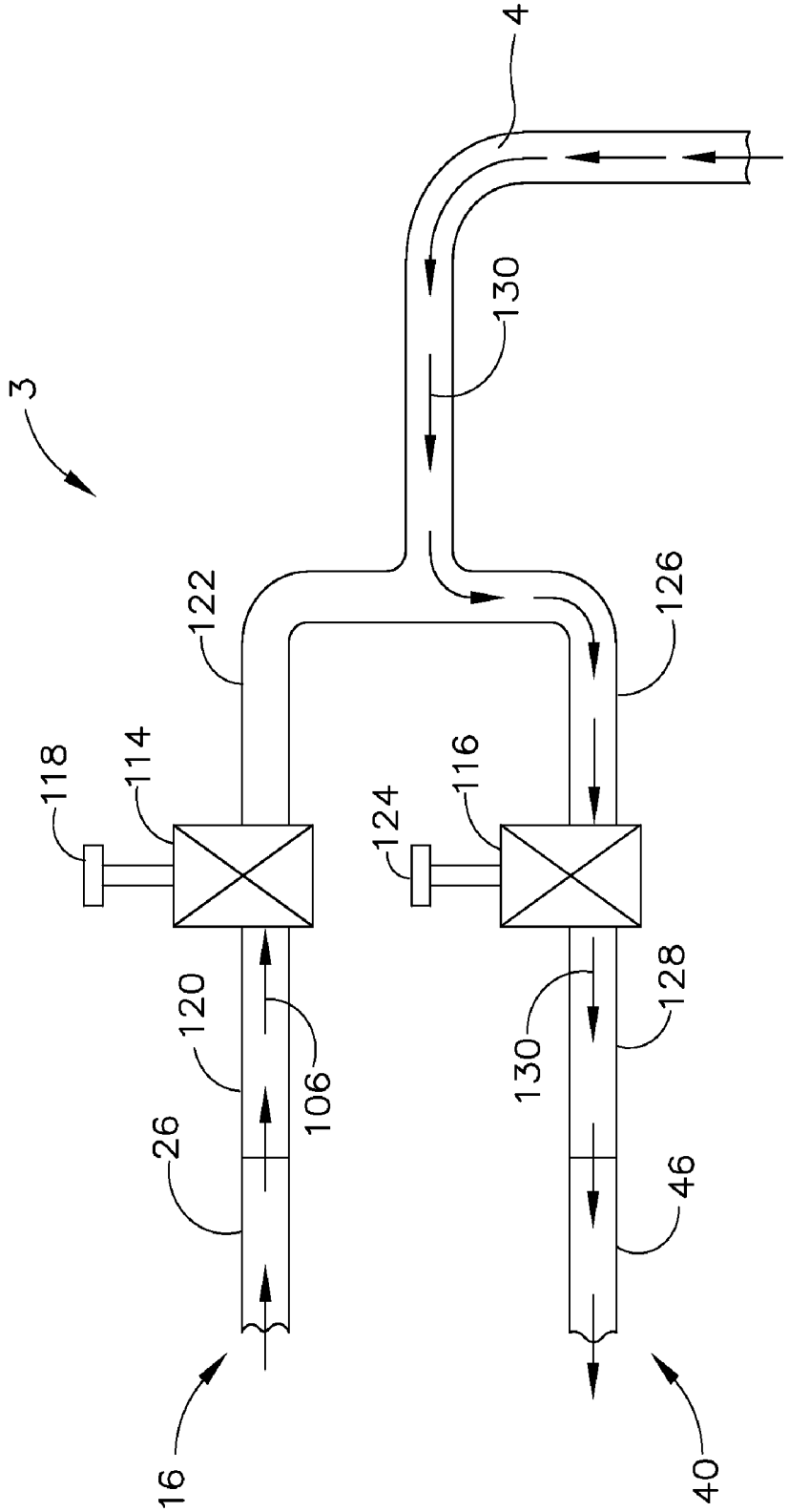


FIG. 12

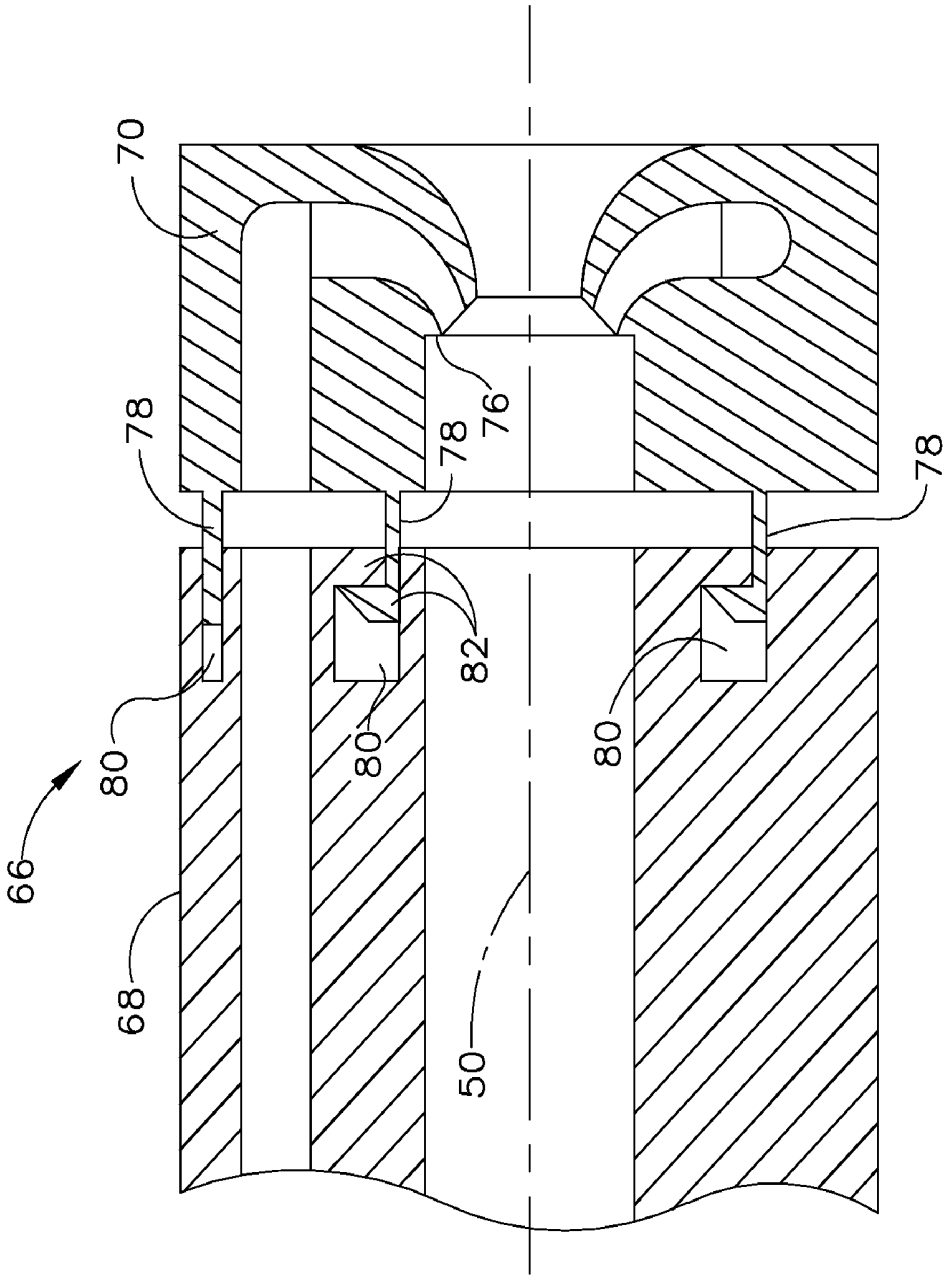


FIG. 13

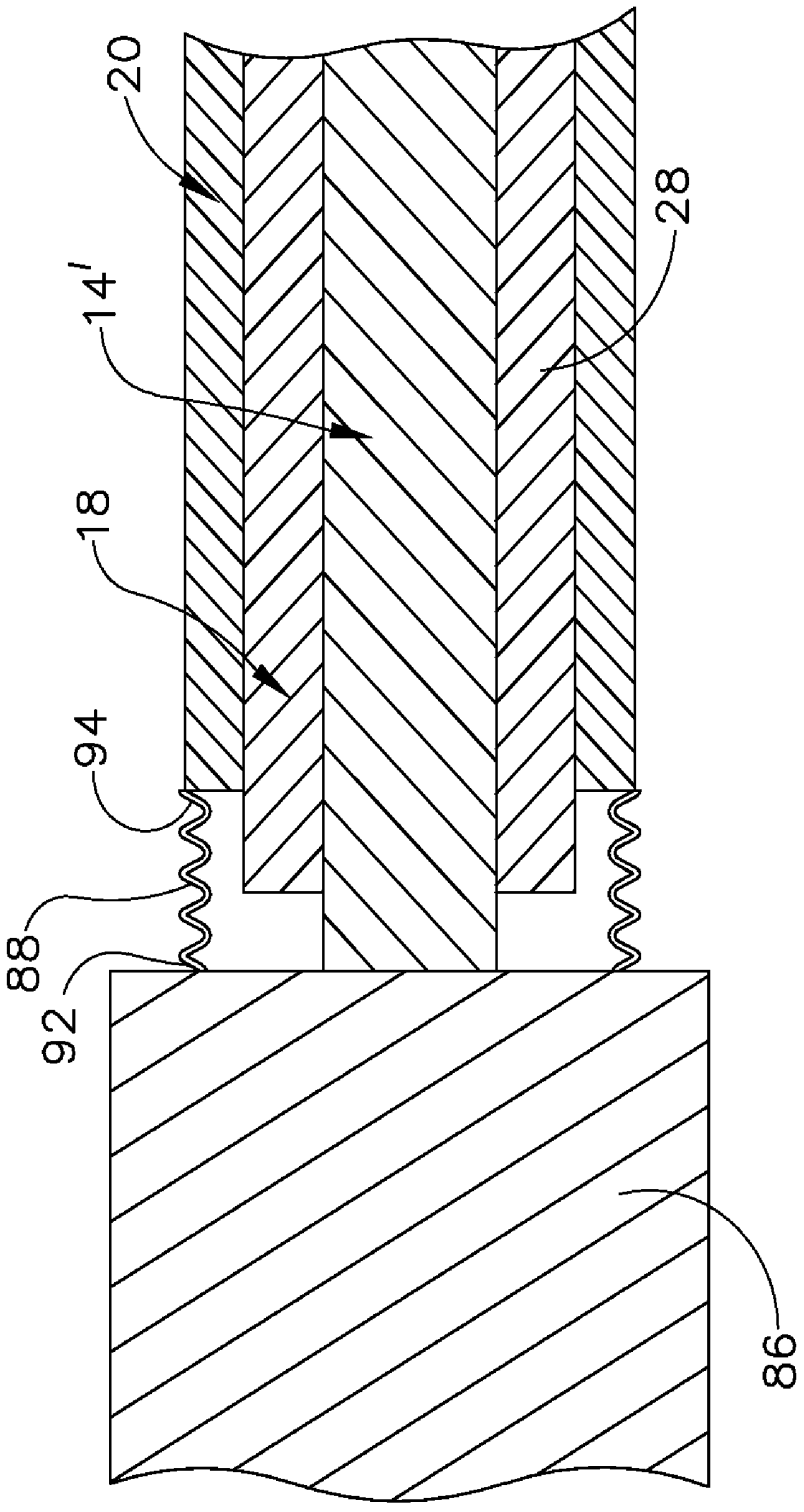


FIG. 14

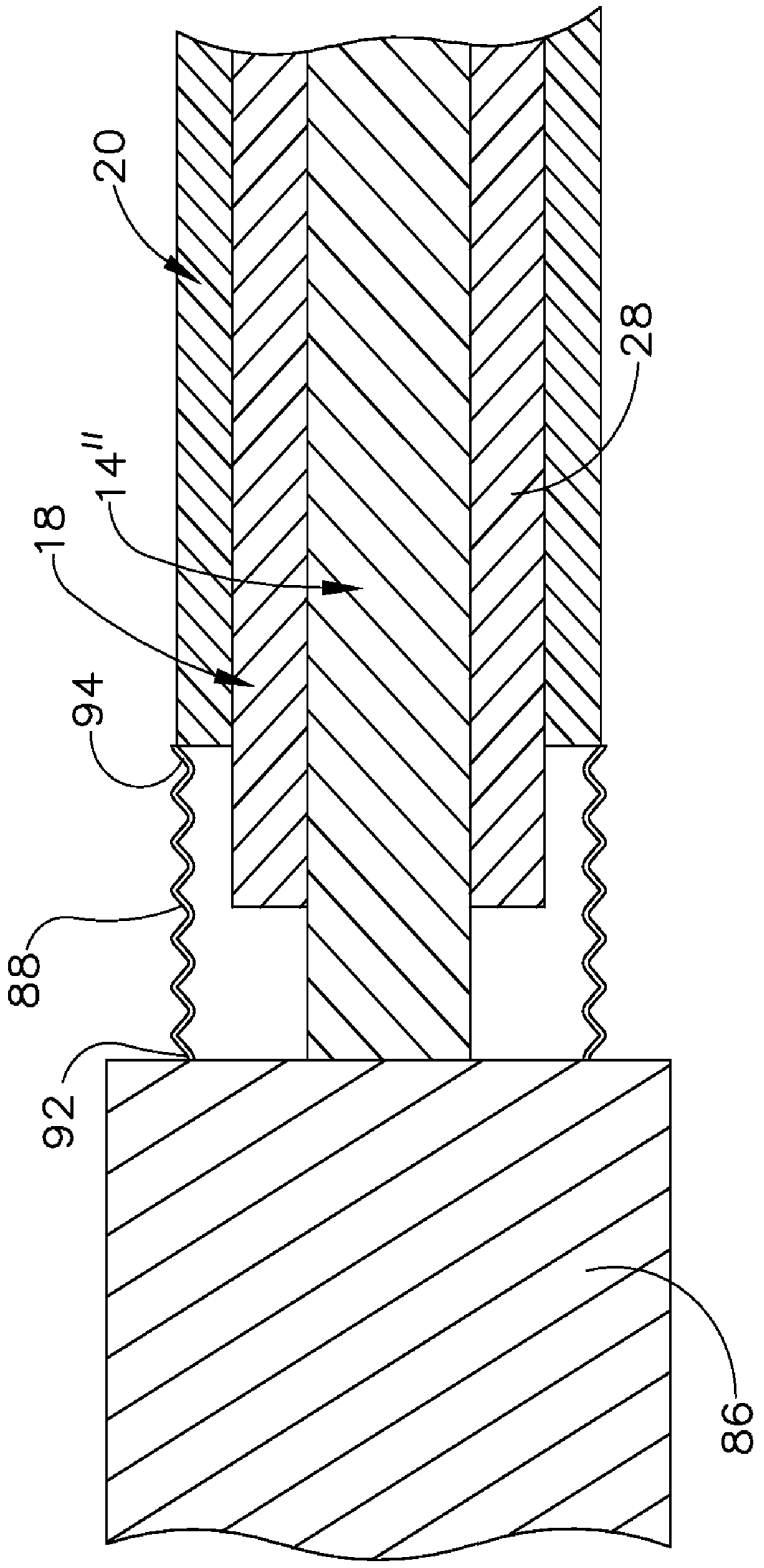


FIG. 15

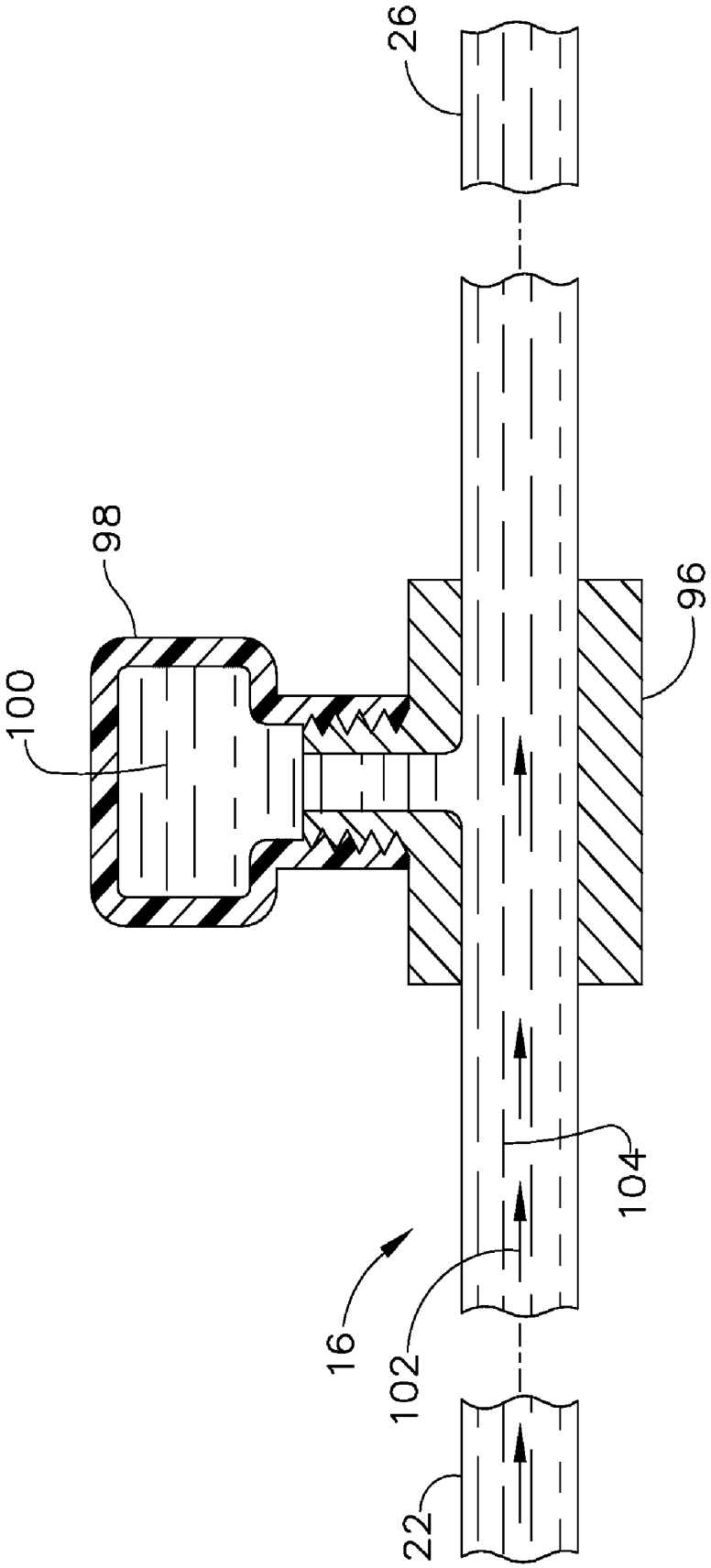


FIG. 16

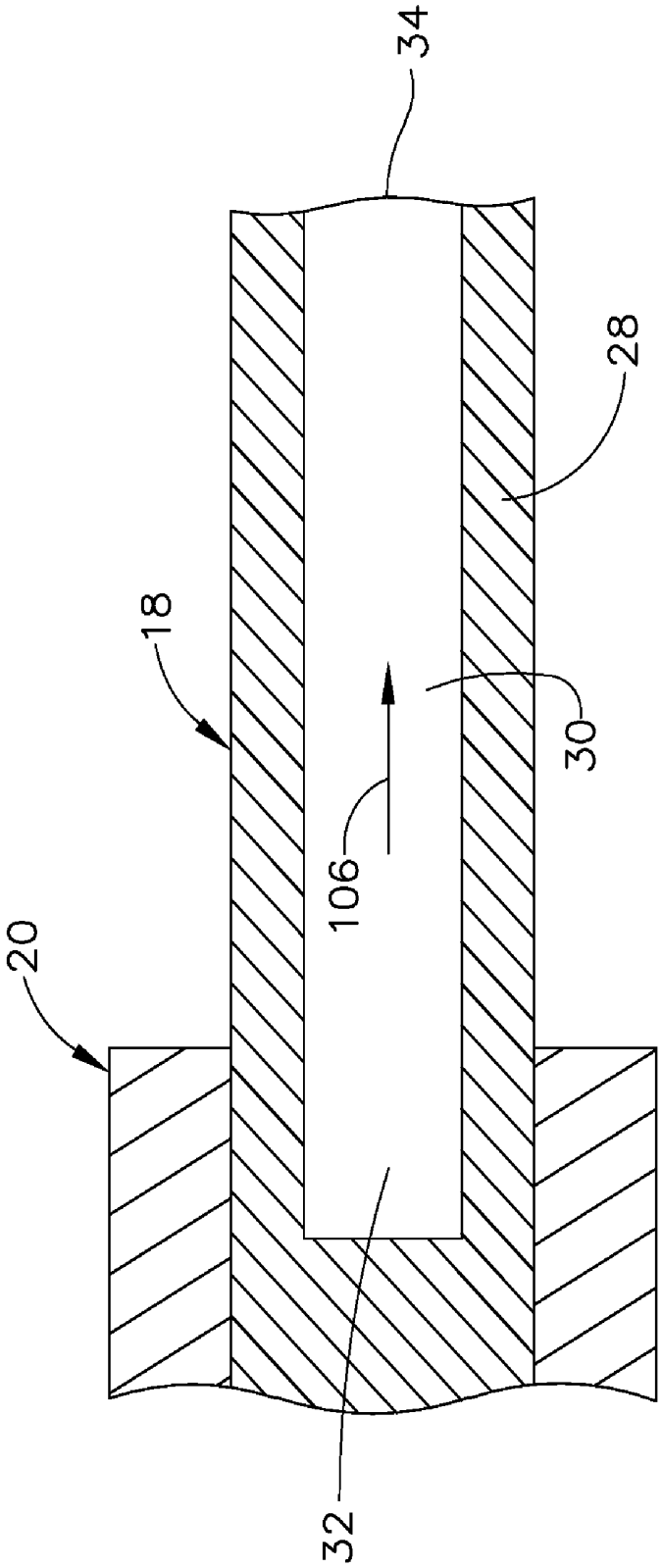


FIG. 17

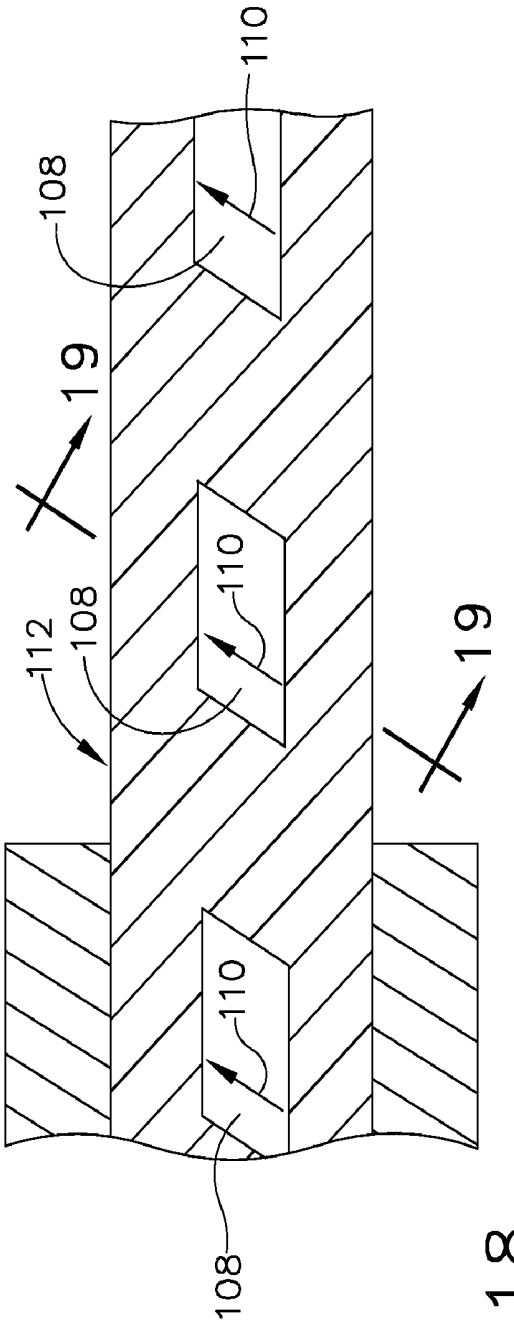


FIG. 18

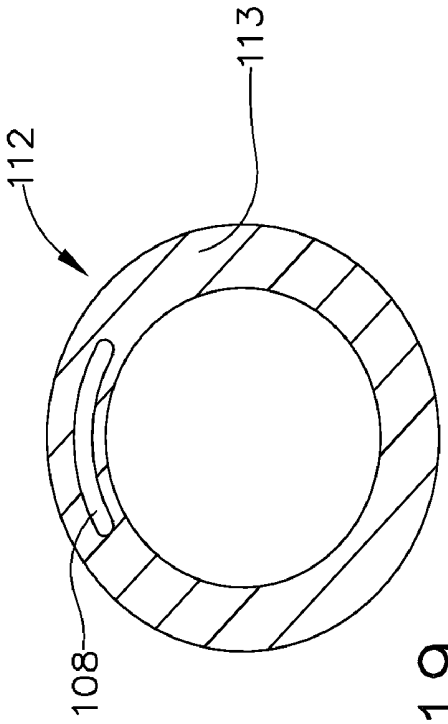


FIG. 19

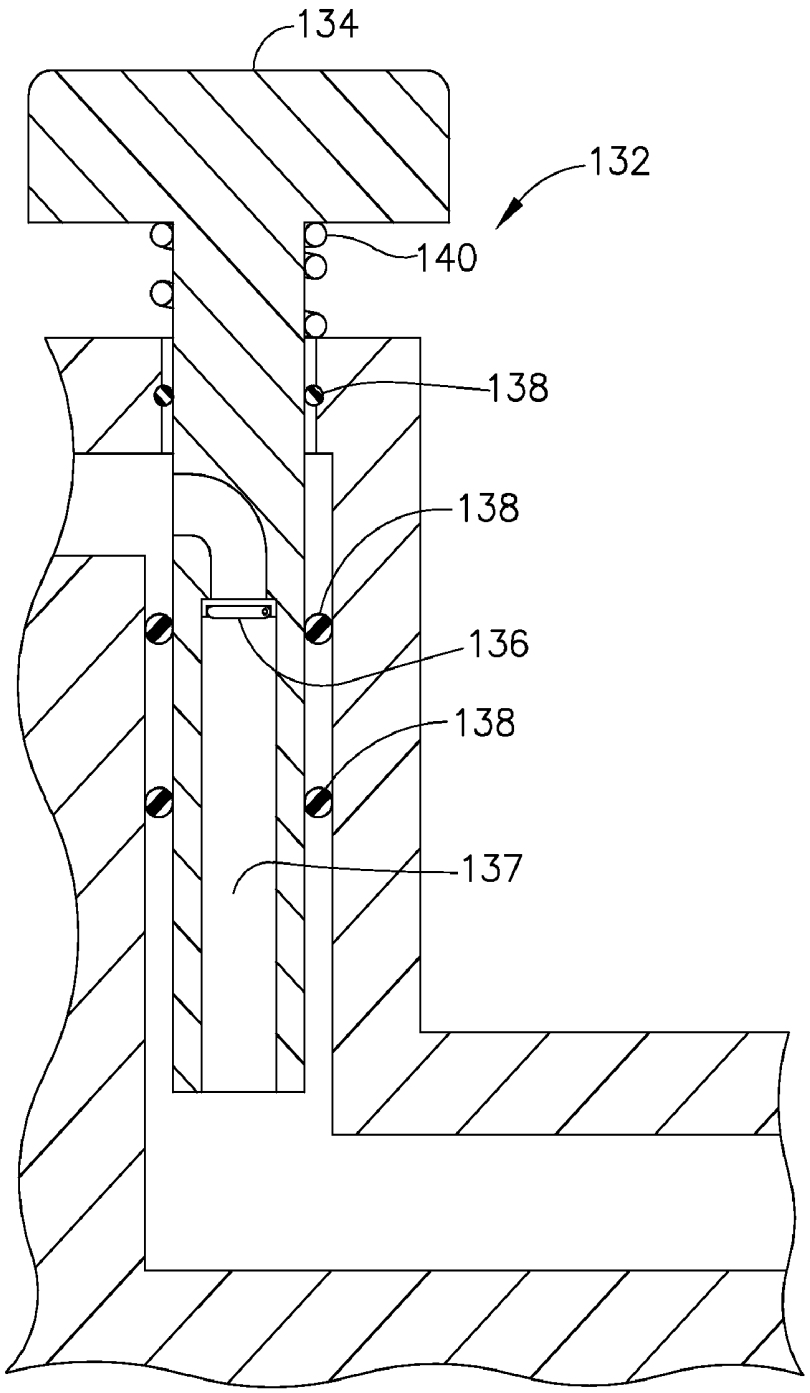


FIG. 20

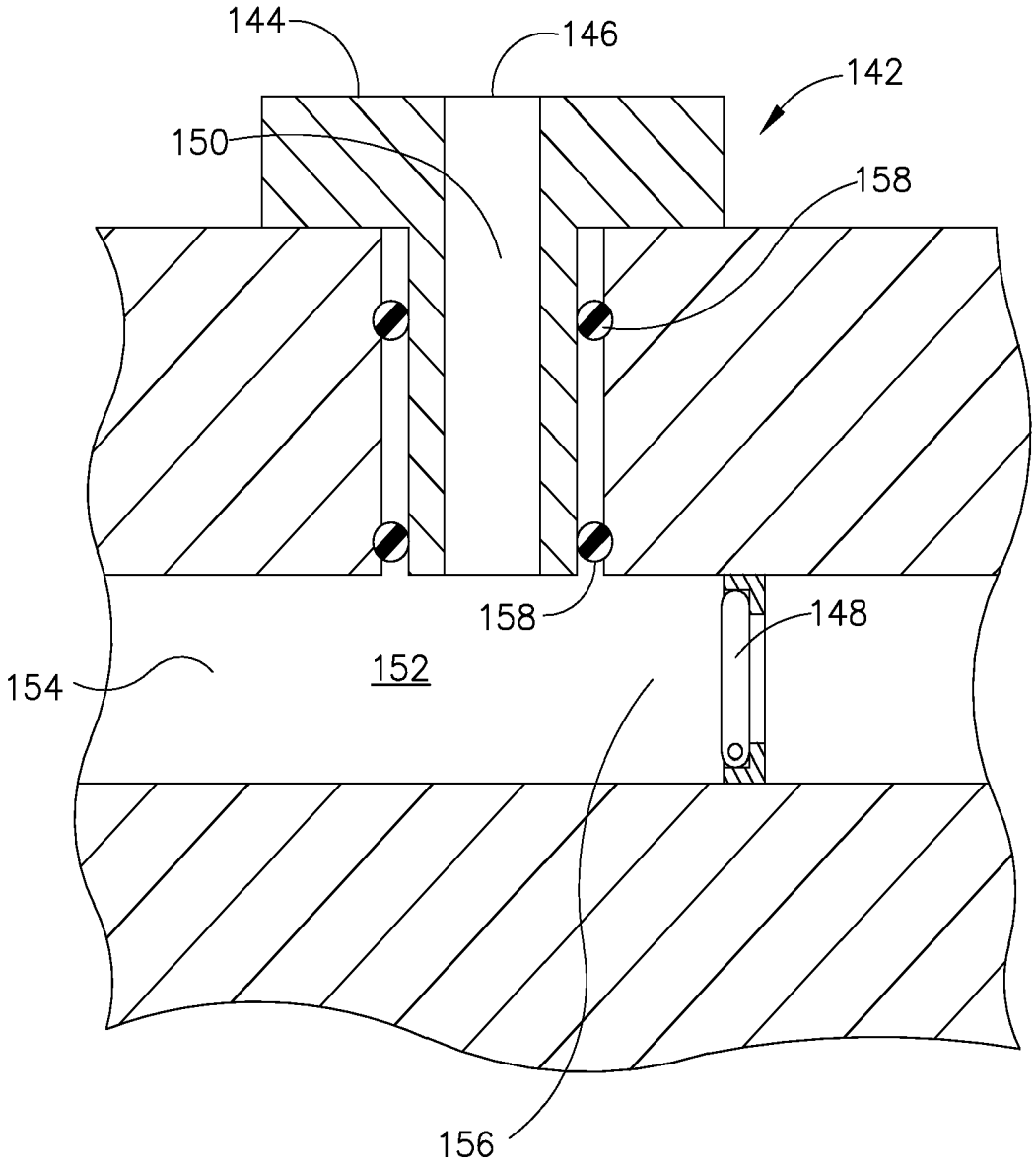


FIG. 21

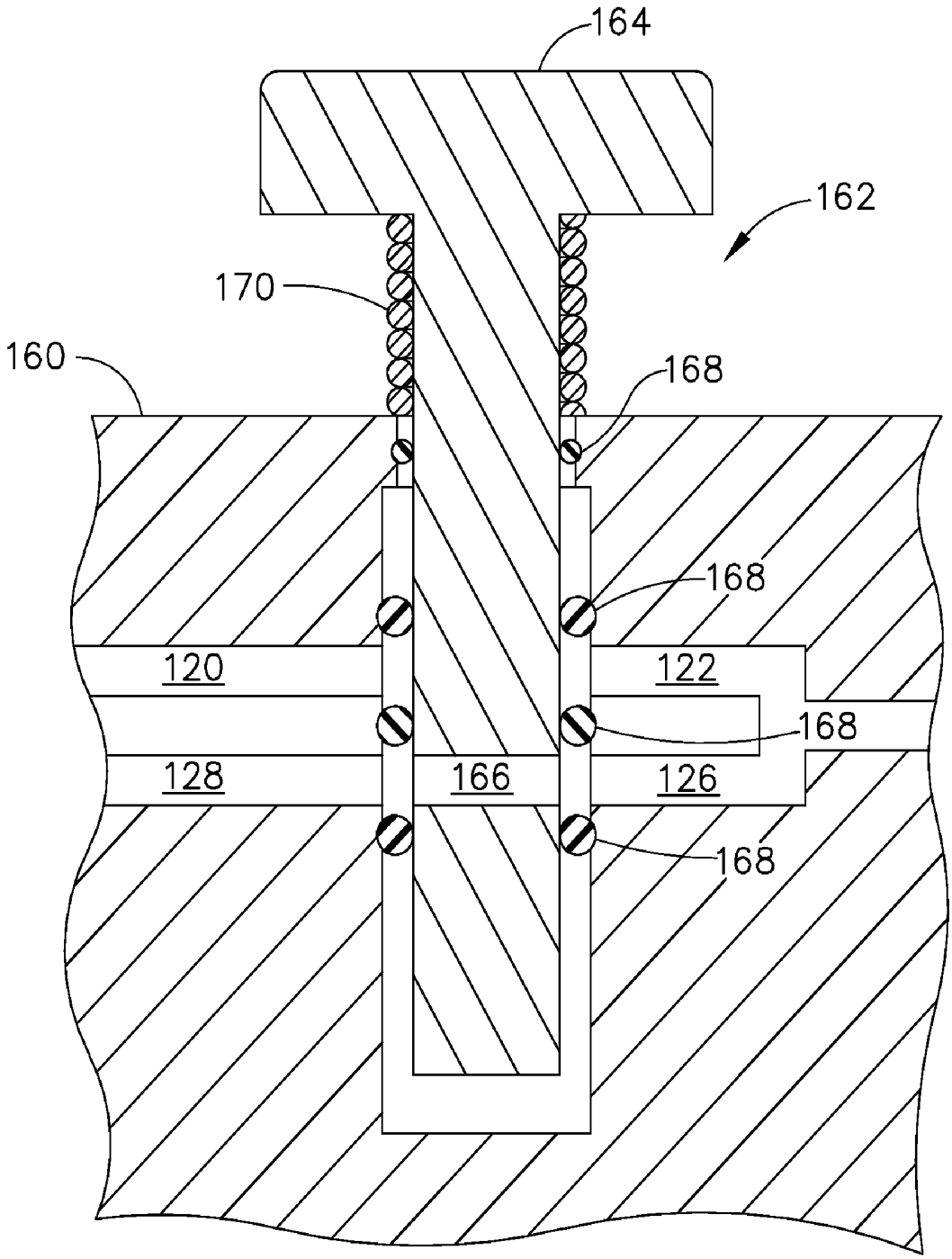


FIG. 22

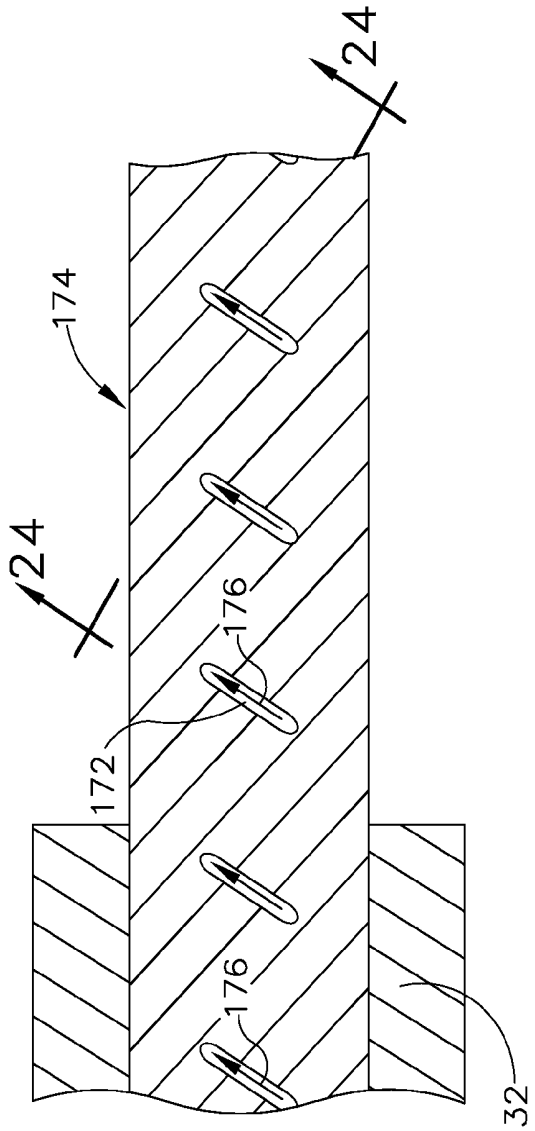


FIG. 23

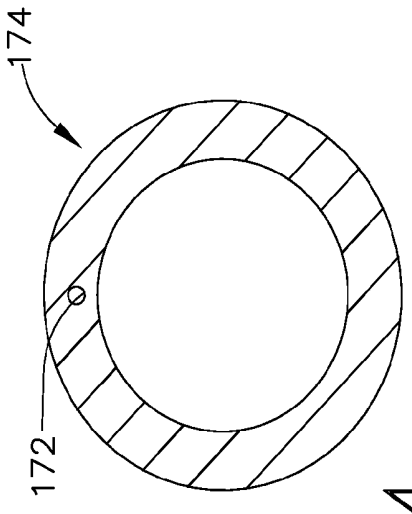


FIG. 24

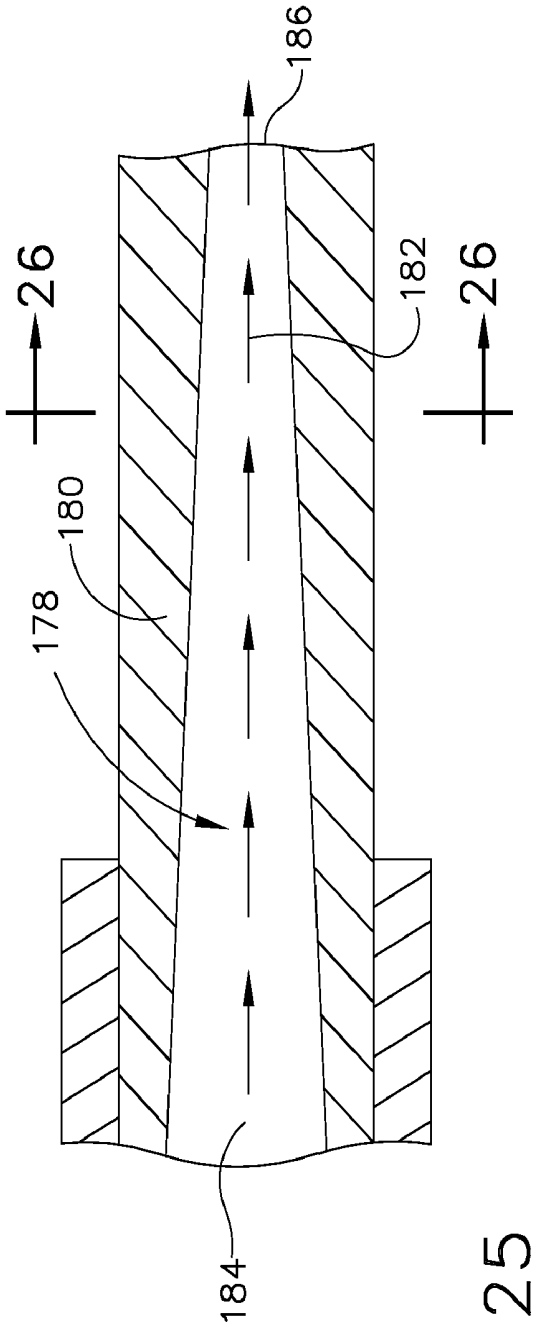


FIG. 25

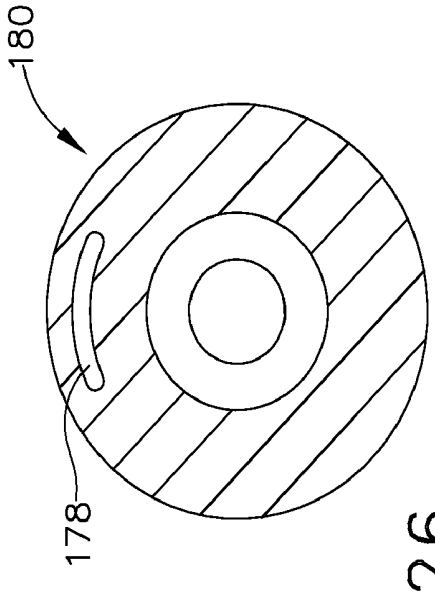


FIG. 26

# APPARATUS FOR KEEPING CLEAN A DISTAL SCOPE END OF A MEDICAL VIEWING SCOPE

## CROSS REFERENCE TO RELATED PATENT APPLICATIONS

**[0001]** This patent application incorporates by reference U.S. patent application Ser. No. 11/542,060 filed Oct. 3, 2006.

## FIELD OF THE INVENTION

**[0002]** The present invention is related generally to medical equipment, and more particularly to apparatus for keeping clean a distal scope end of a medical viewing scope.

## BACKGROUND OF THE INVENTION

**[0003]** During some conventional laparoscopic procedures, first and second trocars are used to create two openings in the patient's abdomen. A rigid laparoscope is inserted through the first trocar to visualize patient tissue. A treating medical instrument is inserted through the second trocar to treat the patient tissue being visualized with the laparoscope. Bodily fluid dispersion and floating debris have a tendency to accumulate on the scope lens of the inserted laparoscope degrading the clarity of the view. Thus, at times during the laparoscopic procedure the laparoscope must be withdrawn from the first trocar and the scope lens wiped to remove the accumulated material which caused the blurred viewing. The removal of the laparoscope is inconvenient and causes delays in the laparoscopic procedure. Upon reinsertion of the laparoscope, it is necessary for the physician to take additional time to maneuver the scope to reacquire the patient tissue of interest.

## SUMMARY

**[0004]** A first expression of a first embodiment of the invention is for apparatus for keeping clean a distal scope end of a medical viewing scope. The apparatus includes a first tube, an annular sheath, and a handpiece. The first tube has a first proximal tube end fluidly connectable to an irrigation fluid source, has a first distal tube end, and has a substantially constant first cross-sectional flow area. The sheath is surroundingly attachable to the scope, wherein the sheath includes a tubular wall having inside and outside diameters and containing a lumen between the inside and outside diameters. The lumen has proximal and distal lumen ends, wherein the lumen has a substantially constant cross-sectional flow area which is substantially equal in area to the first cross-sectional flow area. The distal scope end is positioned proximate the distal lumen end of the attached sheath. The handpiece is mounted to the sheath, is fluidly connected to the first distal tube end, and is in fluid communication with the proximal lumen end. The handpiece is adapted to have a user-selectable first internal flow configuration preventing fluid communication between the first distal tube end and the proximal lumen end and a user-selectable second internal flow configuration allowing fluid communication between the first distal tube end and the proximal lumen end.

**[0005]** A second expression of a first embodiment of the invention is for apparatus for keeping clean a distal scope end of a medical viewing scope. The apparatus includes first and second tubes, an annular sheath, and a handpiece. The first tube has a first proximal tube end fluidly connectable to an irrigation fluid source and has a first distal tube end. The second tube has a second proximal tube end fluidly connectable to a vacuum source and has a second distal tube end. The sheath is surroundingly attachable to the scope, wherein the sheath includes a tubular wall having inside and outside diameters and containing a lumen between the inside and outside diameters. The lumen has proximal and distal lumen ends, wherein the lumen has a cross-sectional flow area which has a substantially crescent shape. The distal scope end is positioned proximate the distal lumen end of the attached sheath. The handpiece is mounted to the sheath, is fluidly connected to the first and second distal tube ends, and is in fluid communication with the proximal lumen end. The handpiece is adapted to have a user-selectable first internal flow configuration preventing fluid communication between the first distal tube end and the proximal lumen end and between the second distal tube end and the proximal lumen end, a user-selectable second internal flow configuration allowing fluid communication between the first distal tube end and the proximal lumen end but not between the second distal tube end and the proximal lumen end, and a user-selectable third internal flow configuration allowing fluid communication between the second distal tube end and the proximal lumen end but not between the first distal tube end and the proximal lumen end.

**[0006]** A third expression of a first embodiment of the invention is for apparatus for keeping clean a distal scope end of a medical viewing scope. The apparatus includes first and second tubes, an annular sheath, and a handpiece. The first tube has a first proximal tube end fluidly connectable to an irrigation fluid source, has a first distal tube end, and has a substantially constant first cross-sectional flow area. The second tube has a second proximal tube end fluidly connectable to a vacuum source and has a second distal tube end. The sheath has a central longitudinal axis, is surroundingly attachable to the scope, and is insertable into a patient. The sheath includes a tubular wall having inside and outside diameters and containing a lumen between the inside and outside diameters. The lumen has proximal and distal lumen ends, wherein the lumen has a substantially constant cross-sectional flow area which is substantially equal in area to the first cross-sectional flow area of the first tube. The sheath includes a distal sheath end portion defining a manifold. The manifold has an annular fluid passageway which has a volume and which is in fluid communication with the distal lumen end. The manifold has a plurality of spaced apart nozzle passageways which together have a total volume, which are in fluid communication with the annular fluid passageway, and which point proximal of the annular fluid passageway. The volume of the annular fluid passageway is greater than the total volume of the nozzle passageways. The distal scope end is positioned proximate the nozzle passageways of the attached sheath. The handpiece is mounted to the sheath, is fluidly connected to the first and second distal tube ends, and is in fluid communication with the proximal lumen end. The handpiece is adapted to have a user-selectable first internal flow configuration preventing fluid communication between the first distal tube end and the proximal lumen end and between the second distal tube end and the proximal lumen end, a user-selectable second internal flow configuration allowing fluid communication between the first distal tube end and the proximal lumen end but not between the second distal tube end and the proximal lumen end, and a user-selectable third internal flow configuration allowing fluid communication

between the second distal tube end and the proximal lumen end but not between the first distal tube end and the proximal lumen end.

**[0007]** A first expression of a second embodiment of the invention is for apparatus for keeping clean a distal scope end of a medical viewing scope. The apparatus includes an annular sheath surroundingly attachable to the scope. The sheath includes a tubular wall having inside and outside diameters and containing a lumen between the inside and outside diameters. The lumen has proximal and distal lumen ends. The lumen substantially continuously varies in at least one of cross-sectional flow area and irrigation flow path direction. The proximal lumen end is fluidly connectable to at least one of an irrigation fluid source and a vacuum source. The distal scope end is positioned proximate the distal lumen end of the attached sheath.

**[0008]** Several benefits and advantages are obtained from one or more of the expressions of embodiments of the invention which provide for keeping clean a distal scope end of a medical viewing scope while the scope remains inserted in a patient. In one example, not removing the scope for cleaning and not reinserting the cleaned scope reduces the time for a laparoscopic procedure. In the same or a different example, not removing the scope for cleaning and not reinserting the cleaned scope keeps the inserted scope aligned with the patient tissue of interest during cleaning so that the physician does not have to take additional time to maneuver the scope to reacquire the patient tissue of interest. In one example of the first and third expressions of the first embodiment, the substantially equal areas reduce flow losses and provide faster response times for irrigation fluid to exit the lumen of the sheath to clean the distal scope end or to clean a magnifying or non-magnifying optional lens (transparent shield) of the sheath which protects the distal scope end.

## BRIEF DESCRIPTION OF THE FIGURES

**[0009]** FIG. **1** is a schematic top view of a first embodiment of the invention including first and second tubes, an annular sheath, a bellows shown in a fully-extended position, and a handpiece;

**[0010]** FIG. **2** is a schematic side view of the embodiment of FIG. **1**;

**[0011]** FIG. **3** is a schematic side view of the embodiment of FIG. **1** together with an irrigation fluid source fluidly connected to the first tube, a vacuum source fluidly connected to the second tube, and a medical viewing scope in the form of a laparoscope having a housing and an insertion tube extending from the housing, wherein the insertion tube has been inserted into the sheath, and wherein other components of the laparoscope have been omitted for clarity;

**[0012]** FIG. **4** is a cross-sectional view of the first tube of FIG. **1**, taken along arrows **4-4** of FIG. **1**, showing the cross-sectional flow area of the first tube;

**[0013]** FIG. **5** is a cross-sectional view of the second tube of FIG. **1**, taken along arrows **5-5** of FIG. **1**, showing the cross-sectional flow area of the second tube;

**[0014]** FIG. **6** is a cross-sectional view of the sheath of FIG. **1**, taken along arrows **6-6** of FIG. **1**, showing the cross-sectional flow area of the lumen of the sheath;

**[0015]** FIG. **7**A is a cross-sectional view of the sheath and the distal end portion of the handpiece of FIG. **2**, taken along lines **7**A-**7**A of FIG. **2**, showing a fluid connection of the distal handpiece passageway portion with the proximal lumen end and showing the manifold defined by the distal sheath end portion, wherein the manifold has an annular fluid passageway in fluid communication with the distal lumen end and has a plurality of spaced apart nozzle passageways in fluid communication with the annular fluid passageway;

**[0016]** FIG. **7**B is a cross-sectional view of the sheath of FIG. **7**A taken along lines **7**B-**7**B of FIG. **7**A;

**[0017]** FIG. **8** is a view, as in FIG. **7**A, but also including the scope of FIG. **3** showing the insertion tube of the scope inserted in the sheath;

**[0018]** FIG. **9** is a view, as in FIG. **8**, but with the sheath inserted into a trocar which has been inserted into a patient;

**[0019]** FIG. **10** is a diagrammatic view of the handpiece and a distal portion of the first and second tubes of FIG. **1**, showing the distal handpiece passageway portion seen in FIG. **7**A and illustrating with flow arrows the first internal flow configuration of the handpiece;

**[0020]** FIG. **11** is a diagrammatic view, as in FIG. **10**, but illustrating with flow arrows the second internal flow configuration of the handpiece;

**[0021]** FIG. **12** is a diagrammatic view, as in FIG. **10**, but illustrating with flow arrows the third internal flow configuration of the handpiece;

**[0022]** FIG. **13** is a cross-sectional view of a first alternate embodiment of the sheath of FIG. **1**, wherein the manifold is rotatable and is longitudinally extendable and retractable;

**[0023]** FIG. **14** is an enlarged cross-sectional view of the bellows, the handpiece, the sheath, and the scope of FIG. **3**, taken along lines **14-14** of FIG. **3**, showing the position of the bellows for a shorter scope;

**[0024]** FIG. **15** is a view, as in FIG. **14**, but showing the position of the bellows for a longer scope;

**[0025]** FIG. **16** is a view of an alternate embodiment of the first tube with a fitting which has threadably received a container containing an anti-fogging liquid;

**[0026]** FIG. **17** is a cross-sectional view of the sheath and the distal end portion of the handpiece of FIG. **7**A taken along lines **17-17** of FIG. **7**A showing the lumen, wherein the lumen has a substantially straight flow path and, from FIG. **6**, has a substantially constant cross-sectional flow area which has a substantially crescent shape;

**[0027]** FIG. **18** is a view, as in FIG. **17**, but of a second alternate embodiment of the sheath of FIG. **1** showing a substantially helical flow path where the lumen has a substantially constant cross-sectional flow area which has a substantially crescent shape;

**[0028]** FIG. **19** is a cross-sectional view of the sheath of FIG. **18** taken along lines **19-19** of FIG. **18** showing the substantially crescent shape of the cross-sectional flow area of the lumen of the sheath;

**[0029]** FIG. **20** is a side elevational cross-sectional view of portion of a first alternate embodiment of the handpiece of FIG. **1** showing a first valve having a first button adapted to pump irrigation fluid into the proximal lumen end of the lumen of the sheath;

**[0030]** FIG. **21** is a side elevational cross-sectional view of a portion of a second alternate embodiment of the handpiece of FIG. **1** showing a second valve having a second button adapted to provide suction to the lumen proximal end of the lumen of the sheath;

**[0031]** FIG. **22** is a side elevational cross-sectional view of a portion of a third alternate embodiment of the handpiece of FIG. **1** showing a single valve having a button adapted to provide irrigation fluid into the proximal lumen end of the lumen of the sheath when partially depressed and adapted to

provide suction to the lumen proximal end of the lumen of the sheath when completely depressed;

**[0032]** FIG. **23** is a view, as in FIG. **17**, but of a third alternate embodiment of the sheath of FIG. **1** showing a substantially helical flow path where the lumen has a substantially constant cross-sectional flow area which has a substantially circular shape;

**[0033]** FIG. **24** is a cross-sectional view of the sheath of FIG. **23** taken along lines **24-24** of FIG. **23** showing the substantially circular shape of the cross-sectional flow area of the lumen of the sheath;

**[0034]** FIG. **25** is a view, as in FIG. **17**, but of a fourth alternate embodiment of the sheath of FIG. **1** showing a substantially straight flow path where the lumen has a tapered cross-sectional flow area which has a substantially crescent shape; and

**[0035]** FIG. **26** is a cross-sectional view of the sheath of FIG. **25** taken along lines **26-26** of FIG. **25** showing the substantially crescent shape of the cross-sectional flow area of the lumen of the sheath.

## DETAILED DESCRIPTION

**[0036]** Before explaining the several embodiments of the present invention in detail, it should be noted that each embodiment is not limited in its application or use to the details of construction and arrangement of parts and steps illustrated in the accompanying drawings and description. The illustrative embodiments of the invention may be implemented or incorporated in other embodiments, variations and modifications, and may be practiced or carried out in various ways. Furthermore, unless otherwise indicated, the terms and expressions employed herein have been chosen for the purpose of describing the illustrative embodiments of the present invention for the convenience of the reader and are not for the purpose of limiting the invention.

**[0037]** It is further understood that any one or more of the following-described expressions, embodiments, examples, etc. can be combined with any one or more of the other following-described expressions, embodiments, examples, etc.

**[0038]** A first embodiment of the invention is shown in FIGS. **1-12**, **14-15**, and **17**. A first expression of the first embodiment, as best seen in FIGS. **1-3**, is for apparatus **10** for keeping clean a distal scope end **12** of a medical viewing scope **14**. The apparatus **10** includes a first tube **16**, an annular sheath **18**, and a handpiece **20**. The first tube **16** has a first proximal tube end **22** fluidly connectable to an irrigation fluid source **24** and has a first distal tube end **26**. As best seen in FIGS. **4-9**, the first tube **16** has a substantially constant first cross-sectional flow area. The sheath **18** is surroundingly attachable to the scope **14**, wherein the sheath **18** includes a tubular wall **28** having inside and outside diameters and containing a lumen **30** between the inside and outside diameters. The lumen **30** has proximal and distal lumen ends **32** and **34**, wherein the lumen **30** has a substantially constant cross-sectional flow area which is substantially equal in area to the first cross-sectional flow area. The distal scope end **12** is disposed proximate the distal lumen end **34** of the attached sheath **18**. As best seen in FIGS. **1-3**, the handpiece **20** is mounted to the sheath **18**, is fluidly connected to the first distal tube end **26**, and, as best seen in FIGS. **7-9**, is in fluid communication with the proximal lumen end **32**. The handpiece **20** is adapted to have, as best seen in FIGS. **9** and **10**, a user-selectable first internal flow configuration **1** preventing fluid communication between the first distal tube end **26** and the proximal lumen end **32**, and to have, as best seen in FIGS. **9** and **11**, a user-selectable second internal flow configuration **2** allowing fluid communication between the first distal tube end **26** and the proximal lumen end **32**. It is noted that "fluid" includes, without limitation, gas or gasses (e.g., pressurized air) and/or liquid or liquids.

**[0039]** In one example of the first expression of the first embodiment, the fluid communication between the first distal tube end **26** and the proximal lumen end **32** includes the handpiece **20** having a distal handpiece passageway portion **4** which exits the handpiece **20** and includes the sheath **18** having a proximal sheath passageway portion **5** which enters the sheath **18**. In this example, the distal handpiece passageway portion **4** is directly fluidly connected to the proximal sheath passageway portion **5**, and the proximal sheath passageway portion **5** is directly fluidly connected to the proximal lumen end **32**.

**[0040]** It is noted that "keeping clean a distal scope end **12**" includes cleaning at least a portion (such as a scope lens if so equipped) of the distal scope end **12** to improve scope clarity (such as scope lens clarity if so equipped), and includes cleaning at least a portion of a sheath lens (if the sheath is so equipped with a sheath lens adapted to protect the distal scope end) to improve scope clarity. It is also noted describing the first tube **16** as having a substantially constant cross-sectional flow area means the cross-sectional flow area is substantially constant from proximate the first proximal tube end **22** to proximate the first distal tube end **26**. It is further noted that describing the lumen **30** as having a substantially constant cross-sectional flow area means the cross-sectional flow area is substantially constant from proximate the handpiece **20** to proximate the distal sheath end **6**.

**[0041]** In one sheath-to-scope attachment technique, the scope **14** is slidingly insertable into the proximal sheath end portion near the handpiece **20**, the distal scope end **12** has an outside diameter, and, although not shown in the figures, the inside diameter of the tubular wall **28** near the distal sheath end **6** is less than the outside diameter of the distal scope end **12**. In one variation, the distal scope end **12** makes a press fit with the sheath **18** near the distal sheath end **6**. In one modification, the inside diameter of the tubular wall **24** has a constant taper. Other attachments, not shown, of the sheath **18** to the scope **14** include, without limitation, an elastomeric sheath, a compression fitting, and an elastomeric O-ring attached to the sheath proximate the distal sheath end **6** and adapted to attachingly engage an advancing scope **14** which has been inserted into the proximal sheath end near the handpiece **20**.

**[0042]** In one enablement of the first expression of the first embodiment, as best seen in FIGS. **8** and **9**, the distal scope end **12** is in fluid communication with the distal lumen end **34** of the attached sheath **18**. In the same or a different enablement, as best seen in FIG. **4**, the first cross-sectional flow area of the first tube **16** has a substantially circular shape, and, as best seen in FIG. **6**, the cross-sectional flow area of the lumen **30** of the sheath **18** has a substantially crescent shape. In one variation, as best seen in FIG. **9**, the scope **14** is a laparoscope, and the sheath **18** is substantially rigid and is insertable into a trocar **36**. Other types of scopes, not shown, include, without limitation, endoscopes (including gastroscopes and colonoscopes). It is noted that scopes include, without limitation, those scopes with video cameras which display an image on a monitor and those scopes having eyepieces for viewing by

a physician. In one modification, as best seen in FIG. **3**, the irrigation fluid source **24** is an operating-room saline bag **38**, and the first proximal tube end **22** is fluidly connected to the saline bag **38**.

**[0043]** A second expression of the first embodiment, as best seen in FIGS. **1-3**, is for apparatus **10** for keeping clean a distal scope end **12** of a medical viewing scope **14**. The apparatus **10** includes first and second tubes **16** and **40**, an annular sheath **18**, and a handpiece **20**. The first tube **16** has a first proximal tube end **22** fluidly connectable to an irrigation fluid source **24** and has a first distal tube end **26**. The second tube **40** has a second proximal tube end **42** fluidly connectable to a vacuum source **44** and has a second distal tube end **46**. The sheath **18** is surroundingly attachable to the scope **14**, wherein the sheath **18** includes a tubular wall **28** having inside and outside diameters and containing a lumen **30** between the inside and outside diameters. The lumen **30** has proximal and distal lumen ends **32** and **34**, wherein the lumen **30** has a cross-sectional flow area which has a substantially crescent shape. The distal scope end **12** is disposed proximate the distal lumen end **34** of the attached sheath **18**. As best seen in FIGS. **1-3**, the handpiece **20** is mounted to the sheath **18**, is fluidly connected to the first and second distal tube ends **26** and **46**, and, as best seen in FIGS. **7-9**, is in fluid communication with the proximal lumen end **32**.

**[0044]** In the second expression of the first embodiment, the handpiece **20** is adapted to have, as best seen in FIGS. **9** and **10**, a user-selectable first internal flow configuration **1** preventing fluid communication between the first distal tube end **26** and the proximal lumen end **32** and between the second distal tube end **46** and the proximal lumen end **32**, to have, as best seen in FIGS. **9** and **11**, a user-selectable second internal flow configuration **2** allowing fluid communication between the first distal tube end **26** and the proximal lumen end **32** but not between the second distal tube end **46** and the proximal lumen end **32**, and to have, as best seen in FIGS. **9** and **12**, a user-selectable third internal flow configuration **3** allowing fluid communication between the second distal tube end **46** and the proximal lumen end **32** but not between the first distal tube end **26** and the proximal lumen end **32**.

**[0045]** It is noted that describing the second tube **40** as having a substantially constant cross-sectional flow area means the cross-sectional flow area is substantially constant from proximate the second proximal tube end **42** to proximate the second distal tube end **46**. It is also noted that the term "vacuum" includes partial vacuum and includes aspiration. It is further noted that the term "vacuum" is relative to the pressure proximate the distal scope end **12** and that, in one example, the vacuum source may be ambient room air when the distal scope end **12** is exposed to a higher pressure within, for example, the insufflated abdomen of a patient **52**.

**[0046]** In one enablement of the second expression of the first embodiment, as best seen in FIGS. **8** and **9**, the distal scope end **12** is in fluid communication with the distal lumen end **34** of the attached sheath **18**. In the same or a different enablement, as best seen in FIGS. **4-6**, the first tube **16** has a substantially constant first cross-sectional flow area, the second tube **40** has a substantially constant second cross-sectional flow area which is substantially equal in area to the first cross-sectional flow area of the first tube **16**, the lumen **30** of the sheath **18** has a substantially constant cross-sectional flow area, the first and second cross-sectional flow areas each have a substantially circular shape, and the cross-sectional flow area of the lumen **30** of the sheath **18** is substantially equal in area to the first cross-sectional flow area of the first tube **16**. In one variation, as best seen in FIG. **9**, the scope **14** is a laparoscope, and the sheath **18** is substantially rigid and is insertable into a trocar **36**. In one example, the first and second tubes **16** and **40** are each ten feet of flexible tubing. In one modification, as best seen in FIG. **3**, the irrigation fluid source **24** is an operating-room saline bag **38**, the first proximal tube end **22** is fluidly connected to the saline bag **38**, the vacuum source **44** is an operating-room suction canister **48**, and the second proximal tube end **42** is fluidly connected to the suction canister **48**.

**[0047]** A third expression of the first embodiment, as best seen in FIGS. **1-3**, is for apparatus **10** for keeping clean a distal scope end **12** of a medical viewing scope **14**. The apparatus **10** includes first and second tubes **16** and **40**, an annular sheath **18**, and a handpiece **20**. The first tube **16** has a first proximal tube end **22** fluidly connectable to an irrigation fluid source **24**, has a first distal tube end **26**, and has a substantially constant first cross-sectional flow area. The second tube **40** has a second proximal tube end **42** fluidly connectable to a vacuum source **44** and has a second distal tube end **46**. The sheath **18** has a central longitudinal axis **50**, is surroundingly attachable to the scope **14**, and is insertable into a patient **52**. The sheath **18** includes a tubular wall **28** having inside and outside diameters and containing a lumen **30** between the inside and outside diameters. The lumen **30** has proximal and distal lumen ends **32** and **34**, wherein the lumen **30** has a substantially constant cross-sectional flow area which is substantially equal to the first cross-sectional flow area of the first tube **16**.

**[0048]** In the third expression of the first embodiment, the sheath **18** includes, as best seen in FIGS. **7-9**, a distal sheath end portion **54** defining a manifold **56**. The manifold **56** has an annular fluid passageway **58** which has a volume and which is in fluid communication with the distal lumen end **34**. The manifold **56** has a plurality of spaced apart nozzle passageways **60** (two are shown in FIG. **7**A and four are shown in FIG. **7**B) which together have a total volume, which are in fluid communication with the annular fluid passageway **58**, and which point proximal of the annular fluid passageway **58**. The volume of the annular fluid passageway **58** is greater than the total volume of the nozzle passageways **60**. The distal scope end **12** is disposed proximate the nozzle passageways **60** of the attached sheath **18**. As best seen in FIGS. **1-3**, the handpiece **20** is mounted to the sheath **18**, is fluidly connected to the first and second distal tube ends **26** and **46**, and, as best seen in FIGS. **7-9**, is in fluid communication with the proximal lumen end **32**.

**[0049]** In the third expression of the first embodiment, the handpiece **20** is adapted to have, as best seen in FIGS. **9** and **10**, a user-selectable first internal flow configuration **1** preventing fluid communication between the first distal tube end **26** and the proximal lumen end **32** and between the second distal tube end **46** and the proximal lumen end **32**, to have, as best seen in FIGS. **9** and **11**, a user-selectable second internal flow configuration **2** allowing fluid communication between the first distal tube end **26** and the proximal lumen end **32** but not between the second distal tube end **46** and the proximal lumen end **32**, and to have, as best seen in FIGS. **9** and **12**, a user-selectable third internal flow configuration **3** allowing fluid communication between the second distal tube end **46** and the proximal lumen end **32** but not between the first distal tube end **26** and the proximal lumen end **32**.

**[0050]** In one example of the third expression of the embodiment, as best seen in FIG. **7**A, the sheath **66** includes a sheath passageway **7** consisting essentially of the proximal sheath passageway portion **5**, the lumen **30**, the annular fluid passageway **58** of the manifold **56**, and the nozzle passageways **60** of the manifold **56**.

**[0051]** In one enablement of the third expression of the first embodiment, as best seen in FIGS. **8** and **9**, the distal scope end **12** is in fluid communication with the nozzle passageways **60**. In the same or a different enablement, as best seen in FIGS. **4-6**, the second tube **40** has a substantially constant second cross-sectional flow area which is substantially equal in area to the first cross-sectional flow area of the first tube **16**, the first and second cross-sectional flow areas each have a substantially circular shape, and the cross-sectional flow area of the lumen **30** of the sheath **18** has a substantially crescent shape. In one example, as best seen in FIG. **6**, the crescent shape is substantially equal in shape to an end view of substantially ninety degrees of a circularly annular right cylinder. In one variation, as best seen in FIG. **9**, the scope **14** is a laparoscope, and the sheath **18** is substantially rigid and is insertable into a trocar **36**. In one modification, as best seen in FIG. **3**, the irrigation fluid source **24** is an operating-room saline bag **38**, the first proximal tube end **22** is fluidly connected to the saline bag **38**, the vacuum source **44** is an operating-room suction canister **48**, and the second proximal tube end **42** is fluidly connected to the suction canister **48**.

**[0052]** In one implementation of the third expression of the first embodiment, as best seen in FIGS. **7**A and **7**B, each nozzle passageway **60** has a proximal nozzle passageway end **62** and a distal nozzle passageway end **64**, and each nozzle passageway **60** is tapered from the corresponding proximal nozzle passageway end **62** to the corresponding distal nozzle passageway end **64**. In the same or a different implementation, as best seen in FIG. **7**A, the distal nozzle passageway end **64** of the attached sheath **18** has a portion abutting the distal scope end **12** and a portion spaced apart from the distal scope end **12**. In one variation, each nozzle passageway **60** is aligned to intersect the central longitudinal axis **50** of the sheath **18** at substantially the same point.

**[0053]** In a first alternate sheath embodiment, as shown in FIG. **13**, the sheath **66** includes a mid sheath portion **68** disposed proximal to the manifold **70**, and the manifold **70** is manually rotatable about the central longitudinal axis **50** of the sheath **66** with respect to the mid sheath portion **68**. In one variation, the manifold **70** and the mid sheath portion **68** are attached by a rotatable (rotatable about the central longitudinal axis **50**) tongue **78** and at-least-partially-annular groove **80** arrangement. In one variation, not shown, the distal scope end is angled for improved sideways viewing, the manifold is correspondingly angled, and the rotatable manifold feature allows rotational alignment of the angled manifold with the angled distal scope end.

**[0054]** In one arrangement of the third expression of the first embodiment, as best seen in FIG. **7**A, the lumen **30** has an irrigation flow path direction which is substantially parallel to the central longitudinal axis **50** of the sheath **18**. In one variation, the manifold **56** has a radiused distal inner wall portion **72** facing the distal lumen end **34**. In one example, the radiused distal inner wall portion **72** receives irrigation flow from the distal lumen end **34** and gradually turns such irrigation flow to fill the annular fluid passageway **58** of the manifold **56**, such gradual turning reducing pressure losses.

**[0055]** In one configuration of the third expression of the first embodiment, as best seen in FIG. **8**, the sheath **18** includes a scope stop **74**, and the scope **14** is insertable into the sheath **18** and is translatable within the sheath **18** to abut the scope stop **74** to define the attached sheath **18**. In one example, the scope stop **74** is a portion of the manifold **56**.

**[0056]** In the first alternate sheath embodiment, as shown in FIG. **13**, the sheath **66** includes a mid sheath portion **68** disposed proximal to the manifold **70**, and the manifold **70** is manually longitudinally extendable and retractable with respect to the mid sheath portion **68**. Here, the scope stop **76** is a portion of the manifold **70**. Typically, scopes **14** vary a small amount (such as one inch) in length, and the extendable and retractable manifold **70** allows scopes **14** of varying length to be fully inserted in the sheath **66** against the scope stop **76**. In one variation, the manifold **70** and the mid sheath portion **68** are attached by a sliding tongue **78** and groove **80** arrangement and have locking tabs **82** which abut during extension of the manifold **70** with respect to the mid sheath portion **68** to prevent separation of the manifold **70** from the mid sheath portion **68**.

**[0057]** In one employment of the third expression of the first embodiment having the scope stop **74**, the distal scope end **12** is the distal scope end **12** of an insertion tube **84** extending from an end of a housing **86** of the scope **14**, wherein the sheath **18** is surroundingly attachable to the insertion tube **84** of the scope **14**. In this employment, the apparatus **10** also includes, as best shown in FIGS. **1-3** and **14-15**, a flexible annular bellows **88** having a central longitudinal axis **90** substantially coaxially aligned with the central longitudinal axis **50** of the sheath **18**. The bellows **88** includes a proximal bellows end **92** and includes a distal bellows end **94** which abuts the handpiece **20**. The bellows **88** is biased (such as by a spring, not shown) to extend proximally from the handpiece **20** to a fully extended position. The bellows **88** is adapted, for the attached sheath **18**, to surround the insertion tube **84** of the scope **14** with the proximal bellows end **92** contacting the end of the housing **86** of the scope **14**. This allows a shorter scope **14'** (see FIG. **14**) or a longer scope **14"** (see FIG. **15**) to be fully inserted against the scope stop **74** (see FIG. **8**) without a longitudinal gap between the housing **86** of the scope **14** and the handpiece **20** (see FIG. **3**).

**[0058]** In one illustration of the third expression of the first embodiment, the sheath **18** is manually rotatable about the central longitudinal axis **50** of the sheath **18** with respect to the handpiece **20**. In one example, the proximal sheath passageway portion **5** has a crescent shape perpendicular to the flow direction. In one variation, not shown, the distal scope end **12** is angled for improved sideways viewing, the manifold **56** is correspondingly angled, and the rotatable sheath feature allows rotational alignment of the angled manifold with the angled distal scope end.

**[0059]** In one extension of the third expression of the first embodiment, as seen in FIG. **16**, the first tube **16** includes a fitting **96** which is disposed between the first proximal tube end **22** and the first distal tube end **26**. The fitting **96** is adapted to threadably receive a container **98** containing an anti-fogging liquid **100**. In one example, the anti-fogging liquid **100** is drawn into the flow **102** of irrigation fluid **104** by the venturi effect.

**[0060]** In one employment of the third expression of the first embodiment, as best seen in FIG. **7**A and **17**, the lumen **30** has a substantially straight proximal-to-distal flow path **106**. Flow path **106** is the flow path of the irrigation fluid in

lumen **30**. It is noted that the vacuum flow path in lumen **30** is the reverse of flow path **106**. In an alternate employment, as seen in figures **18** and **19**, the lumen **108** has a substantially helical flow path **110**. Flow path **110** is the flow path of the irrigation fluid in lumen **108**. In one variation (which can be pictured as having the sheath **112** of FIG. **18** substituted for the sheath **18** of FIG. **7**A), this allows the distal lumen end **34** to be substantially tangentially aligned with the annular fluid passageway **58** of the manifold **56** which reduces pressure losses.

**[0061]** In one design of the third expression of the first embodiment, the first, second, and third internal flow configurations **1**, **2** and **3** of the handpiece **20** are achieved by, as best shown in FIGS. **10-12**, having the handpiece **20** include a first valve **114** and a second valve **116**. The first valve **114** is operatively disposed between the first distal tube end **26** and the proximal lumen end **32**, and the second valve **116** is operatively disposed between the second distal tube end **46** and the proximal lumen end **32**. The first valve **114** has a first valve button **118**, has a first fluid inlet **120** fluidly connected to the first distal tube end **26** (also seen in FIG. **1**), and has a first fluid outlet **122**. The second valve **116** has a second valve button **124**, has a second fluid inlet **126**, and has a second fluid outlet **128** fluidly connected to the second distal tube end **46** (also seen in FIG. **1**). The first fluid outlet **122** and the second fluid inlet **126** form the arms of a "Y" whose leg is the distal handpiece passageway portion **4** (seen in FIG. **7**A). FIG. **10** shows the first internal flow configuration **1** where the first and second buttons **118** and **124** are biased upward. FIG. **11** shows the second internal flow configuration **2** where the first valve button **118** has been depressed. FIG. **12** shows the third internal flow configuration **3** where the second valve button **124** has been depressed. Arrows **106** indicate the irrigation fluid flow path, and arrows **130** indicated the suction flow path. In one example, the first and second valves **114** and **116** are trumpet valves. In one variation, the saline bag **38** is disposed at a height for sufficient flow of irrigation fluid to quickly impinge the distal scope end **12** once the first valve button **118** is depressed. In one modification, a bladder, not shown, is placed around the saline bag **38** to compress the bag to increase the pressure of the irrigation fluid.

**[0062]** In an alternate embodiment of the first valve, as seen in FIG. **20**, the first valve **132** has a first button **134** and is adapted to pump irrigation fluid into the proximal lumen end **32** (also see FIGS. **10** and **7**A) when the first button **134** is manually depressed and when the first proximal tube end **22** is fluidly connected to the irrigation fluid source **24**. Note the one-way flapper valve **136** (in the button passageway **137** of the first button **134**), the O-ring seals **138**, and the button return spring **140** of the first valve **132** in FIG. **20**. The flapper valve **136** is biased open when the first button **134** is not depressed allowing irrigation fluid to flow downward below the flapper valve **136**. When the first button **134** is depressed, the flapper valve **136** is forced shut by the resisting irrigation fluid allowing a pumping action of the irrigation fluid by the downwardly-moving first button **134**.

**[0063]** In an alternate embodiment of the second valve, as seen in FIG. **21**, the second valve **142** has a second (immovable) valve button **144** with an orifice **146**, has a one-way flapper valve **148**, and is adapted to suction air from the orifice **146** when the orifice **146** is exposed and is adapted to provide suction to the proximal lumen end **32** when the second valve button **144** is manually covered all when the second proximal tube end **42** is fluidly connected to the vacuum source **44**. The orifice **146** is disposed at the top of the second valve button **144** and is in fluid communication with a button passageway **150** of the second valve button **144**. The button passageway **150** is in fluid communication with a suction passageway **152** having a first portion **154** extending proximal of the button passageway **150** toward the second distal tube end **46** and having a second portion **156** extending distal of the button passageway **150** toward the proximal lumen end **32**. The one-way flapper valve **148** is disposed in the second portion **156** of the suction passageway **152**. When the orifice is exposed, the one-way flapper valve **148** is biased shut preventing applying suction to the proximal lumen end **32**. When the orifice is covered, the one-way flapper valve **148** is forced open, by the pressure differential, allowing suction to be applied to the proximal lumen end **32**. Note the O-ring seals **158**.

**[0064]** In an alternate embodiment which replaces the first and second valves with a single valve, as seen in FIG. **22**, the handpiece **160** includes a single valve **162** having a single valve button **164** having first, second, and third positions, wherein the valve **162** is adapted to provide the first, second, and third internal flow configurations **1**, **2**, and **3** based correspondingly on the first, second, and third positions of the valve button **164**. The valve button **164** has a single transverse button passageway **166**. When the valve button **164** is biased upward, the button passageway **166** is not aligned with the first fluid inlet **120** or with the second fluid outlet **128**. When the valve button **164** is partially depressed, the button passageway **166** is aligned with the first fluid inlet **120** and the first fluid outlet **122** providing fluid communication between the first fluid inlet **120** and the first fluid outlet **122**. When the valve button **164** is fully depressed, the button passageway **166** is aligned with the second fluid inlet **126** and the second fluid outlet **128** providing fluid communication between the second fluid inlet **126** and the second fluid outlet **128**. Note the O-ring seals **168**, and the button return spring **170** of the valve **162** in FIG. **22**.

**[0065]** A second embodiment of the invention is shown in FIGS. **1-12**, **14-15**, and **17-19**, wherein FIGS. **1-12**, **14**, **15**, and **17** illustrate the first embodiment having sheath **18**, and wherein FIGS. **18-19** illustrate the lumen portion of a second alternate embodiment of the sheath **112** which replaces the lumen portion of sheath **18** to create the second embodiment. A first expression of the second embodiment is for apparatus **10** for keeping clean a distal scope end **12** of a medical viewing scope **14**. The apparatus **10** includes an annular sheath **112** surroundingly attachable to the scope **14**, wherein the sheath **112** includes a tubular wall **113** having inside and outside diameters and containing a lumen **108** between the inside and outside diameters, wherein the lumen **108** has proximal and distal lumen ends **32** and **34**, wherein the lumen **108** substantially continuously varies in at least one of cross-sectional flow area and irrigation flow path direction, wherein the proximal lumen end **32** is fluidly connectable to at least one of an irrigation fluid source **24** and a vacuum source **44**, and wherein the distal scope end **12** is disposed proximate the distal lumen end **34** of the attached sheath **112**.

**[0066]** In one variation of the first expression of the second embodiment, the distal scope end **12** is in fluid communication with the distal lumen end **34** of the attached sheath **112**. In the same or a different variation, the irrigation fluid flow path **110** has a substantially helical shape with a substantially constant cross-sectional flow area. In one example, the lumen **108** has a substantially crescent shape.

**[0067]** In a third alternate sheath embodiment, as shown in FIGS. **23-24**, the lumen **172** of the sheath **174** has a flow path direction **176** (the irrigation fluid flow path direction is shown) which has a substantially helical shape. In this embodiment, the cross-sectional flow area of the lumen **172** is substantially constant and has a substantially circular shape.

**[0068]** In a fourth alternate sheath embodiment, as shown in FIGS. **25-26**, the lumen **178** of the sheath **180** has a flow path direction **182** (the irrigation fluid flow path direction is shown) which is a substantially straight flow path direction. In this embodiment, the cross-sectional flow area of the lumen **178** has a substantially crescent shape which substantially continuously tapers from proximate the proximal lumen end **182** to proximate the distal lumen end **184**.

**[0069]** Several benefits and advantages are obtained from one or more of the expressions of embodiments of the invention which provide for keeping clean a distal scope end of a medical viewing scope while the scope remains inserted in a patient. In one example, not removing the scope for cleaning and not reinserting the cleaned scope reduces the time for a laparoscopic procedure. In the same or a different example, not removing the scope for cleaning and not reinserting the cleaned scope keeps the inserted scope aligned with the patient tissue of interest during cleaning so that the physician does not have to take additional time to maneuver the scope to reacquire the patient tissue of interest. In one example of the first and third expressions of the first embodiment, the substantially equal areas reduce flow losses and provide faster response times for irrigation fluid to exit the lumen of the sheath to clean the distal scope end or to clean a magnifying or non-magnifying optional lens (transparent shield) of the sheath which protects the distal scope end.

**[0070]** While the present invention has been illustrated by a description of several expressions, embodiments, and examples, etc. thereof, it is not the intention of the applicants to restrict or limit the spirit and scope of the appended claims to such detail. Numerous other variations, changes, and substitutions will occur to those skilled in the art without departing from the scope of the invention. For instance, the apparatus of the invention has application in robotic assisted surgery taking into account the obvious modifications of such apparatus to be compatible with such a robotic system. It will be understood that the foregoing description is provided by way of example, and that other modifications may occur to those skilled in the art without departing from the scope and spirit of the appended Claims.

What is claimed is:

**1**. Apparatus for keeping clean a distal scope end of a medical viewing scope, wherein the apparatus comprises:

a) a first tube having a first proximal tube end fluidly connectable to an irrigation fluid source, having a first distal tube end, and having a substantially constant first cross-sectional flow area;

b) an annular sheath surroundingly attachable to the scope, wherein the sheath includes a tubular wall having inside and outside diameters and containing a lumen between the inside and outside diameters, wherein the lumen has proximal and distal lumen ends, wherein the lumen has a substantially constant cross-sectional flow area which is substantially equal in area to the first cross-sectional flow area, and wherein the distal scope end is disposed proximate the distal lumen end of the attached sheath; and

c) a handpiece mounted to the sheath, fluidly connected to the first distal tube end, and in fluid communication with the proximal lumen end, wherein the handpiece is adapted to have a user-selectable first internal flow configuration preventing fluid communication between the first distal tube end and the proximal lumen end and a user-selectable second internal flow configuration allowing fluid communication between the first distal tube end and the proximal lumen end.

**2**. The apparatus of claim **1**, wherein the distal scope end is in fluid communication with the distal lumen end of the attached sheath.

**3**. The apparatus of claim **1**, wherein the first cross-sectional flow area of the first tube has a substantially circular shape, and wherein the cross-sectional flow area of the lumen of the sheath has a substantially crescent shape.

**4**. The apparatus of claim **3**, wherein the scope is a laparoscope, and wherein the sheath is substantially rigid and is insertable into a trocar.

**5**. The apparatus of claim **4**, wherein the irrigation fluid source is an operating-room saline bag, and wherein the first proximal tube end is fluidly connected to the saline bag.

**6**. Apparatus for keeping clean a distal scope end of a medical viewing scope, wherein the apparatus comprises:

a) a first tube having a first proximal tube end fluidly connectable to an irrigation fluid source and having a first distal tube end;

b) a second tube having a second proximal tube end fluidly connectable to a vacuum source and having a second distal tube end;

c) an annular sheath surroundingly attachable to the scope, wherein the sheath includes a tubular wall having inside and outside diameters and containing a lumen between the inside and outside diameters, wherein the lumen has proximal and distal lumen ends, wherein the lumen has a cross-sectional flow area which has a substantially crescent shape, and wherein the distal scope end is disposed proximate the distal lumen end of the attached sheath; and

d) a handpiece mounted to the sheath, fluidly connected to the first and second distal tube ends, and in fluid communication with the proximal lumen end, wherein the handpiece is adapted to have a user-selectable first internal flow configuration preventing fluid communication between the first distal tube end and the proximal lumen end and between the second distal tube end and the proximal lumen end, a user-selectable second internal flow configuration allowing fluid communication between the first distal tube end and the proximal lumen end but not between the second distal tube end and the proximal lumen end, and a user-selectable third internal flow configuration allowing fluid communication between the second distal tube end and the proximal lumen end but not between the first distal tube end and the proximal lumen end.

**7**. The apparatus of claim **6**, wherein the distal scope end is in fluid communication with the distal lumen end of the attached sheath.

**8**. The apparatus of claim **6**, wherein the first tube has a substantially constant first cross-sectional flow area, wherein the second tube has a substantially constant second cross-sectional flow area which is substantially equal in area to the first cross-sectional flow area of the first tube, wherein the lumen has a substantially constant cross-sectional flow area,

wherein the first and second cross-sectional flow areas each have a substantially circular shape, and wherein the cross-sectional flow area of the lumen is substantially equal in area to the first cross-sectional flow area of the first tube.

**9**. The apparatus of claim **8**, wherein the scope is a laparoscope, and wherein the sheath is substantially rigid and is insertable into a trocar.

**10**. The apparatus of claim **9**, wherein the irrigation fluid source is an operating-room saline bag, wherein the first proximal tube end is fluidly connected to the saline bag, wherein the vacuum source is an operating-room suction canister, and wherein the second proximal tube end is fluidly connected to the suction canister.

**11**. Apparatus for keeping clean a distal scope end of a medical viewing scope, wherein the apparatus comprises:

a) a first tube having a first proximal tube end fluidly connectable to an irrigation fluid source, having a first distal tube end, and having a substantially constant first cross-sectional flow area;

b) a second tube having a second proximal tube end fluidly connectable to a vacuum source and having a second distal tube end;

c) an annular sheath having a central longitudinal axis, surroundingly attachable to the scope, and insertable into a patient, wherein the sheath includes a tubular wall having inside and outside diameters and containing a lumen between the inside and outside diameters, wherein the lumen has proximal and distal lumen ends, wherein the lumen has a substantially constant cross-sectional flow area which is substantially equal in area to the first cross-sectional flow area of the first tube, wherein the sheath includes a distal sheath end portion defining a manifold, wherein the manifold has an annular fluid passageway which has a volume and which is in fluid communication with the distal lumen end, wherein the manifold has a plurality of spaced apart nozzle passageways which together have a total volume, which are in fluid communication with the annular fluid passageway, and which point proximal of the annular fluid passageway, wherein the volume of the annular fluid passageway is greater than the total volume of the nozzle passageways, and wherein the distal scope end is disposed proximate the nozzle passageways of the attached sheath; and

d) a handpiece mounted to the sheath, fluidly connected to the first and second distal tube ends, and in fluid communication with the proximal lumen end, wherein the handpiece is adapted to have a user-selectable first internal flow configuration preventing fluid communication between the first distal tube end and the proximal lumen end and between the second distal tube end and the proximal lumen end, a user-selectable second internal flow configuration allowing fluid communication between the first distal tube end and the proximal lumen end but not between the second distal tube end and the proximal lumen end, and a user-selectable third internal flow configuration allowing fluid communication between the second distal tube end and the proximal lumen end but not between the first distal tube end and the proximal lumen end.

**12**. The apparatus of claim **11**, wherein the distal scope end is in fluid communication with the nozzle passageways.

**13**. The apparatus of claim **11**, wherein the second tube has a substantially constant second cross-sectional flow area which is substantially equal in area to the first cross-sectional flow area of the first tube, wherein the first and second cross-sectional flow areas each have a substantially circular shape, and wherein the cross-sectional flow area of the lumen of the sheath has a substantially crescent shape.

**14**. The apparatus of claim **13**, wherein the crescent shape is substantially equal in shape to an end view of substantially ninety degrees of a circularly annular right cylinder.

**15**. The apparatus of claim **13**, wherein the scope is a laparoscope, and wherein the sheath is substantially rigid and is insertable into a trocar.

**16**. The apparatus of claim **15**, wherein the irrigation fluid source is an operating-room saline bag, wherein the first proximal tube end is fluidly connected to the saline bag, wherein the vacuum source is an operating-room suction canister, and wherein the second proximal tube end is fluidly connected to the suction canister.

**17**. The apparatus of claim **11**, wherein each nozzle passageway has a proximal passageway end and a distal passageway end, and wherein each nozzle passageway is tapered from the corresponding proximal passageway end to the corresponding distal passageway end.

**18**. The apparatus of claim **11**, wherein each nozzle passageway has a proximal passageway end and a distal passageway end, and wherein the distal passageway end of the attached sheath has a portion abutting the distal scope end and a portion spaced apart from the distal scope end.

**19**. The apparatus of claim **11**, wherein the sheath includes a mid sheath portion disposed proximal to the manifold, and wherein the manifold is manually rotatable about the central longitudinal axis of the sheath with respect to the mid sheath portion.

**20**. The apparatus of claim **11**, wherein the lumen has an irrigation flow path direction which is substantially parallel to the central longitudinal axis of the sheath, and wherein the manifold has a radiused distal inner wall portion facing the distal lumen end.

**21**. The apparatus of claim **11**, wherein the sheath includes a scope stop, and wherein the scope is insertable into the sheath and is translatable within the sheath to abut the scope stop to define the attached sheath.

**22**. The apparatus of claim **21**, wherein the sheath includes a mid sheath portion disposed proximal to the manifold, and wherein the manifold is manually longitudinally extendable and retractable with respect to the mid sheath portion.

**23**. The apparatus of claim **22**, wherein the manifold and the mid sheath portion are attached by a sliding annular tongue and annular groove arrangement and have locking tabs which abut during extension of the manifold with respect to the mid sheath portion to prevent separation of the manifold from the mid sheath portion.

**24**. The apparatus of claim **21**, wherein the distal scope end is the distal scope end of an insertion tube extending from an end of a housing of the scope, wherein the sheath is surroundingly attachable to the insertion tube of the scope, and also including a flexible annular bellows having a central longitudinal axis substantially coaxially aligned with the central longitudinal axis of the sheath, wherein the bellows includes a proximal bellows end and includes a distal bellows end which abuts the handpiece, wherein the bellows is biased to extend proximally from the handpiece to a fully extended position, and wherein the bellows is adapted, for the attached

sheath, to surround the insertion tube of the scope with the proximal bellows end contacting the end of the housing of the scope.

**25**. The apparatus of claim **11**, wherein the sheath is manually rotatable about the central longitudinal axis of the sheath with respect to the handpiece.

**26**. The apparatus of claim **11**, wherein the first tube includes a fitting which is disposed between the first proximal tube end and the first distal tube end and which is adapted to threadably receive a container containing an anti-fogging liquid.

**27**. The apparatus of claim **11**, wherein the lumen has a substantially straight flow path.

**28**. The apparatus of claim **11**, wherein the lumen has a substantially helical flow path, and wherein the distal lumen end is substantially tangentially aligned with the annular fluid passageway of the manifold.

**29**. The apparatus of claim **11**, wherein the handpiece includes a first valve operatively disposed between the first distal tube end and the proximal lumen end and a second valve operatively disposed between the second distal tube end and the proximal lumen end.

**30**. The apparatus of claim **29**, wherein the first valve has a first valve button and is adapted to pump irrigation fluid into the proximal lumen end when the first valve button is manually depressed and when the first proximal tube end is fluidly connected to the irrigation fluid source.

**31**. The apparatus of claim **29**, wherein the second valve has a second valve button with an orifice and a one-way flapper valve and is adapted to suction air from the orifice when the orifice is exposed and is adapted to provide suction to the proximal lumen end when the second valve button is manually covered all when the second proximal tube end is fluidly connected to the vacuum source.

**32**. The apparatus of claim **11**, wherein the handpiece includes a single valve having a single valve button having first, second, and third positions, wherein the valve is adapted to provide the first, second, and third internal flow configurations based correspondingly on the first, second, and third positions of the valve button.

**33**. Apparatus for keeping clean a distal scope end of a medical viewing scope, wherein the apparatus comprises an annular sheath surroundingly attachable to the scope, wherein the sheath includes a tubular wall having inside and outside diameters and containing a lumen between the inside and outside diameters, wherein the lumen has proximal and distal lumen ends, wherein the lumen substantially continuously varies in at least one of cross-sectional flow area and irrigation flow path direction, wherein the proximal lumen end is fluidly connectable to at least one of an irrigation fluid source and a vacuum source, and wherein the distal scope end is disposed proximate the distal lumen end of the attached sheath.

**34**. The apparatus of claim **33**, wherein the distal scope end is in fluid communication with the distal lumen end of the attached sheath.

**35**. The apparatus of claim **33**, wherein the flow path direction has a substantially helical shape.

**36**. The apparatus of claim **33**, wherein the path direction is a substantially straight irrigation flow path direction, and wherein the cross-sectional flow area of the lumen has a substantially crescent shape which substantially continuously tapers from proximate the proximal lumen end to proximate the distal lumen end.

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摘要(译)

用于保持医疗观察镜的远端镜体端部清洁的装置的第一表现形式包括管，环形护套和手持件。该管具有可流动地连接到冲洗流体的近端，并且具有流体连接到手持件的远端。护套可环绕地附接到窥视镜并且包括护套的内径和外径之间的内腔。内腔具有基本恒定的横截面流动面积，其面积基本上等于管的横截面流动面积。手持件与近端腔端部流体连通。远端窥镜端部定位在附接的护套的远端腔端附近。该装置的第二表现形式具有基本上新月形的内腔，而对其横截面流动面积没有任何限制。在一个替代实施例中，内腔在横截面流动面积和/或冲洗流动路径方向上基本上连续变化。