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Dhindsa

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(54) **MODULAR ENDOSCOPE VALVE ASSEMBLY AND METHOD**

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This patent is subject to a terminal disclaimer.

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(22) Filed: **Dec. 12, 2001**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 09/761,784, filed on Jan. 17, 2001.

(51) **Int. Cl.**[7] **A61B 1/12**

(52) **U.S. Cl.** **600/159**; 600/156; 600/158; 600/135

(58) **Field of Search** 600/159, 105, 600/135, 158, 156, 153, 131

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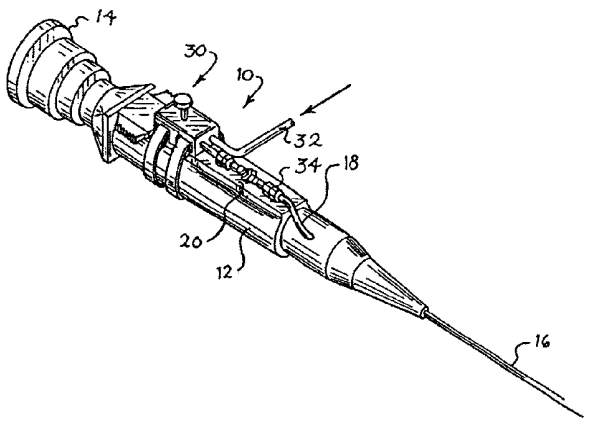
(57) **ABSTRACT**

A modular endoscope valve assembly is releasably mounted on the handpiece of an endoscope. This valve assembly includes an inlet port, an outlet port, and a valve manually operable selectively to block and to allow the flow of irrigation fluid from the inlet port to the outlet port. The valve assembly is releasably held to the handpiece of the endoscope by a mechanical fastener such as a pressure-sensitive adhesive, a strap, a snap lock, or otherwise. Once the valve assembly is releasably mounted to the handpiece, the physician using the endoscope can manually control the flow of irrigation fluid, and optionally suction, with the same hand as the one that supports the handpiece, thereby leaving the other hand of the physician free for surgical procedures. The modular valve assembly of this invention can be used with the widest variety of endoscopes, including flexible, rigid and semi rigid ureteroscopes as well as various percutaneous endoscopes.

43 Claims, 6 Drawing Sheets



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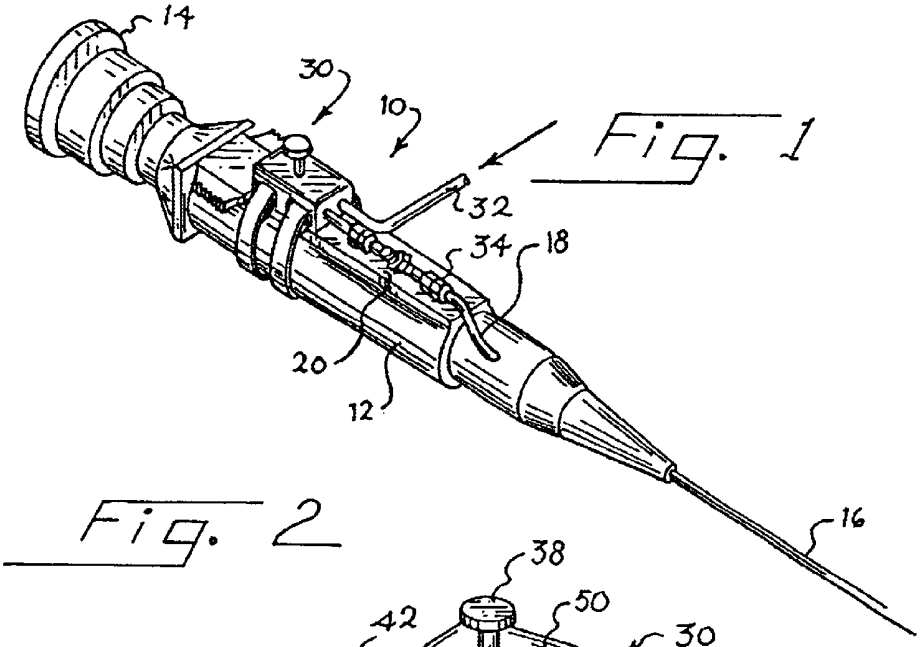


Fig. 1

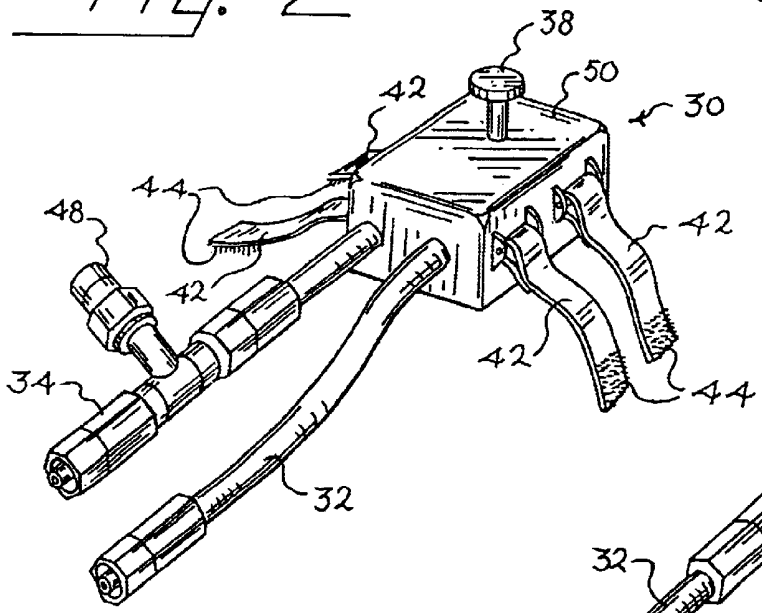


Fig. 2

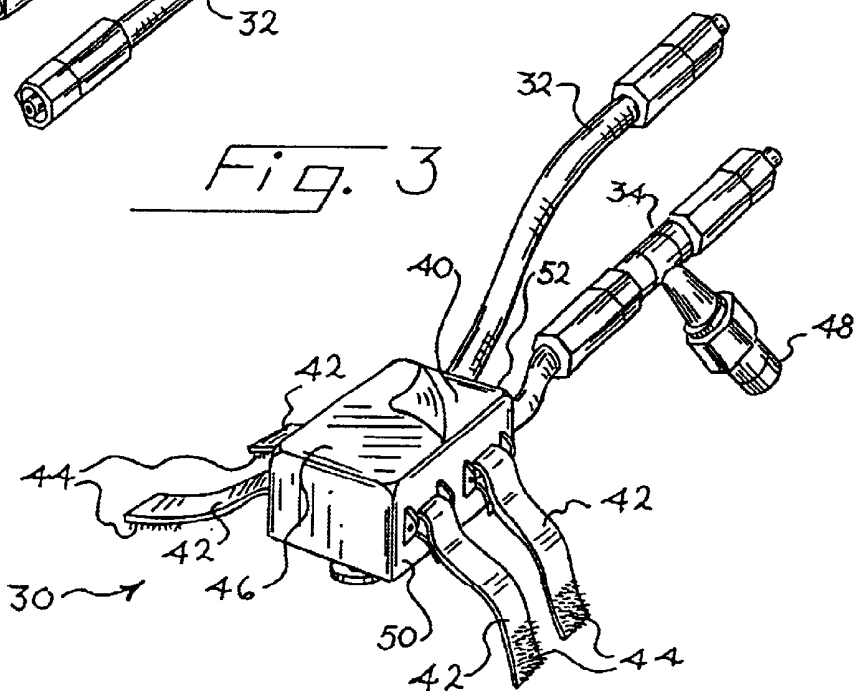


Fig. 3

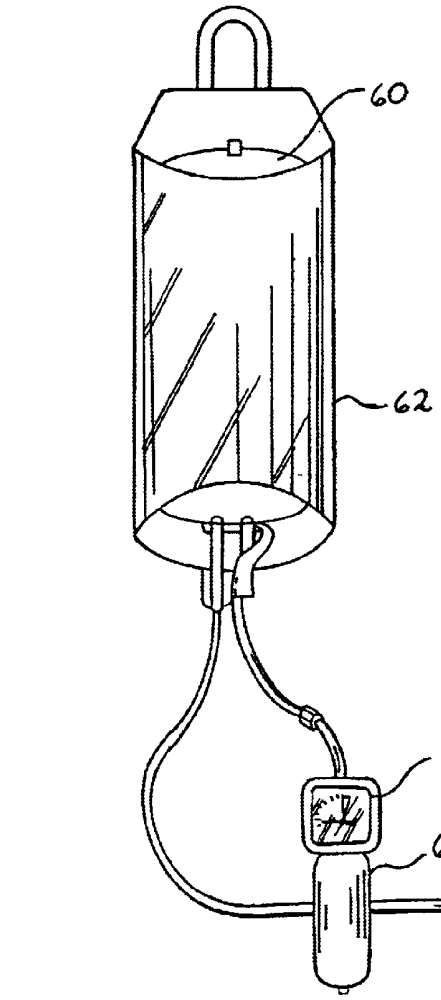


Fig. 4

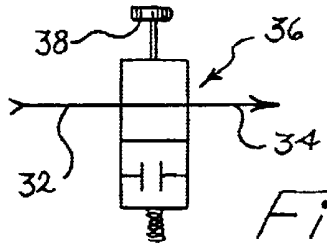


Fig. 5

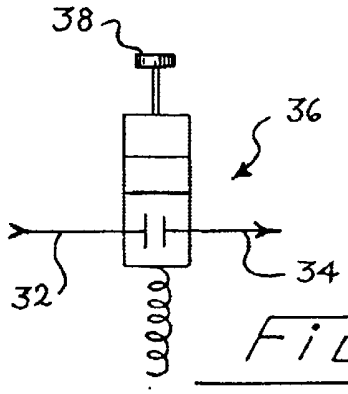


Fig. 6

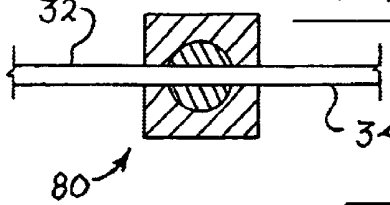


Fig. 7

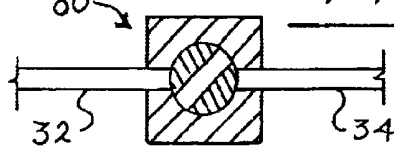


Fig. 8

Fig. 9

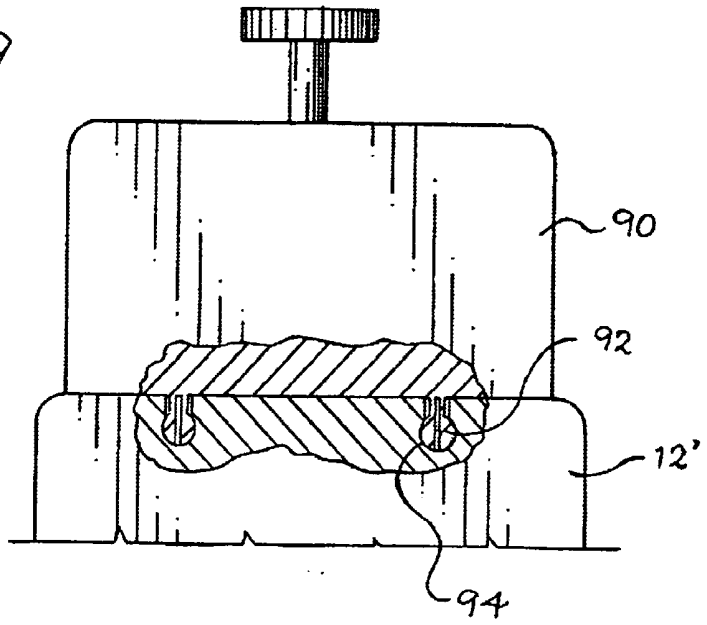


Fig. 10

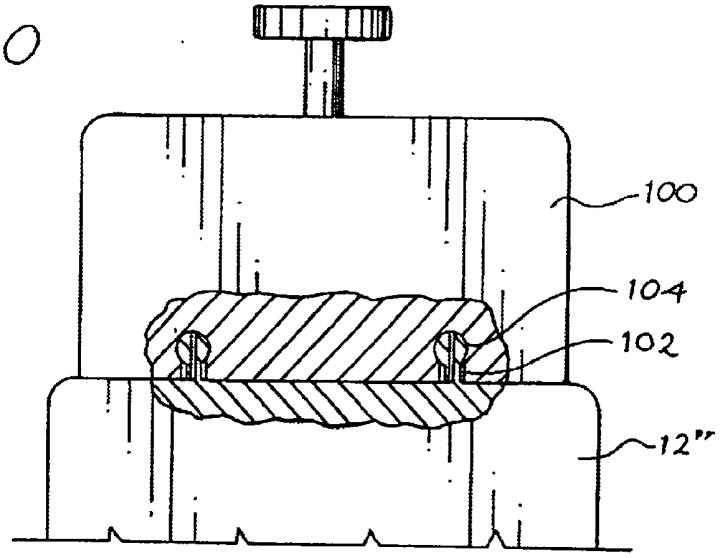


Fig. 11

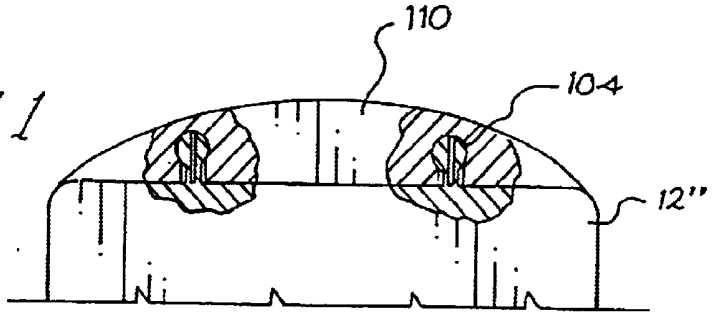


Fig. 12

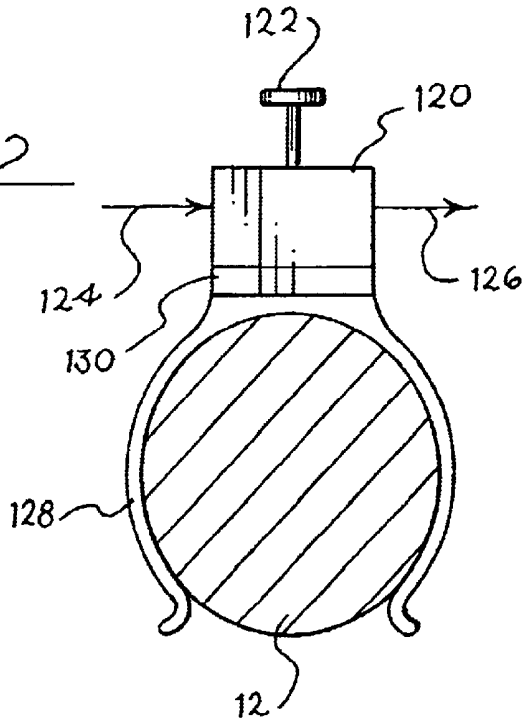


Fig. 13

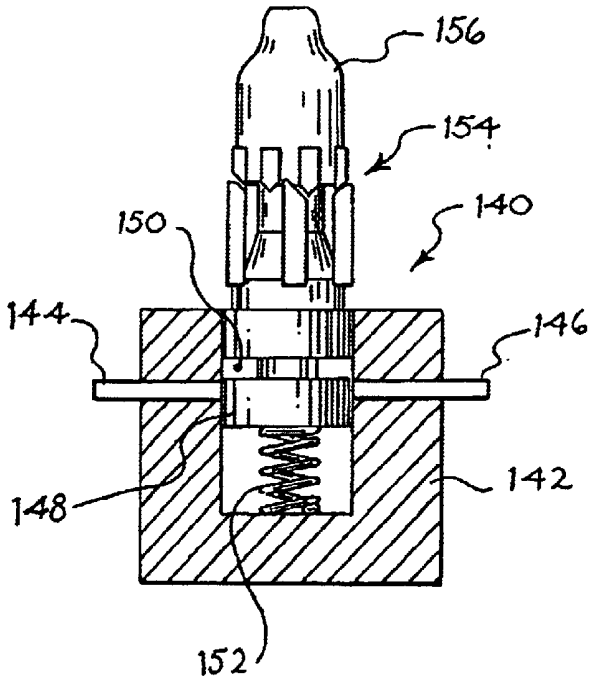


Fig. 14

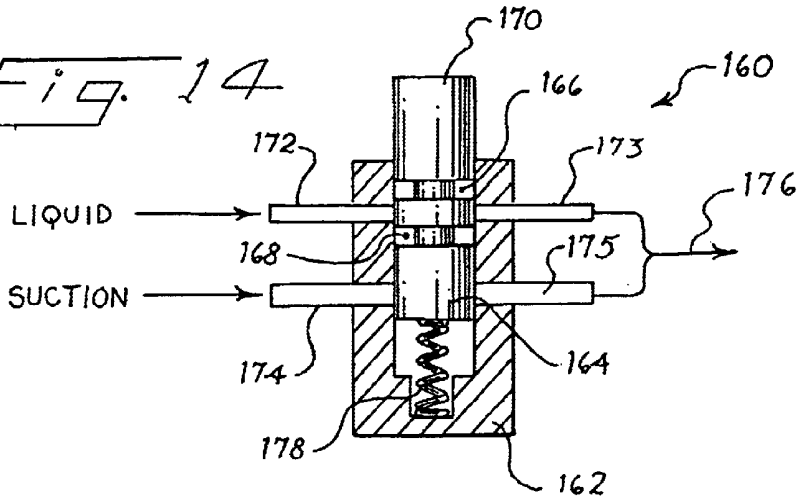


Fig. 15

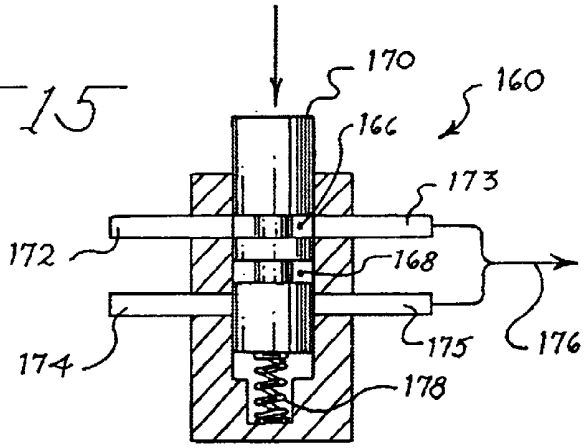
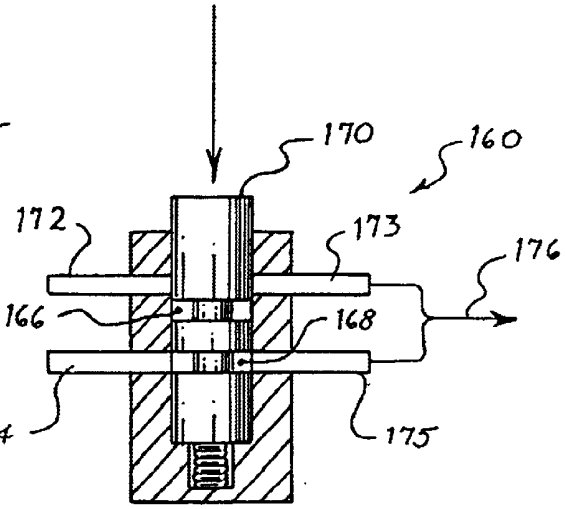


Fig. 16



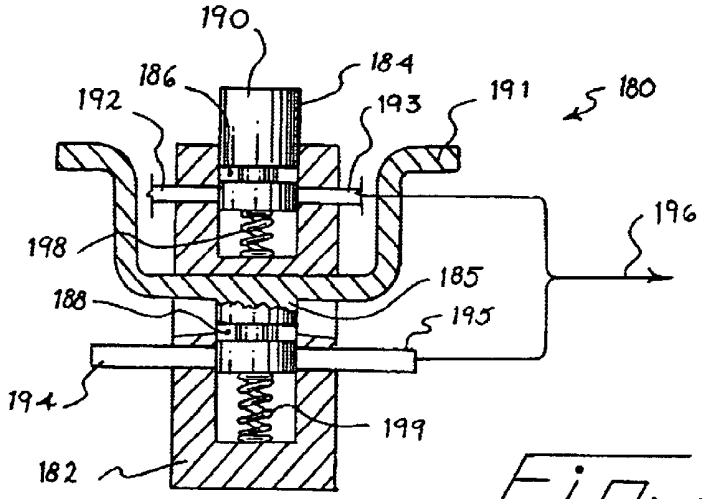


Fig. 17

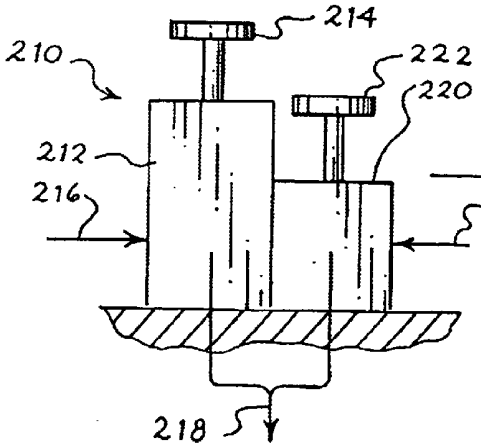


Fig. 18

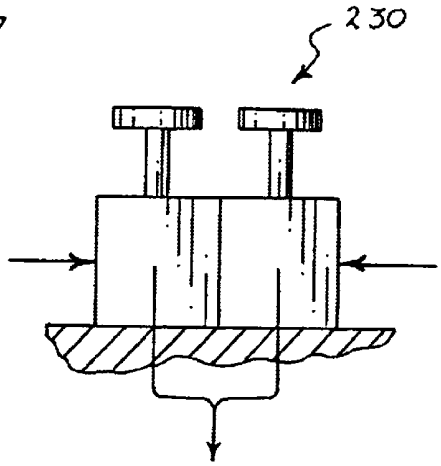


Fig. 20

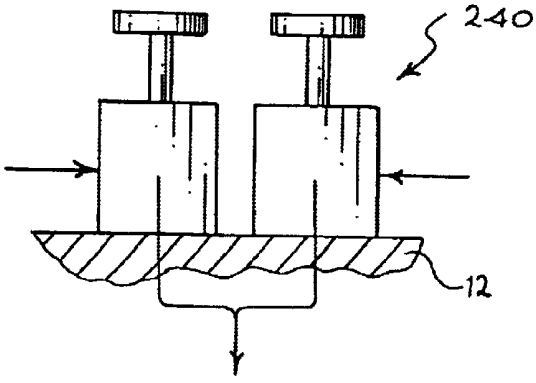


Fig. 19

MODULAR ENDOSCOPE VALVE ASSEMBLY AND METHOD

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of co-pending U.S. patent application Ser. No. 09/761,784, filed Jan. 17, 2001, the entirety of which is hereby incorporated by reference.

BACKGROUND

The present invention relates to endoscopic surgical devices, and in particular to valve assemblies used to control the flow of irrigation fluid in such devices.

Endoscopic devices are customarily provided with an irrigation port that conducts an irrigation liquid to the viewing area at the end of the endoscopic device. One prior-art approach is to pressurize irrigation fluid in an IV fluid bag, and then to supply the pressurized irrigation fluid directly into an endoscope such as a ureteroscope. The endoscope includes integral valves that are generally operated with one hand while the other hand holds the handpiece of the endoscope. The advantage of this system is that the irrigation fluid is pressurized, thereby providing dilation of a ureter and good visibility. One potential disadvantage with this type of irrigating system is that it may be difficult to control fluid flow since two hands are required. If the fluid flow is not controlled properly, a stone can be dislodged back into the middle or upper ureter by an excessively high rate of flow. Also, in the event of extravasation, uncontrolled amounts of fluid can flow into the retroperitoneum.

Another type of irrigation system is a hand-operated, pressurized irrigating system commercially manufactured by Bard, Boston Scientific, and ACMI. This approach allows the amount of fluid being injected to be controlled, but the apparatus is relatively bulky. This system is mounted separately from the ureteroscope, and separate hands are used to hold the handpiece of the ureteroscope and to control the flow of irrigation fluid. On occasion, an assistant controls fluid flow while the physician holds the endoscope in the left hand and performs an endoscopic procedure with the right hand. In this case, precise control of the rate of fluid flow is difficult, because oral instructions are slower and less precise than direct manual control by the physician.

A third type of irrigation system includes two or more syringes that are operated by an assistant one at a time to supply pressurized irrigation fluid to the endoscopic device. Generally a valve is provided that allows the assistant to fill one of the syringes while the other is in use.

A fourth type of irrigation system includes a roller pump mechanism that delivers irrigation fluid at a constant set pressure. This system may incorporate a blow-off valve to prevent excessive pressure, and it is generally used in endoscopic specialties such as orthopedics in performing arthroscopies. This system requires the use of an electric motor and controller, and it is therefore costly and bulky.

Goodman U.S. Pat. No. 4,567,880 discloses an endoscopic device having a three-way valve forming a permanent portion of the handpiece of the endoscope. This system allows a physician to control the flow of irrigation fluid with the same hand as that used to hold the handpiece. However, the Goodman system requires a specially constructed endoscope, and the irrigation system is an integral part of the endoscope. This limits the irrigation system to use with one particular endoscope.

The present invention is directed to an improved system and method for controlling the flow of irrigation fluid in an endoscopic device.

SUMMARY

The preferred embodiment described below includes a modular valve assembly having a housing that carries an inlet port, an outlet port and a valve. The valve can be manually controlled by a user with the hand holding the endoscope to selectively allow or block fluid flow from the inlet port to the outlet port.

In use, the housing is releasably mounted to the handpiece of an endoscope by a pressure-sensitive adhesive, strap, or other fastener. The inlet port is connected to a source of pressurized irrigation fluid and the outlet port is connected to the irrigation port of the endoscope. The physician can then use a single hand to perform both the function of holding the handpiece and the function of controlling the flow of irrigation fluid. Typically, the physician holds the handpiece in the palm, using the thumb and fingers of one hand. The physician controls the flow of irrigation fluid with one finger of the hand that is holding the handpiece. This leaves the other hand free for performing a surgical procedure via the working port of the endoscope, e.g., positioning and manipulating a stone extraction basket. Once the surgical procedure is completed, the modular housing can simply be removed from the endoscope and discarded. This eliminates the need to clean the valve or the ports of the valve assembly.

The housing may be formed in one or more parts, and it may include a second valve to allow the physician to control the application of suction in addition to the flow of irrigation fluid.

This section has been provided by way of general introduction, and it should not be used to narrow the scope of the following claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a ureteroscope on which is mounted a modular valve assembly.

FIG. **2** is a top perspective view of the valve assembly of FIG. **1**, prior to mounting on the ureteroscope.

FIG. **3** is a bottom perspective view of the valve assembly of FIG. **2**.

FIG. **4** is a perspective view of the valve assembly of FIGS. **2** and **3** connected to a source of pressurized irrigation fluid.

FIGS. **5** and **6** are schematic views showing the valve of the valve assembly of FIGS. **1–3** in the opened and closed positions, respectively.

FIGS. **7** and **8** are schematic views of an alternative, rotary-motion valve in the opened and closed positions, respectively.

FIG. **9** is a fragmentary sectional view of another modular valve assembly of this invention mounted on a ureteroscope.

FIG. **10** is a fragmentary sectional view of yet another modular valve assembly of this invention.

FIG. **11** is a fragmentary sectional view of the ureteroscope of FIG. **10** and a cover plate.

FIG. **12** is a fragmentary sectional view of another modular valve assembly of this invention mounted on a ureteroscope.

FIG. **13** is a cross-sectional view of another modular valve assembly of this invention including a mechanical latch to hold the valve in a selected position.

FIGS. **14**, **15** and **16** are three sectional views of another modular valve assembly of this invention in three different positions.

FIG. **17** is a sectional view of another modular valve assembly of this invention.

FIGS. **18**, **19** and **20** are side views of three additional modular valve assemblies of this invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Turning now to the drawings, FIG. **1** is a perspective view of an endoscopic device **10** that in this embodiment is a ureteroscope. The ureteroscope **10** includes a handpiece **12** that carries an eyepiece **14** at one end and a shaft **16** at the other end. An irrigation port **18** is carried by the handpiece **12**, and irrigation fluid introduced via the irrigation port **18** is conducted to the viewing area at the end of the shaft **16** that is inserted into the patient. The handpiece **12** also defines an exterior surface **20**.

The endoscopic device **10** can take any suitable form, and the present invention is not limited to any particular embodiment. For example, the endoscopes of any of the following U.S. Patents can be adapted for use with this invention: Wallace U.S. Pat. No. 2,691,370, Ibe U.S. Pat. No. 4,132,227, Goodman U.S. Pat. No. 4,567,880, Cho U.S. Pat. No. 5,083,549, Muller U.S. Pat. No. 5,199,417, Bonati U.S. Pat. No. 5,290,279, and Odanacka U.S. Pat. No. 5,830,126. Conventional endoscopes such as the ureteroscopes manufactured by ACMI, Wolf, Olympus and Storz are also well-adapted for use with this invention. This list is intended only by way of illustration, in the widest variety of ureteroscopes, arthroscopes, laparoscopes, hysteroscopes, sinuscopes, and endoscopes adapted for other specialties can be used with this invention, including flexible, semi-rigid, and rigid endoscopes.

In use, the physician holds the handpiece with one hand, thereby presenting the eyepiece for viewing and positioning the shaft as desired. The other hand is typically used to manipulate surgical tools introduced into the patient via the working port on the shaft. As shown in FIG. **1**, a modular endoscope valve assembly **30** is releasably secured to the handpiece **12**. This valve assembly **30** is shown in greater detail in FIGS. **2** and **3**, and it includes an inlet port **32** and an outlet port **34**. In use the inlet port **32** is releasably connected to a source of pressurized irrigation fluid, and the outlet port **34** is releasably connected to the irrigation port **18** of the handpiece.

The valve assembly **30** includes a valve that is interposed between the inlet port **32** and the outlet port **34** and is controlled by a valve actuator **38**. The valve assembly **30** also includes a housing **50** that includes a mounting surface **52**. The mounting surface **52** carries a pressure-sensitive adhesive **40** initially covered by a release paper **46**. The housing **50** also supports a pair of straps **42** that include respective hook-and-loop fasteners **44**. A contrast-introduction port **48** is provided in fluid communication with the outlet port **34**. Check valves, not shown, can be provided to prevent flow from the outlet port **34** to the contrast-introduction port **48** and vice-versa.

FIG. **4** shows the manner in which the inlet port **32** of the valve assembly **30** can be releasably connected to a source of pressurized irrigation fluid, in this case contained within an IV bag **60**. The IV bag **60** is disposed within a pressure cuff **62** that can be inflated with an inflator **64** to a pressure indicated by a pressure gauge **66**. Standard Luer-lock fittings can be used to connect the inlet port **32** to a tube **68** that is in turn connected to the IV bag **60**. The IV bag contains a conventional irrigation fluid, which is pressurized by inflating the pressure cuff **62** to a desired pressure with the inflator **64**.

FIGS. **5** and **6** show two schematic views of the valve **36** of the valve assembly **30**. In FIG. **5** the valve actuator **38** is depressed and the valve **36** allows fluid flow from the inlet port **32** to the outlet port **34**. When manual pressure is removed from the valve actuator **38**, the valve **36** returns to the position of FIG. **6**, in which the valve **36** blocks the flow of fluid between the inlet and the outlet ports **32**, **34**. Alternatively, the valve **38** may be arranged such that fluid flow is blocked when the actuator **38** is depressed and unblocked when the actuator **38** is released.

The valve **36** of FIGS. **5** and **6** is a linear valve that slides along a linear axis between the opened position of FIG. **5** and the closed position of FIG. **6**. Other types of valves are suitable, including the linear valve of U.S. Pat. No. 4,238,108 and the rotary valve **80** of FIGS. **7** and **8**. A rotary valve **80** rotates about an axis between the opened position of FIG. **7** and the closed position of FIG. **8**, and the associated valve actuator (not shown in FIGS. **7** and **8**) moves in a rotary motion as well.

In use, the valve assembly **30** is distributed separately from the endoscope **10**. In this embodiment, the valve assembly **30** is shaped to fit on a wide variety of endscopes **10** such that the endoscope **10** does not have to be specially shaped or configured for the valve assembly **30**. Prior to an endoscopic procedure, the release paper **46** is removed, thereby exposing the pressure-sensitive adhesive **40** on the mounting surface **52**. Then the valve assembly **30** is placed on the exterior surface **20** of the endoscope **10**, and the pressure-sensitive adhesive **40** releasably holds the valve assembly **30** in place. The straps **42** are positioned around the handpiece **12**, and the hook-and-loop fasteners **44** are secured together to hold the valve assembly **30** in place.

Either before or after the valve assembly **30** is secured to the handpiece **12**, the inlet port **32** is releasably secured to the tube **68** (FIG. **4**) and the outlet port **34** is releasably secured to the irrigation port **18** of the handpiece **12** (FIG. **1**). Preferably, the valve assembly **30** is flushed after it is connected to the tube **68** and before it is connected to the irrigation port **18**.

The physician then performs the desired endoscopic procedure, using a single hand both to hold the handpiece **12** and to control the flow of pressurized irrigation fluid with the valve assembly **30**. A part of the hand that holds the handpiece (e.g. the fingers or the heel) is used to move the valve actuator.

Once the endoscopic procedure has been completed, the valve assembly **30** can simply be removed from the endoscope **10** by releasing the hook-and-loop fasteners **44** and lifting or twisting the valve assembly **10** away from the handpiece **12** until the pressure-sensitive adhesive **40** releases.

The valve assembly **30** described above uses both a pressure-sensitive adhesive and a set of straps to releasably secure the valve assembly **30** in place on the handpiece **12**. In alternative embodiments the adhesive may be used without the reinforcing straps, or the reinforcing straps can be used without the adhesive. The strap may be varied widely. For example, the strap may pass over the top of the valve assembly, and the actuator may pass through an opening in the strap. The strap may be fixed to the valve assembly or not. Also, other types of fasteners can be used to releasably hold the valve assembly in place on the endoscope.

FIG. **9** shows a second preferred embodiment **90** of the modular valve assembly of this invention. The valve assembly **90** is identical to the valve assembly **30** described above except for the manner of releasably attaching the valve assembly **90** to the handpiece **12'**. In this case the valve assembly **90** is provided with mechanical fasteners **92** and the handpiece **12'** is provided with mating mechanical fasteners **94** such that the valve assembly **90** can be snapped in place on the handpiece **12'** and removed from the handpiece **12'** as desired. In this example, the fasteners **92** take the form of protruding studs and the mating fasteners **94** take the form of recesses shaped to receive the fasteners **92** in a snap-lock action.

FIG. **10** shows portions of a third valve assembly **100** which is similar to that of FIG. **9** except that the fasteners **102** are shaped as recesses and the mating fasteners **104** are shaped as protruding studs that fit into the fasteners **102** in a snap-lock manner.

FIG. **11** shows the handpiece **12"** of FIG. **10** with a cover **110** snapped in place on the mating fasteners **104**. The cover **110** covers the mating fasteners **104** when a valve assembly is not in place on the handpiece **12"**.

FIG. **12** shows another modular valve assembly **120** mounted in place on the handpiece **12** of an endoscopic device. The valve assembly **120** includes an actuator **122**, an inlet port **124**, and an outlet port **126**. The valve assembly **120** is mounted on a base **130**, and the base **130** supports a spring clip **128** that is designed to fit at least partially around the handpiece **12** and to releasably hold the base **130** and therefore the valve assembly **120** in position on the handpiece **12**. The spring clip **128** is another example of a mechanical fastener that is suitable for releasably securing a modular valve assembly to an endoscopic device. In this example, the outer surface of the handpiece **12** can be considered a mating fastener that cooperates with the spring clip **128** to releasably hold the valve assembly **120** in place on the endoscopic device. The details of construction of the modular valve assembly **120** can be varied widely, in accordance with any of the other valve assemblies described in this specification.

FIG. **13** provides a sectional view of another modular valve assembly **140**. The modular valve assembly **140** includes a housing **142** that supports an inlet port **144** and an outlet port **146**. A valve element **148** is slidably received in a cylinder defined by the housing **142**, and the valve element **148** defines an annular recess **150**. The annular recess **150** completely encircles the valve element **148**, and thereby provides an interconnecting flow path between the inlet port **144** and the outlet port **146** when the recess **150** is aligned with the ports **144**, **146**. The valve element **148** is biased to the upper position shown in FIG. **13** by a spring **152**. The valve assembly **140** includes an actuator **156** that can be pressed downwardly by a finger of the user. A latch **154** is interposed between the actuator **156** and the valve element **148**, and the latch **154** operates to hold the valve element **148** in a selected position.

In use, the inlet port **144** is coupled to a source of irrigation fluid and the outlet port **146** is coupled to the irrigation port of an endoscopic device. In the position shown in FIG. **13**, the recess **150** is out of alignment with the inlet and outlet ports **144**, **146**, and no irrigation fluid is passed to the outlet port **146**. When the user presses the actuator **156** downwardly in the view of FIG. **13**, the recess **150** comes into alignment with the inlet and outlet ports **144**, **146**, thereby permitting irrigation liquid to flow to the endoscopic device. Further downward movement of the actuator **156** causes the latch **154** to hold the valve element **148** in a position in which the recess **150** is aligned with the inlet and outlet ports **144**, **146**. Once the latch **154** is engaged, the user can take his or her hand off of the actuator **156**, and high volume flow of irrigation fluid is maintained from the inlet port **144** to the outlet port **146**.

In order to stop the flow of irrigation fluid, the user again depresses the actuator **156**, thereby causing the latch **154** to release the valve element **148** to move upwardly, back to the position of FIG. **13**.

The valve assembly **140** allows the user to modulate the flow of irrigation fluid as described above as he or she gradually depresses the actuator **156**. The latch **154** also allows the user to latch the valve in the open position, until it is released by the user.

Many alternative structures can be used for the latch **154**. For example, the latch **154** can be constructed like the latch mechanism conventionally used with retractable ballpoint pens. Such latch mechanisms respond to first depression of the actuator by latching the latched element down, and they respond to a next depression of the actuator by allowing the latched element to move upwardly. This is only one example, and many alternatives are possible.

FIGS. **14**, **15** and **16** provide three views of another modular valve assembly **160** that can be used as described above. As best shown in FIG. **14**, the modular valve assembly **160** includes a housing **162** that supports a valve element **164** for sliding movement. The valve element **164** defines two spaced, annular recesses **166**, **168**, and the upper end of the valve element **164** forms an actuator **170**. The valve element **164** is biased to the upper position shown in FIG. **14** by a spring **178**.

The housing **162** supports first and second inlet ports **172**, **174** and aligned tubes **173**, **175** that are connected to an outlet port **176**. The first inlet port **172** in use is connected to a liquid source, such as a source of irrigation fluid. The second inlet port **174** in use is connected to a suction source, such as a partial vacuum. The outlet port **176** in use is connected to an irrigation port of an endoscopic device. Check valves, not shown, may be used to prevent flow from the tube **173** to the tube **175** and vice-versa.

In the rest position of FIG. **14**, the valve element **164** isolates both the first and second inlet ports **172**, **174** from the outlet port **176**. This is because the first inlet port **172** is out of alignment with the first recess **166**, and the second inlet port **174** is out of alignment with the second recess **168**.

FIG. **15** shows the valve assembly **160** in a second position, in which the user has depressed the actuator **170**, thereby compressing the spring **178** and bringing the first recess **166** into alignment with the first inlet port **172** and the tube **173**. In this position, irrigation fluid from the liquid source is passed by the assembly **160** to the outlet port **176**.

As shown in FIG. **16**, when the actuator **170** is further depressed, the first recess **166** is moved out of alignment with the first inlet port **172**, and the second recess **168** is moved into alignment with the second inlet port **174**. In this position, the valve assembly **160** allows suction from the suction source to pass via the second inlet port **174** and the second tube **175** to the outlet port **176**.

The modular valve assembly **160** of FIGS. **14** through **16** is intended to be removably attached to the handpiece of an endoscopic device, all as described above. Any of the mechanisms described above for releasably securing the valve assembly to the handpiece can be used. The valve assembly **160** provides all of the functions described above regarding the valving of irrigation fluid from the liquid

source to the outlet port **176**. In addition, the valve assembly **160** allows the physician efficiently and easily to introduce suction to the endoscopic device by moving the actuator **170** to the fully depressed position of FIG. **16**. Thus, a single valve assembly controls both the introduction of irrigation fluid and the application of suction to the irrigation port of the endoscopic device.

The valve assembly **160** utilizes a linear slide valve to implement the valving functions described above. It should of course be understood that this invention is not limited to such linear slide valves, and that the widest variety of valve mechanisms can be used to perform these valving functions.

FIG. **17** shows a sectional view of another modular valve assembly **180** also intended to be releasably secured to the handpiece of an endoscopic device as described above. The modular valve assembly **180** includes a housing **182** that supports first and second valve elements **184**, **185**. The first valve element **184** includes a first recess **186** and a first actuator **190**. The first valve element **184** is biased to the upper position shown in FIG. **17** by a spring **198**. In this upper position the valve element **184** blocks the flow of liquid between a first inlet port **192** and a tube **193**. As shown in FIG. **17**, the tube **193** is coupled to an outlet port **196**, which may in turn be coupled to an irrigation port of an endoscopic device as described above (not shown). When the first actuator **190** is depressed to bring the first recess **186** into alignment with the first inlet port **192** and the first tube **193**, irrigation fluid from a liquid source (not shown) passes from the first inlet port **192** to the outlet port **196**.

The second valve element **185** defines a second recess **188** and is biased to an upper position as shown in FIG. **17** by a second spring **199**. The upper portion of the second valve element **185** is coupled to a second actuator **191**. In this non-limiting example, the second actuator **191** is arranged so that the physician can reach it from any side of the valve assembly **180**. This can be accomplished by forming the upper portion of the actuator **191** as a ring that encircles the housing **182**. Alternatively, the actuator **191** may include a swivel, not shown, that allows the physician to rotate the upper portion of the actuator **191** to a desired angular position relative to the lower portion of the actuator **191** about an axis parallel to the sliding motion of the second valve element **185**. In the rest position shown in FIG. **17**, the second valve element **185** blocks the flow of suction from a second inlet port **194** to the tube **195** (which is in turn coupled to the outlet port **196**). When the user depresses the second actuator **191** to bring the second recess **188** into alignment with the second inlet port **194** and the second tube **195**, suction is applied to the outlet port **196**.

The modular valve assembly **180** is provided with adhesive straps, mechanical fasteners, spring clips or the like for releasably securing it to the handpiece of an endoscopic device (not shown). The modular valve assembly **180** allows the user to control the flow of irrigation fluid and the application of suction to the outlet port **196**. In this case, the user moves his or her finger between the first and second actuators **190**, **191** to provide irrigation fluid or suction to the outlet port **196**, respectively.

FIG. **18** shows another modular valve assembly **210** that performs all of the functions described above in conjunction with FIGS. **16** and **17**. The modular valve assembly **210** includes a housing **212**, **220** that supports two separate valves, each controlled by a respective actuator **214**, **222**. The actuator **214** controls the flow of irrigation fluid between a first inlet port **216** and an outlet port **218**, and the second actuator **222** controls the introduction of suction from the second inlet port **224** to the outlet port **218**. In this case the actuators **214**, **222** and the associated valves are positioned in side-by-side relationship, but at differing elevations to assist the user in discriminating between the two actuators **214**, **222**.

The modular valve assembly **230** of FIG. **19** is similar to the valve assembly **210**, except that in this case the two actuators are positioned at the same elevation.

The modular valve assembly **240** of FIG. **20** is similar to the modular valve assembly **230**, but in this case the two valves are mounted some distance from one another on the handpiece **12**. FIG. **20** shows the manner in which a housing may include two or more spatially separated parts.

The modular valve assemblies of FIGS. **12** through **20** are all intended to be releasably mounted to an endoscopic device and to allow the user to control the flow of at least irrigation fluid to the irrigation port of the endoscopic device. The modular valve assemblies of FIGS. **14** through **20** additionally allow the user to control the application of suction to the irrigation port. The valve assemblies of FIGS. **14** through **20** are used in the same manner as the valves described above, except that the first inlet port **172**, **192**, **212** is connected to a source of irrigation fluid and the second inlet port **174**, **194**, **224** is connected to a source of suction prior to the surgical procedure. This can be done either before or after the modular valve assembly **160**, **180**, **210**, **230**, **240** is releasably mounted to the handpiece of the endoscopic device.

It should be apparent from the foregoing description that the improved modular valve assembly of this invention provides the important advantage that little or no modification is required to a conventional endoscope, yet the physician using the endoscope is provided with improved control over the flow of irrigation fluid. In particular, the physician can use direct finger pressure to modulate the flow of irrigation fluid as desired, while still leaving one hand free for surgical procedures. In this way, the need for a trained surgical nurse is reduced, and the physician's control over irrigation fluid flow is improved. The valve assembly described above is well suited for use with a wide variety of endoscopes including modern, small endoscopes that are too small for built-in valves.

Of course, it should be understood that a wide range of changes and modifications can be made to the preferred embodiments described above. For example, the valve of the valve assembly can take any suitable form, and it is not limited to the specific examples described above. The motion used to open or close the valve **36** can be varied as appropriate for the application, and it can include a lifting motion, a depressing motion, a sliding motion parallel to the length of the handpiece, or a rotating motion as desired. As a further alternative, the valve may be implemented as an element that pinches a resilient tube to slow or block flow through the tube. Thus, the valve can be implemented as a one-piece or a multiple-piece system having sliding, hinged, rotating or other motions.

Similarly, the mechanical fasteners that releasably hold the valve assembly in place on the handpiece of the endoscope can take any suitable form, and such fasteners are not limited to the adhesives, straps, snap-lock studs, and recesses described above. Many other mechanical fasteners can be adapted for use with this invention, as for example linear or rotary guides (including, e.g., dovetail guides or bayonet sockets) and various types of resilient or bendable elements that releasably hold the valve assembly in place.

As used herein, the term "position" is intended broadly to encompass a range of positions. Thus, the valve may block

fluid flow between the inlet and outlet ports in a range of blocking positions and the valve may allow fluid to flow from the inlet port to the outlet port in a range of opened positions. The valve may be configured as an on/off valve or as a modulating valve.

The term "handpiece" is intended broadly to refer to the part of an endoscope that carries the eyepiece and is held by the user, whether referred to as the handpiece, the bridge, or by some other term by the manufacturer of the endoscope.

The term "housing" is intended broadly to include one-part housings as well as housings having two or more parts that may be physically integrated with one another or spatially separated from one another.

The term "valve" is intended broadly to encompass valves having one or more moveable valve elements controlling the flow of one or more fluids.

The term "inlet port" is intended broadly to refer to a port that is connected either to a fluid source or to a suction source.

Also, any suitable structure can be used for pressurizing the irrigation liquid, including simple gravity feeds in some examples.

The foregoing detailed description has discussed only a few of the many forms that this invention can take. This detailed description is therefore intended by way of illustration and not by way of limitation. It is only the following claims, including all equivalents, that are intended to define the scope of this invention.

What is claimed is:

1. A medical endoscope with a releasably mounted modular endoscope valve assembly comprising:

a medical endoscope comprising an exterior surface and an irrigation port; and

a modular endoscope valve assembly releasably mounted to the exterior surface of the endoscope, the modular endoscope valve assembly comprising:

a housing comprising an inlet port, an outlet port, and a mounting surface, wherein the outlet port is releasably connected to the irrigation port of the endoscope;

a valve carried by the housing and coupled between the inlet port and the outlet port, the valve comprising a manually-controlled actuator movable by a user between a first position, in which the valve blocks flow between the inlet port and the outlet port, and a second position, in which the valve allows flow between the inlet port and the outlet port; and

a pressure-sensitive adhesive carried by the mounting surface, wherein the mounting surface of the housing is releasably held in place on the exterior surface by the adhesive.

2. The invention of claim **1** wherein the endoscope comprises a ureteroscope.

3. A medical endoscope with a releasably mounted modular endoscope valve assembly comprising:

a medical endoscope comprising an exterior surface and an irrigation port; and

a modular endoscope valve assembly releasably mounted to the exterior surface of the endoscope, the modular endoscope valve assembly comprising:

a housing comprising an inlet port, an outlet port, and a mounting surface, wherein the outlet port is releasably connected to the irrigation port of the endoscope;

a valve carried by the housing and coupled between the inlet port and the outlet port, the valve comprising a manually-controlled actuator movable by a user between a first position, in which the valve blocks flow between the inlet port and the outlet port, and a second position, in which the valve allows flow between the inlet port and the outlet port; and

a strap carried by the housing, wherein the mounting surface of the housing is releasably held in place on the exterior surface by the strap.

4. The invention of claim **3** wherein the endoscope comprises a ureteroscope.

5. A medical endoscope with a releasably mounted modular endoscope valve assembly comprising:

a medical endoscope comprising an exterior surface and an irrigation port; and

a modular endoscope valve assembly releasably mounted to the exterior surface of the endoscope, the modular endoscope valve assembly comprising:

a housing comprising an inlet port, an outlet port, and a mounting surface, wherein the outlet port is releasably connected to the irrigation port of the endoscope;

a valve carried by the housing and coupled between the inlet port and the outlet port, the valve comprising a manually-controlled actuator movable by a user between a first position, in which the valve blocks flow between the inlet port and the outlet port, and a second position, in which the valve allows flow between the inlet port and the outlet port; and

a mechanical fastener carried by the mounting surface, the mechanical fastener releasably engaged with a mating fastener on the endoscope.

6. The invention of claim **1** or **5** further comprising a strap carried by the housing and operative to releasably secure the housing to the endoscope.

7. The invention of claim **5** wherein the endoscope comprises a ureteroscope.

8. The invention of claim **5** wherein the mechanical fastener comprises a spring clip, and wherein the mating fastener comprises a surface of the endoscope shaped to engage the spring clip.

9. The invention of claim **1**, **3** or **5** wherein the actuator is mounted to slide linearly between the first and second positions.

10. The invention of claim **1**, **3** or **5** wherein the actuator is mounted to rotate between the first and second positions.

11. The invention of claim **1**, **3** or **5** wherein the outlet port comprises a contrast-introduction port.

12. The invention of claim **1**, **3** or **5** further comprising a latch coupled with the valve and operative to releasably hold the valve in a selected state in response to a control input by the user.

13. The invention of claim **12** wherein the latch is coupled to the actuator and operative to hold the valve in a state that allows flow between the inlet port and the outlet port in response to user manipulation of the actuator.

14. The invention of claim **1**, **3** or **5**, wherein the inlet port comprises a first inlet port, wherein the housing further comprises a second inlet port, wherein the valve blocks flow between the second inlet port and the outlet port in the first and second positions, and wherein the actuator is movable by the user to a third position, in which the valve allows flow between the second inlet port and the outlet port while blocking flow between the first inlet port and the outlet port.

15. The invention of claim **14** wherein the first inlet port is connected to a fluid source, and wherein the second inlet port is connected to a suction source.

16. The invention of claim **1**,**3** or **5** further comprising:

a second inlet port included in the housing;

a second valve carried by the housing and coupled between the second inlet port and the outlet port, the second valve comprising a manually controlled second actuator movable by the user between a third position, in which the second valve blocks flow between the second inlet port and the outlet port, and a fourth position, in which the second valve allows flow between the second inlet port and the outlet port.

17. The invention of claim **16** wherein the first inlet port is connected to a liquid source, and wherein the second inlet port is connected to a suction source.

18. A method for enhancing control efficiency of a medical endoscope, the method comprising:

(a) providing a medical endoscope comprising an exterior surface and an irrigation port;

(b) providing a modular endoscope valve assembly comprising:

a housing comprising an inlet port, an outlet port, and a mounting surface;

a valve carried by the housing and coupled between the inlet port and the outlet port, the valve comprising a manually-controlled actuator movable by a user between a first position, in which the valve blocks flow between the inlet port and the outlet port, and a second position, in which the valve allows flow between the inlet port and the outlet port;

a pressure-sensitive adhesive carried by the mounting surface;

(c) releasably securing the valve assembly to the exterior surface of the endoscope with the adhesive;

(d) removably coupling the outlet port of the valve assembly to the irrigation port of the endoscope; and then

(e)removing the valve assembly from the exterior surface of the endoscope after a surgical procedure.

19. The method of claim **18** wherein the valve assembly of (b) further comprises a strap carried by the housing.

20. The method of claim **19** further comprising:

(f) releasably securing the valve assembly to the endoscope with the strap after (c) and before (e).

21. A method for enhancing control efficiency of a medical endoscope, the method comprising:

(a) providing a medical endoscope comprising an exterior surface and an irrigation port;

(b) providing a modular endoscope valve assembly comprising:

a housing comprising an inlet port, an outlet port, and a mounting surface;

a valve carried by the housing and coupled between the inlet port and the outlet port, the valve comprising a manually-controlled actuator movable by a user between a first position, in which the valve blocks flow between the inlet port and the outlet port, and a second position, in which the valve allows flow between the inlet port and the outlet port;

a strap carried by the housing;

(c) releasably securing the valve assembly to the exterior surface of the endoscope with the strap;

(d) removably coupling the outlet port of the valve assembly to the irrigation port of the endoscope; and then

(e) removing the valve assembly from the exterior surface of the endoscope after a surgical procedure.

22. A method for enhancing control efficiency of a medical endoscope, the method comprising:

(a) providing a medical endoscope comprising an exterior surface and an irrigation port;

(b) providing a modular endoscope valve assembly comprising:

a housing comprising an inlet port, an outlet port, and a mounting surface;

a valve carried by the housing and coupled between the inlet port and the outlet port, the valve comprising a manually-controlled actuator movable by a user between a first position, in which the valve blocks flow between the inlet port and the outlet port, and a second position, in which the valve allows flow between the inlet port and the outlet port;

(c) releasably securing the valve assembly to the exterior surface of the endoscope;

(d) removably coupling the outlet port of the valve assembly to the irrigation port of the endoscope; and then

(e) removing the valve assembly from the exterior surface of the endoscope after a surgical procedure.

23. The method of claim **22** wherein the valve assembly provided in (b) comprises a mechanical fastener, and wherein (c) comprises engaging the mechanical fastener with the exterior surface of the endoscope.

24. The method of claim **23** wherein the mechanical fastener comprises a spring clip shaped to fit at least partially around the endoscope.

25. The invention of claim **22**, wherein the modular endoscope valve assembly comprises a pressure-sensitive adhesive carried by the mounting surface, and wherein (c) comprises releasably securing the valve assembly to the exterior surface of the endoscope with the adhesive.

26. The invention of claim **22**, wherein the modular endoscope valve assembly comprises a strap carried by the housing, and wherein (c) comprises releasably securing the valve assembly to the exterior surface of the endoscope with the strap.

27. The invention of claim **22**, wherein the modular endoscope valve assembly comprises a resilient element carried by the housing, and wherein (c) comprises releasably securing the valve assembly to the exterior surface of the endoscope with the resilient element.

28. The method of claim **18**, **21** or **22** wherein the valve assembly provided in (b) further comprises a latch coupled with the valve and operative to releasably hold the valve in a selected state in response to a control input by the user.

29. The method of claim **28** wherein the latch is coupled to the actuator and operative to hold the valve in a state that allows flow between the inlet port and the outlet port in response to user manipulation of the actuator.

30. The method of claim **18**, **21** or **22**, wherein the inlet port comprises a first inlet port, wherein the housing provided in (b) further comprises a second inlet port, wherein the valve blocks flow between the second inlet port and the outlet port in the first and second positions, and wherein the actuator is movable by the user to a third position, in which the valve allows flow between the second inlet port and the outlet port while blocking flow between the first inlet port and the outlet port.

31. The method of claim **30** further comprising:

(f) connecting the first inlet port to a liquid source prior to (e); and

(g) connecting the second inlet port to a suction source prior to (e).

32. The method of claim **18**, **21** or **22** wherein the housing provided in (b) further comprises a second inlet port, and

wherein the valve assembly provided in (b) further comprises a second valve carried by the housing and coupled between the second inlet port and the outlet port, the second valve comprising a manually controlled second actuator movable by the user between a third position, in which the second valve blocks flow between the second inlet port and the outlet port, and a fourth position, in which the second valve allows flow between the second inlet port and the outlet port.

33. The method of claim **32** further comprising:

(f) connecting the first-mentioned inlet port to a liquid source prior to (e); and

(g) connecting the second inlet port to a suction source prior to (e).

34. A modular endoscope valve assembly comprising:

a housing comprising an inlet port, an outlet port, and a mounting surface shaped to mount on at least three locations on an endoscope;

a valve carried by the housing and coupled between the inlet port and the outlet port, the valve comprising a manually-controlled actuator movable by a user between a first position, in which the valve blocks flow between the inlet port and the outlet port, and a second position, in which the valve allows flow between the inlet port and the outlet port; and

a resilient element coupled with the housing and operative to releasably secure the housing to the endoscope.

35. The invention of claim **34** further comprising a pressure-sensitive adhesive carried by the mounting surface and operative to releasably secure the housing to the endoscope.

36. The invention of claim **34** further comprising a strap carried by the housing and operative to releasably secure the housing to the endoscope.

37. The invention of claim **34**, wherein the endoscope comprises a ureteroscope.

38. The invention of claim **34** further comprising a latch coupled with the valve and operative to releasably hold the valve in a selected state in response to a control input by the user.

39. The invention of claim **38**, wherein the latch is coupled to the actuator and operative to hold the valve in a state that allows flow between the inlet port and the outlet port in response to user manipulation of the actuator.

40. The invention of claim **38**, wherein the inlet port comprises a first inlet port, wherein the housing further comprises a second inlet port, wherein the valve blocks flow between the second inlet port and the outlet port in the first and second positions, and wherein the actuator is movable by the user to a third position, in which the valve allows flow between second inlet port and the outlet port while blocking flow between the first inlet port and the outlet port.

41. The invention of claim **40** wherein the first inlet port is connected to a fluid source, and wherein the second inlet port is connected to a suction source.

42. The invention of claim **34** further comprising:

a second inlet port included in the housing;

a second valve carried by the housing and coupled between the second inlet port and the outlet port, the second valve comprising a manually controlled second actuator movable by the user between a third position, in which the second valve blocks flow between the second inlet port and the outlet port, and a fourth position, in which the second valve allows flow between the second inlet port and the outlet port.

43. The invention of claim **42** wherein the first inlet port is connected to a liquid source, and wherein the second inlet port is connected to a suction source.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

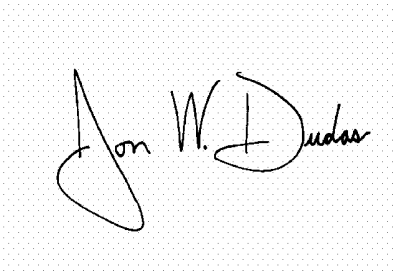
PATENT NO. : 6,666,818 B2
DATED : December 23, 2003
INVENTOR(S) : Avtar S. Dhindsa

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [73], Assignee, delete "Porter," and substitute -- Valparaiso, -- in its place.

Signed and Sealed this

Fifth Day of October, 2004



JON W. DUDAS
Director of the United States Patent and Trademark Office

专利名称(译)	模块化内窥镜阀组件和方法		
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摘要(译)

模块化内窥镜阀组件可释放地安装在内窥镜的手持件上。该阀组件包括入口端口，出口端口和可手动操作的阀门，该阀门可选择性地阻塞并允许冲洗流体从入口端口流到出口端口。阀组件通过机械紧固件（例如压敏粘合剂，带子，弹簧锁或其它）可释放地保持在内窥镜的手持件上。一旦阀组件可释放地安装到手持件上，使用内窥镜的医生可以用与支撑手持件的手相同的手手动控制冲洗流体的流动，并且可选地抽吸，从而使医生的另一只手保持自由用于外科手术。本发明的模块化阀组件可以与最广泛的内窥镜一起使用，包括柔性，刚性和半硬性输尿管镜以及各种经皮内窥镜。