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(71) Applicant: **IANTECH, INC.** [—/US]; 707 Oregon Avenue, San Mateo, CA 94402 (US).

(72) Inventors: **CLAUSON, Luke**; 8747 Technology Way, Reno, NV 89521 (US). **CHAMNESS, Scott**; 903 Timothy Lane, Menlo Park, CA 94025 (US). **SCHALLER, Michael**; 107 Oakwood Drive, Redwood City, CA 94061 (US).

(74) Agent: **HOEKENDIJK, Jens**; Law Office of Jens Hoekendijk, 135 Oliver Street, Daly City, CA 94014 (US).

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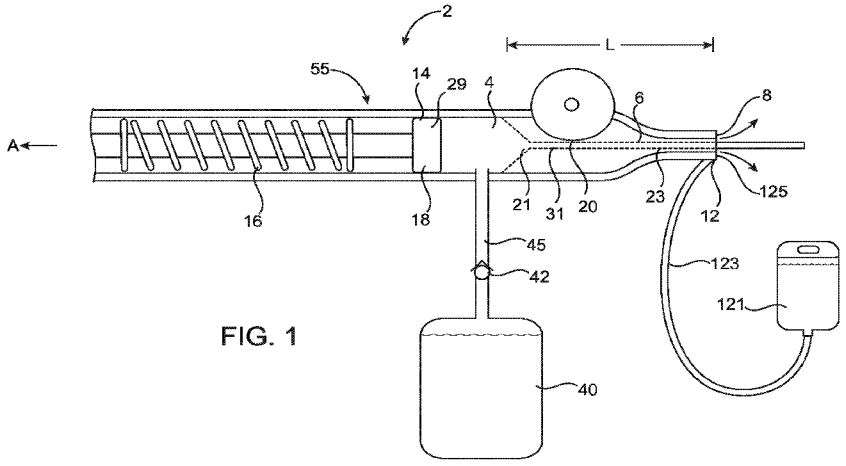


FIG. 1

(57) Abstract: A hand-held aspiration device is provided which has a relatively small suction volume along a suction path to improve responsiveness of the aspiration device when the device is activated. The device may be manually powered and may be provided without electronic controls. The device has a suction path which may be purged into a disposal enclosure to reduce the volume of material under the influence of the suction pressure during the procedure. The suction source may also be part of the hand-held unit to further reduce the suction path and suction volume.

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DEVICES AND METHODS FOR OCULAR SURGERY

FIELD OF THE INVENTION

This invention generally relates to devices and methods for ocular surgery with one such procedure being removal of a lens from a human eye. More specifically the invention relates to capturing, fragmenting and extracting of lenticular or other tissue in ophthalmic surgery.

BACKGROUND

Certain types of conventional ophthalmic surgery require breaking up lenticular tissue and solid intraocular objects, such as the intraocular lens into pieces so that it can be extracted from the eye. For example, extraction of lenses for cataract surgery is one of the most common outpatient surgical fields with more than 3 million cases performed annually in the United States alone. During cataract surgery a commonly used method for lens extraction is phacoemulsification which uses ultrasonic energy to break up the lens and then aspirate the lens fragments through the instrument. Other methods of lens fragmentation and extraction may include the use of instruments such as hooks, knives, or laser to break up the lens into fragments and then extract through an incision in the cornea in an ab-interno approach. Intraocular, ab-interno fragmentation of the lenticular tissue is extremely important in cataract surgery in order to allow removal of cataracts from ocular incisions which are typically not exceeding 2.8-3 mm.

A disadvantage of some lens extraction techniques are unwanted complications from aspiration of the lens particularly with the use of phacoemulsification. Ultrasonic energy and high volume during phacoemulsification may create turbulent flow which may have a deleterious effect on the tissue within the eye such as the corneal endothelium.

A device or method which is capable of extracting lenticular tissue from the anterior chamber without damaging other ocular structures would be a significant advantage to existing tools and techniques.

Additionally, certain aspiration and inspiration configurations require large pieces of capital equipment as in the case of phacoemulsification or may require certain resources such as wall vacuum which may not be available in all surgical settings particularly in under developed areas.

A device or method which is capable of inspiration or aspiration with less capitally intensive equipment would be a significant benefit to many surgical settings. The aspiration device may be an independent tube or cannula or may be associated with another device such as a phacoemulsification unit ("phaco system"). Flow control and pressure control of phaco systems typically requires electronic control by a main console. A handpiece is used which has a suction line extending from the handpiece to the main console. The handpiece also typically has an inspiration line with inspiration driven by simple gravity feed or by flow controlled by the main console with a fluid bag/cartridge mounted to the console.

Another problem with phaco devices and other devices using a remote vacuum source is that the suction lines are long which means that they will often contain compressible material during the

procedure, such as gas or compressible tissue, which affects the responsiveness of suction at the tip when suction is turned on and off. The problem of responsiveness is exacerbated by manually deformable/compliant hoses and lines which also respond to changes in pressure when starting and stopping suction which further delays initiation and termination of suction at the tip. Yet another problem with some systems is that the disposal enclosure is also exposed to vacuum pressure and, as such, the container and gas or other compressible material therein, also responds to changes in pressure and further contributing to the delay in initiation and termination of suction at the tip and contributing to the low responsiveness of some systems.

Still another problem with conventional methods and devices for aspirating material from the eye is that the suction opening can readily clog during the procedure. Suction must be stopped and, if necessary, the material removed independently with another instrument inside the eye. The necessity to stop the procedure and unclog the distal opening undesirably increases the procedure time and need for unnecessary manipulations of the instrument(s) in the eye.

A final problem with some devices is the cost and complexity of the systems. A lower cost alternative with the same or better performance would also be desirable alternative such as one not requiring a costly control console and electronic control system.

SUMMARY OF THE INVENTION

What is invented are novel methods and devices for intraocular fragmentation and removal of the lens and other tissues during intraocular surgery. In various embodiments an ocular surgical device is described which utilizes cutting strings, filaments, snares, baskets, bags, loops and other devices designed to engage and fragment the lenticular tissue and aid in its removal from the eye in a minimally invasive, ab-interno approach.

In other embodiments, novel devices and methods for inspiration and aspiration of fluids from the eye are described.

The aspiration device has improved responsiveness compared to some prior art devices using remote suction devices with long manually deformable/compliant suction lines. In one aspect of the present invention, a hand-held device is provided which may also be powered (manually) by the user and does not require electronic control. The device may further have a short suction path with a small suction volume. The device may include a hand-held suction source which, of course, eliminate the need for hoses from the handpiece to the console thereby greatly reducing the length of line and also the amount of material subject to the suction pressure which may compress or expand to reduce responsiveness.

In another aspect of the present invention, the device has a purging mechanism which purges the material from the suction path and into the disposal enclosure. The purging mechanism may be part of the suction device or may be a separate mechanism. In a specific aspect, the purging mechanism is a plunger which pushes the material in direction opposite the suction direction and into the disposal enclosure. A valve, which may be a one-way valve, permits the material to enter the disposal enclosure. The valve (or one-way valve) may also prevent the material from entering the disposal enclosure when material is suctioned along the suction path during use.

Purging the suction path during the procedure reduces the volume of material in the suction path compared to systems having long fluid lines to remote suction systems. Purging the suction line may occur in-between suction times and may be accomplished using a movable element which also creates the suction pressure. In a specific aspect, the movable element may be a spring-loaded plunger which is manually set.

In still another aspect, the suction device may include a movable element within the suction path. For example, the suction device may be the spring-loaded plunger which is manually actuated. Of course, any other suction device may be used including a pneumatic system with bladders and/or balloons, a deformable wall and roller system, or any other suitable system for creating suction pressure such as a venturi. The movable element of the suction device of the present invention may also be used to purge the suction path but the two functions may, of course, be separated and performed in different manners without departing from various and independent aspects of the present invention.

The present invention is also directed to reducing the likelihood of clogging by providing a restrictor which restricts material in the vicinity of the distal opening. The restrictor reduces the likelihood of clogging by restricting the material that can enter the distal opening. The restrictor may also be movable (longitudinally and/or rotationally) to clear material from in and around the opening and to gather material as well.

The present invention also includes a tissue manipulator and method of manipulating tissue. The tissue manipulator has a shaft having a lumen with a distal opening, A first loop has a first leg and a second leg with at least one of the first and second legs extending through the lumen. The first loop is movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the lumen and out the distal opening in the lumen. A second loop has a first leg and a second leg with at least one of the first and second legs extending through the lumen. The second loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the lumen and out the distal opening in the lumen. The shaft may be sized for introduction of a distal end of the shaft into an eye.

The first loop may have an unbiased shape which bounds an area defined in an orientation that maximizes the area. The area has an effective diameter which is equal to the diameter of a circle having the same area. The first loop moves toward the unbiased shape when moving from the collapsed position to the expanded position. The effective diameter of the area of the first loop is 4.5 mm to 6.5 mm or can be 5.0 mm to 6.0 mm in the expanded position. The effective diameter of the unbiased shape of the second loop may be within 20% of an effective diameter of the expanded position of the first and/or second loops. In this manner, the first and/or second loops provide for a soft deployment and are flexible during use. Use of a superelastic material further enhances the flexibility of the first and second loops. To this end, the first and second loops may be formed of superelastic wire having a diameter of about 0.003 inch although any size may be used with any suitable cross-sectional shape.

The tissue manipulator may also include an intermediate element positioned between the first loop and the second loop. The intermediate element may be a third loop positioned between the first loop and the second loop. The intermediate element may include an interconnecting element extending between the first loop and the second loop. The interconnecting element may be integrally formed with the first loop and the second loop. Alternatively, the interconnecting element may be a flexible filament extending between the first loop and the second loop. The third loop may have the features of the first and second loops.

The first and second loops provide a controlled amount of exposed surface therebetween to control, and optionally cut, a controlled amount of the material. The exposed surface between the first loop and the second loop has an area of 15 mm(3) to 60 mm(3). Stated another way, the exposed surface between the first loop and the second loop is 3-10 times the effective diameter in the expanded position (or the unbiased position since they may be the same).

The exposed surface between the first loop and the second loop may have 2-8, 2-6, 2-4 or even just 2 independent cells when viewed in a radially inward direction relative to the orientation axis of the first and second loops. The exposed surface has an area which is at least 4 times larger than an surface area of the intermediate element when expanded between the first and second loops and viewed radially inward with respect to the loops. In this manner, the intermediate element does not take up an excessive amount of room as compared to some net-type devices.

The device may include a first support element extending from a distal end of the shaft when the first loop is expanded. The first support element may be an elongate element that extends to a free end. The first support element is positioned with the free end positioned within an area of the first loop when viewing the first loop along an orientation that maximizes the area of the first loop. A second support element which cooperates with the second loop in the same manner may also be provided. The first loop and/or second loop may have at least one interconnecting element extending from a first connection to the first loop to a second connection to the first loop or may be substantially free of any such interconnecting elements depending upon the desired use.

In yet another aspect of the present invention, the tissue manipulator has a concave element coupled to a first loop to form a basket. The concave element may have one end integrally formed with the first loop with the other end movable within the lumen independent of the first and second legs. Alternatively, both ends may be integrally formed with the loop. A second loop having another concave element may be provided to form another basket with the two baskets being movable relative to one another between a nested position and a position in which the two baskets oppose one another.

In use, the device is introduced into the eye with a distal end and distal opening of the shaft inside the eye. The first loop is expanded and the second loop is also expanded (simultaneously or independently). Material is positioned within the first and/or second loop and then the first and/or second loop is collapsed around the material to contain, manipulate or cut the material. Furthermore, a suction source may be coupled to the lumen to suction the material, fluid, and the

cut material into the lumen or another lumen. The method may include all features of the device which are expressly incorporated here for all purposes.

In another aspect of the present invention, another device is provided which has a shaft having an elongate element that is bowed outwardly by biasing the elongate element with a load when deployed. The loop is movable from a collapsed position to an expanded position when a first shaft part (coupled to the first end of the elongate element) and a second shaft part (coupled to the second end of the elongate element) are moved relative to one another from a first position to a second position. Material is positioned in the loop and then cut by collapsing the loop. The loop may be expanded so that the loop advances between the capsular bag and a whole lens contained within the capsular bag.

The elongate element may have a first and a second flexible portion with an intermediate portion therebetween which is at least 1.5 more stiff in bending than the flexible portions. In another aspect, the first end may change in orientation relative to the proximal end of the shaft when deployed. The change in orientation may be provided by simply pinning or otherwise rotatably coupling the first end to the shaft so that the angle (orientation) changes by at least 120 degrees or 180 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position. The distal end of the shaft may also include a flexible portion which changes in orientation relative to the proximal portion of the shaft when the loop is expanded. The distal end may change in orientation by at least 30 degrees. The first end rotates so that the loop advances distally beyond a distal end of the shaft as the loop moves from the collapsed position to the expanded position. The second end may also be rotatably coupled to the shaft or may include the flexible portion. Use of and discussion of all aspects of the first flexible portion or the first end are equally applicable to the second end and are specifically incorporated herein. Furthermore, a mixture of first end and second end are also expressly incorporated such as a flexible first end and a rotatable second end.

These and other aspects and features will become evident from the following description of the preferred embodiments, drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a device for suctioning material.

Fig. 2 shows another device for suctioning material.

Fig. 3A shows still another device for suctioning material.

Fig. 3B shows an alternative suction source using a bellows.

Fig. 4 shows yet another suction device using a venture.

Fig. 5 shows still another suction device having a bladder as the suction source.

Fig. 6A shows a flow restrictor covering an opening in a shaft and in a stored position in the dotted-line position.

Fig. 6B shows the flow restrictor movable longitudinally relative to the shaft with the dotted line position showing a working position.

Fig. 6C shows show an alternative shaft having a y-arm.

Fig. 7 shows an end view of the flow restrictor.

Fig. 8A shows a tissue manipulator in a collapsed position within a lumen of a shaft.

Fig. 8B shows the tissue manipulator expanded with filaments extending between loops.

Fig. 8C shows another view of the loops with the filaments removed.

Fig. 9 shows another tissue manipulator with integrally formed intermediate elements.

Fig. 10 shows another tissue manipulator with integrally formed intermediate elements.

Fig. 11 shows still another tissue manipulator with a net-like material within the loops.

Fig. 12 shows still another tissue manipulator having a loop with an integrally formed concave element.

Fig. 13 shows still another tissue manipulator with a rotating cutter.

Fig. 14 shows another tissue manipulator with a net-like material.

Fig. 15 shows still another tissue manipulator.

Fig. 16 shows a tissue manipulator having two opposing baskets.

Fig. 17 shows the opposing baskets in a nested position.

Fig. 18A shows a device for cutting material within the eye.

Fig. 18B shows a side view of the device of Fig. 19A.

Fig. 18C shows the device of Fig. 19A with an elongate element deformed to expand a loop formed by the device.

Fig. 18D shows the device of Fig. 19C further expanded.

Fig. 19 shows the device of Fig. 19A-D full expanded and positioned within a capsular bag and advanced between the capsular bag and the lens when the loop is expanded.

Fig. 20A shows another cutting device in a collapsed position.

Fig. 20B shows the device of Fig. 21A partially expanded with the distal end changing oricntation with respect to the proximal end of the shaft.

Fig. 20C shows a loop formed by the device advancing distally.

Fig. 21A shows the loop expanded further.

Fig. 21B shows the loop expanded with the proximal end of the elongate element also changing orientation with respect to the shaft.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

During cataract surgery it is desirable to have a supply of balanced saline solution (BSS) delivered to the eye as well as a supply of suction to remove fluids and other materials. Certain ophthalmic surgical tips have the ability to inspirate and aspirate fluid through dual lumen designs. These devices must be connected to a supply of suction and pressurized BSS fluid.

In some embodiments, the invented device includes the ability to provide suction or BSS pressurized fluid through simple mechanisms, some of which may be manually powered or regulated. In Fig. 1 a separate plunger device is shown which may be depressed in order to create a vacuum which provides suction when connected to the hand piece. The hand piece may also be connected to a pressurized BSS source such as a hanging bag or any number of other pressurized sources such as spring loaded syringes and the like. Alternatively vacuum may be supplied by any number of other mechanisms such as a bellows mechanism, diaphragm pump, venturi pump, entrapment pump, positive displacement pump, regenerative pump, momentum transfer pump, sealed containers of vacuum that are released, micro pumps, or the like. When connected to a hand piece, suction is supplied to the tip to provide aspiration. In one embodiment, a compressible bulb such as a turkey baster may be used to provide suction. The user may depress the bulb with a finger and control the amount of suction by the release of the finger from the bulb. Other lever mechanisms may additionally create vacuum in a hand held instrument. In some embodiments, a nurse or assistant may create vacuum with a device that is connected to the hand held instrument. For example, a foot pedal may be used to create suction that is connect to the surgeons device. The hand piece may contain any number of waste containers that contain the withdrawn fluid and store it in the hand piece or off the hand piece. The various vacuum mechanisms may be powered in any number of ways such as a manual operation by the user or assistant. In this embodiment, the user may 'charge' the device with energy such as by depressing a spring loaded plunger before beginning the procedure and then controlling the amount of vacuum with a valve or other input mechanism. In some embodiments, the BSS pressurized supply may be coupled to the hand piece and may be 'charged' at the same time as the vacuum or separately. For example, the surgeon may depress one plunger that creates a spring force on the vacuum and the BSS fluid such that the surgeon may control the release of both with a single button or multiple buttons during the procedure. In other embodiments, the BSS may be in a hanging bag or other pressurized system and piped into the handpiece.

In some embodiments, the hand piece may include a flow control valve for additionally allowing the surgeon to select the rate or pressure of the fluids aspirated or inspirated. The surgeon may adjust the amount of flow desired by rotating a knob that compresses a tube a certain amount or opens a ball valve a certain amount or any number of other flow control mechanisms. The device may also include a button that can be depressed to regulate when the device is inspirating or aspirating. The amount the surgeon depresses the button may in itself control the variable flow. There may be a single button for controlling inspiration and aspiration or individual buttons for each. It should be understood that button simply means a control interface for the

user and that any number of interfaces may be contemplated. Additionally the control interface may be on the hand held device or may be in another location. For example a foot pedal may be used to control the flow or a separate device held with a different hand may be used.

In some embodiments, the device may include a dual lumen design for inspiration and aspiration. In other embodiments, there may be more than 2 lumens or the lumens may be oriented concentrically.

In various other embodiments, device and methods for the removal or fragmentation of the lenticular tissue is described. Bags or meshes which are attached to snares or loops may be incorporated to grab lenticular tissue that is either whole or partially fragmented. The bags and meshes may be used to pull the tissue from the eye through a paracentesis. In some embodiments, a separate tool may be inserted into the bag or mesh after a fragment of the lens is captured and the separate tool may be used to break the tissue into smaller fragments. For example, a spinning cutter instrument may be inserted either with a different device or through a lumen of the bag device to cut the tissue into smaller pieces while it is within the bag or container so that may be withdrawn through the paracentesis.

In other embodiments, various baskets are used to capture the lens material and either pull it from the eye or further fragment the material into smaller pieces that may be aspirated. In each embodiment, the bags and meshes and baskets may be made of any number of materials. For example, nitinol material may be used and shaped into the proper orientation. Certain material such as nitinol may be elastically changed between multiple shapes and used to enter the eye through a small profile and expand within the eye to capture the lens material. Any number of shapes are contemplated such as coin purses, expanding balloons, curved bags, and the like. The devices may be comprised any plurality of materials such as stainless steel, nitinol, biocompatible plastics, and the like. Additionally, nitinol may be used in either its super elastic state or shape memory state or both in multiple components.

In some embodiments, cutter and augers and the like may be used to mechanically fragment the lens into multiple pieces. These devices may additionally include integrated suction for the aspiration of the lens material.

The aspects of the invention mentioned above are applicable to all suitable embodiments described herein. Thus, use of nitinol as described above is applicable to all suitable aspects concerning any cutting filament, element or device described herein. Similarly, any aspect of the aspiration device described above are equally applicable to all aspiration embodiments described herein. Finally, the features, aspects and methods of using each of the devices and methods is equally applicable to the other devices and methods described herein (including cutting) and all such features are expressly incorporated herein.

Referring to Fig. 1, a device 2 for removing material during procedures on the eye is shown. The device 2 has a suction path 4 which extends through a lumen 6 to an opening 8 in the lumen 6 at or near a distal end 12 of the lumen 6. The opening 8 is positioned in the eye for removal of material from the eye. A suction source 14 is coupled to the suction path 4 to draw material into the opening 8. The suction source 14 is a manually loaded spring 16 coupled to a plunger 18 but

may be any other suitable source. The suction source 14 is also hand held providing for a short suction path 4 and the benefits of such a short path and small suction volume within the suction path 4.

The suction path 4 has a proximal suction volume 21 which may be substantially under the influence of suction pressure by the suction source 14 at all times so that the system is prepared or "primed," in a sense, to suction material. An actuator 20 is positioned near the opening 8 with the proximal volume of the suction path 4 less than 25 ml and already under suction pressure proximal to the actuator. The proximal volume is defined by the volume of the suction path 4 between the actuator and the suction source 14 (in this case the plunger 18). A distal volume 23 of the suction path 4 is also small since the actuator 20 is positioned relatively near the opening 8 and may be less than 2 ml. The actuator may be movable to a number of different positions and may be continuously variable to allow for the desired amount of suction by the user as described herein and specifically incorporated here. The term actuator 20 is used herein to refer to the element that acts on the suction path 4. A button 25 acts as an interface, however, the button or interface may be remote to the actuator 20. In this case, the button 25 acts directly on the actuator and may also have elastic properties itself.

The suction source 14 may have a movable element 29, such as the plunger 18, which is displaced in a direction shown by arrow A to draw the material into the opening and through the suction path 4. The movable element is displaced in an opposite direction to the direction A to move material into the suction path 4 into the disposal enclosure as explained in greater detail below in association with purging of the suction path 4.

The suction source 14 is hand-held in that the movable element is part of a hand held unit. The device also may have no electronic control and no electric powered parts and may even be powered by the user in that the spring 16 is manually loaded (extended). The movable element 29 is coupled to the spring 16 to manually load the movable element 29 with a spring load. The movable element 29 may be a piston, a plug, stopper, ball or a movable part of a wall such as a bladder or balloon. Once loaded, the movable element 29 continuously exerts suction pressure until the spring 16 is completely relaxed or otherwise restrained.

The actuator 20 also serves as a valve for the suction path 4 and may act on a deformable part 31 of the suction path 4. The opening 8 is exposed to suction pressure refers to the fact that suction pressure may be applied by exposing the opening to the suction pressure when activating the actuator. Alternatively, the opening 8 may be exposed to the suction pressure when activating the suction device itself. For example, even the spring-loaded mechanism of the device 2 may be coupled to a controller (not shown) so that suction pressure is applied and released and, when applied, exposes the opening 8 to suction pressure to draw material into the opening. Of course, responsiveness may be affected but other aspects of the present invention may, nevertheless, be practiced with on-demand suction. The actuator 20 may be continuously variable by simply depressing more or less to deform more or less of the deformable portion 31 between at least two different open positions. Fig. 1 shows a continuously variable actuator between the fully open and fully closed positions by simply varying the amount the deformable part 31 is deformed.

A disposal enclosure 40 is coupled to the suction path 4 to receive material from the suction path 4. A valve 42, such as a one-way valve, is positioned between the disposal enclosure 40 and the suction path 4. The valve 42 permits material to move to the disposal enclosure 40 and isolates the disposal enclosure 40 during suction operation. The valve 42 may be an actuated valve or a passive one-way valve which opens and closes automatically as necessary. The valve 42 isolates the disposal enclosure 40 so that the compressibility of the material does not affect the responsiveness of the system as described herein. The suction path 4 may increase in diameter at parts outside the eye similar to or the same as a syringe. Furthermore, the suction path 4 may take any shape without departing from the invention.

The disposal enclosure 40 is configured to be supported independently, for example, by the table a traditional hanger, or any other suitable structure. Furthermore, aspects of the present invention may be practiced with the disposal enclosure 40 hand-held or remotely located without departing from aspects of the invention. The disposal enclosure 40 has a disposal lumen 45 extending from the suction path 4 to the disposal enclosure. As mentioned above, the valve 42 (or one-way valve) isolates the disposal enclosure 40 from the suction pressure thereby preventing any pressure response by the disposal enclosure 40 during use. Of course, aspects of the present invention may be practiced without the valve 42.

The device 2 is hand-held to a large extent in that the suction path 4 is hand-held and the suction source 14 is hand-held as well. Within the meaning of the present invention, the suction source 14 does not include tubing or the like from the suction machine but defines the mechanical source that is creating the suction pressure. Although the present invention describes specific suction mechanisms and devices any other may be used. For example, a roller with tubing, a pneumatic system, a bladder or venturi may be used to create suction pressure without departing from aspects of the invention. The suction path 4 may also be more than half non-manually deformable or even at least 90% non-manually deformable. Most systems with remote suction devices include manually deformable tubes and hoses which may respond to pressure changes which further reduces responsiveness. The suction path 4 may be small to further improve responsiveness. To this end, the suction path 4 may have a length (longitudinal) L of less than 20 cm or a volume of less than 25 ml and even less than 15 ml.

As mentioned above, the present invention is particularly useful for removing material from the eye. As such, the lumen 6 may be appropriately sized. The suction path 4 includes a shaft 51 having the lumen 6. The lumen is sized for introduction into the eye and has a longitudinal axis with a cross-sectional area of the outer perimeter (or diameter) of the shaft 51 being no more than 0.8 mm(2) while the lumen has a cross-sectional area of at least 0.28 mm(2).

The plunger 18 is also operated to manually purge the suction path 4. Purging the suction path 4 reduces the material in the suction path 4 when suction is reinitiated. In this manner, the devices and methods of the present invention provide improvements in responsiveness compared to systems having long lines containing relatively large amounts of material between the handpiece and remote suction source 14.

A purging mechanism 55 may be the movable element 29 (plunger 18) or may be a separate element which moves the material from the suction path 4 to the disposal enclosure. In one aspect, the purging mechanism moves the material through the suction path 4 in an opposite direction to suction of material along the suction path 4 as shown by arrow A. The valve 42 permits flow from the suction path 4 to the disposal enclosure 40 when the movable element 29 is advanced. The purging mechanism 55 may also include an element separate from the movable element 29 which forms part of the suction device and may be completely independent of the suction source 14. As defined herein, the suction path 4 includes volumes occupied by movable elements 29. For example, the plunger 18 moves between fully retracted and fully advanced positions with the suction path 4 essentially changing in length and in volume. As used herein, the defined length and volume of the suction paths shall be defined with the minimum volume contained therein by the suction source 14. Thus, the length and volume is defined by the most advanced position of the plunger/movable element that minimizes the length and volume.

As described herein, "compressible" material such as a gas may also refer to the "expansibility" of the material in that suction pressure applied to entrained gas and material may permit the gas and material to expand slightly under the lower suction pressure (rather than compress). The compressibility (or expandability) of gasses and the effect on pressure responsiveness is typically deemed a problem of "compressibility" of gasses and is also so described herein and it is understood that this term also applies to the expandable nature of gasses and materials. With respect to the hoses and lines, the ability to resist compression by the suction pressure is a material property relevant to the responsiveness of such systems with manually deformable materials typically also responding mechanically to pressure variations.

Referring to Fig. 2, another suction device 102 is shown wherein the same or similar reference numbers refer to the same or similar structure. The suction source 114 is also a plunger 103 which is manually loaded with a spring 105. The spring 105 is loaded with a pivoting lever 107 attached to a housing 109. The disposal enclosure 111 is also mounted to and within the housing 109 and is hand-held with the device 102. Pressing the lever 107 advances the plunger 103 to purge the material in suction path 4 to the disposal enclosure 111. A first valve 113 and a second valve 115 (which may be one-way valves) permit suction through the lumen and purging of material into the disposal enclosure 111.

The lever 107 may be selectively locked and unlocked once advanced or the user may continue to apply pressure to the lever 107 to essentially stop suction. When suction is desired again, the lever 107 may be released with variable pressure to vary the amount of suction produced. Alternatively, the first valve 113 may include an interface 115, such as a button, which is actuated to open and close the suction path 104. The interface 114 may act as an actuator described herein and separates a proximal volume 117 from a distal volume 119 of the suction path 104. The first valve 113 may be formed over a deformable portion 121 of the suction path 104 along the valve 113 for use as described herein and all such uses of the deformable portion and actuator are expressly incorporated here. The second valve 115 (which may be a one-way valve) regulates flow to the disposal enclosure 111. A source of irrigation fluid 121 is also coupled to the shaft for irrigating the eye using a source of irrigation fluid 121. The source of

irrigation fluid 121 may be a gravity fed bag or part of a fluid delivery system such as a phaco system. An irrigation lumen 123 has an opening 125 positioned in the eye for delivery the irrigation fluid.

Referring to Figs. 3A, another suction device 302 is shown wherein the same or similar reference numbers refer to the same or similar structure. The suction source 314 is also a plunger 318 or movable element 329 which is manually loaded with a spring 316, however, the suction source 314 is remote from the hand-held housing 331. The spring is loaded manually. An irrigation source 121, such as a bag of balanced saline solution, is coupled to an irrigation lumen 323. A valve 325 controls flow of the irrigation fluid. The actuator 320 is used in the same manner as the actuator 20 above and suction path 304 includes the deformable portion 331 and all aspects and methods of these elements are incorporated expressly here. Purging of the suction path 104 is also accomplished in the same manner with the material moving into the disposal enclosure when the movable element 329, such as the plunger 318, is advanced. A valve 342 may be are provided in the same manner as described above for controlling the flow into the disposal enclosure 40 and discussion of these aspects are also incorporated here.

Referring to Fig. 3B, the suction source 314 may also be a bellows 350 (rather than the plunger) which may be actuated by foot with a foot pedal. The bellows 350 are biased to an open position so that the bellows 350 provides suction after the foot pedal is depressed. Similar to other embodiments, when the bellows 350 is compressed by the user's foot the material within the bellows 350, which also constitutes part of suction path 304 as described herein, is moved to the disposal enclosure 340.

Referring to Fig. 4, yet another suction device 402 is shown wherein the same or similar reference numbers refer to the same or similar structure. The device 402 has a venturi 406 coupled to a source of pressurized gas 408. The venturi 406 directs the pressurized gas toward the disposal enclosure 440 which also directs the material within suction path 404 also toward the disposal enclosure 440. The venturi 406 also acts as the suction source 414 producing suction pressure along the suction path 404. The suction path 404 includes a 415 chamber in communication with the venturi 406 so suction pressure is created in the chamber 415 by the venture 406. The venturl 406 is opened and closed with a pivoting lever 421.

Referring to Fig. 5, another suction device 502 is shown wherein the same or similar reference numbers refer to the same or similar structure. The suction source 514 has a movable element 529 which a bladder 531 which is deformed manually by the user. Once compressed, compression is maintained on the bladder 531 to stop suction and reduced to produces suction. Stated another way, the bladder 531 is moved from an unbiased stated to a compressed state with the user releasing compression to begin suctioning material into the opening 508. Movement of the bladder 531 from the unbiased state to the compressed state may also move material from the suction path 504 (which includes the internal volume of the bladder) to the disposal enclosure. A first valve 513 may also include an interface, such as a button 533, so that the first valve 533 acts as the actuator described herein and separates a proximal volume 535 from a distal volume 537 of the suction path 504. The first valve 513 may be formed over a deformable portion 541 of the suction path 504 along the valve 513 as described herein. A second valve 543 (which may be a

one-way valve) regulates flow to the disposal enclosure 545. An irrigation source 547 may also be provided with a spring loaded delivery 549 coupled to an actuator (not shown).

All aspects and methods of the suction devices described herein are applicable to the other suction devices and all such methods and aspects are expressly incorporated for each from the others. For example, the suction path length and volume as well as dimensions of the lumen and shaft are applicable to each of the other suitable embodiments described herein.

Referring now to Figs. 6A-6C, a suction tip 600 is shown for suctioning material from the eye. The suction tip 600 has a shaft 602 with a lumen 604 extending through the shaft 602. A distal opening 608 in the shaft 602 has an area which is defined by an opening axis OA which maximizes a size of the opening 608. The opening area may be circular, oval or any other suitable shape. The opening area defines an effective diameter defined as the diameter equivalent for a circle having the same area as the opening area.

The suction tip also 600 has a restrictor 610 which extends over the distal opening 608 when viewed along the opening axis OA. The restrictor 610 has a support arm 612 extending from the shaft 602. The restrictor 610 may have a stop 614 attached to the support arm 612 with the stop 614 spaced apart from the distal opening and positioned over the distal opening when viewed along the opening axis as shown in Fig. 7. The restrictor 610 is spaced apart from the distal opening 0.80 to 1.10 times, or 0.85 to 1.00 times, the effective diameter measured along the opening axis and aligned with the distal opening when viewed along the opening axis. The restrictor 610 also may optionally extend a short distance from the distal end of the shaft so that it does not impede use. To this end, the restrictor 610 may have a distal end 615 that extends no more than 1.5 times the effective diameter from the distal opening measured along the opening axis. The restrictor has an area when viewed along the opening axis which may be 0.1 to 1.2 times the area of the distal opening when viewed along the opening axis. Thus, the restrictor may be somewhat small when less concerned with moving, gathering or clearing material from the opening.

The support arm 612 may have an angular extent B when viewed along the opening axis of no more than 90 degrees as shown in Fig. 7. The distal opening 604 may be free of obstruction apart from the support arm between the distal opening and a stop on the restrictor when viewed along the opening axis OA. The restrictor 610 forms a feed opening 622 leading to the distal opening 604 when the restrictor 610 is in the working position shown by the dotted-line position of Fig. 6B. The feed opening 622 defines a surface 626 extending between and defined by the restrictor 610 and a distal end of the shaft 623 around the opening 604. The surface 626 may be an elongate surface that, essentially, extends from one side of the support arm 612 to the other. In this manner, an average length of the surface is 2.5-3.5 times the effective diameter. The surface may have a width of 0.8 to 1.1 times the effective diameter.

The support arm 612 may be longitudinally and/or rotatably movable relative to the shaft to adjust a longitudinal or rotational position of the support arm as shown in the dotted-line and solid line positions. The support arm 612 is movable from a working position (as defined above) to a displaced position with the working position being a position used when suctioning material

into the distal opening. The shaft has a longitudinal axis LA and the restrictor is formed with the support arm 612 rotating and/or longitudinally displaceable. The restrictor 610 may be formed so that the displaced position moves material toward the distal opening 608. The restrictor 610 may also be extended outwardly to help gather or otherwise organize material to be suctioned. The restrictor 610 may be movable to a position which is at least two effective diameters from the distal opening 608 measured along the opening axis.

The restrictor 610 may be mounted over the shaft, for example, in a concentric manner although an interlocking or independent lumens may be used without departing from the scope of the invention so long as the restrictor 610 is over the shaft and outside the lumen in some embodiments. The restrictor 610 is movable to a stored position in which the entire restrictor is positioned proximal to the distal opening and optionally completely outside the lumen as shown in the dotted-line position of Fig. 6A. Thus, the user may elect to use the suction device without restriction, for example, when the likelihood of clogging the opening is low. The restrictor 610 may be deformed when in the stored position and, to this end, the restrictor 610 has a living hinge 640 with the support arm 612 forming part, or all, of the living hinge 640 which is deformed in the stored position.

The stop 614 may be part of the support arm 612 in that the distal end of the support arm 612 simply forms the stop 614. Furthermore, the restrictor 610 may also simply be part of an extension of the shaft without departing from various aspects of the present invention. Finally, the restrictor 610 and methods associated with the restrictor 610 may be used with any of the other devices described herein including those associated with cutting and/or removing the lens. Furthermore, the devices may be used through the lumen of any of the devices described herein by simply providing a y-arm 642 and a suitable connector 641 which forms a seal around the cutting device. Thus, the lumen may be a substitute for any lumen described herein and the method of cutting the lens in combination and aspirating material and the device combination including any lens cutting device coupled with any aspirating device being specifically incorporated herein. For example, referring to Figs 6B and 6C, a seal is provided at the Y-arm 642 in the lumen and suction path through which any of the cutting devices described herein (or another cutting device) may be introduced. Fig. 6B shows the seal centrally located rather than on a Y-arm so the cutting device extends directly through the lumen with suction in the annular space between the cutting device and the shaft. Furthermore, an irrigation lumen, which may be concentric or separate, may be provided and the process of irrigating may be practiced with any method or combination method described herein and such methods are specifically incorporated here as shown in one or more embodiments and expressly incorporated into those which do not.

In use, the distal end of the shaft is positioned in the eye for any procedure on the eye including cataract surgery. During cataract surgery pieces of the cataract are removed using suction. The present invention may be used for this purpose as now described. Material is suctioned into the distal opening by applying suction which draws material into the distal opening. The restrictor 610 may help to reduce clogging of the distal opening compared to conventional suction devices which permit unrestricted flow toward the distal opening. As mentioned above, a problem with the conventional method is that material which is larger than the suction opening is free to

approach and, thus, clog the opening. Suction must be stopped and, if necessary, the material removed independently by another instrument. The present invention is directed to reducing the likelihood of clogging by providing the restrictor. The present invention may be used with any device including a stand-alone aspiration device, a re-usable phacoemulsion tip, or a disposable aspect of any aspiration device.

In another aspect of the present invention, a tissue manipulator 660 and method of manipulating tissue are described. The tissue manipulator 660 has a shaft 662 having a lumen 664 with a distal opening 668. A first loop 670 has a first leg 672 and a second leg 674 with at least one of the first and second legs 672, 674 extending through the lumen 664. The first loop 670 is movable from a collapsed position of Fig. 8A to an expanded position of Fig. 8B when the first and second legs are advanced through the lumen 664 and out the distal opening 668. A second loop 676 has a first leg 678 and a second leg 680 with the first and second legs 678, 680 extending through the lumen 664. The second loop 676 is also movable from a collapsed position to an expanded position when the first and second legs are advanced through the lumen and out the distal opening 668. The shaft 662 may be sized for introduction of a distal end of the shaft into an eye.

The first loop 670 may have an unbiased shape which bounds an area defined in an orientation OR that maximizes the area. The area has an effective diameter which is equal to the diameter of a circle having the same area. The first loop 670 moves toward the unbiased shape when moving from the collapsed position to the expanded position. The effective diameter of the area of the first loop is 4.5 mm to 6.5 mm or can be 5.0 mm to 6.0 mm. The effective diameter of the unbiased shape of the first and/or second loops may be within 20% of an effective diameter of the expanded position of the first and/or second loops, respectively. In this manner, the first and/or second loops provide for a soft deployment and are flexible during use. Use of a superelastic material further enhances the flexibility of the first and second loops. To this end, the first and second loops 670, 676 may be formed of superelastic wire having a diameter of about 0.003 inch although any size may be used with any suitable cross-sectional shape.

The first and second loops are each defined by the orientation OA which maximizes an area of the first loop and second loop when in the expanded position when viewed along each orientation. The orientation of the first and/or second loop may be within 45 degrees of perpendicular to the longitudinal axis LA at a distal end of the shaft. The first loop 670 is spaced apart from the second loop 676 to define a volume V therebetween when the first and second loops are in the expanded position with the volume therebetween being 48-84 mm(3).

The tissue manipulator 660 may also include an intermediate element 680 positioned between the first loop 670 and the second loop 676. The intermediate element 680 may be a third loop 682 positioned between the first loop 670 and the second loop 676. The intermediate element 680 may include an interconnecting element 682 extending between the first loop 670 and the second loop 676. The interconnecting element 682 may be integrally formed elements 681 with the first loop and the second loop as shown in Figs. 9 and 10. Alternatively, the interconnecting element may be a flexible filament 684 extending between the first loop and the second loop as shown in Fig. 8B. The third loop 682 may have the features of the first and second loops. The

orientation OA which maximizes an area of the third loop may be within 30 degrees of perpendicular to the longitudinal axis LA.

The first and second loops provide a controlled amount of exposed surface therebetween to control, and optionally cut, a controlled amount of the material. The exposed surface ES between the first loop 670 and the second loop 676 has an area of 15 mm(2) to 60 mm(2). Stated another way, the exposed surface between the first loop and the second loop is 3-10 times the effective diameter in the expanded position (or the unbiased position since they may be the same).

The exposed surface between the first loop and the second loop may have 2-8, 2-6, 2-4 or even just 2 independent cells when viewed in a radially inward direction relative to the orientation axis of the first and second loops 670, 676. The exposed surface ES has an area which is at least 4 times larger than an area of the intermediate element 680 positioned between the first loop and the second loop 670, 676 when the exposed surface ES is viewed radially inward with respect to the first and second loops 670, 676. In this manner, the intermediate element 680 does not take up an excessive amount of room as compared to some net-type devices.

The first loop 670 may also be formed so that at least 80% of the loop is 1.5-3.5 mm from the second loop 676. The first and second loops 670, 676 (and optional intermediate element) may also be configured to cut material contained within therein when collapsed. A source of suction may be coupled to the lumen with suction being used together with or separately from the tissue manipulator. Irrigation may also be supplied with the other shafts incorporated herein and such incorporation is expressly provided here.

The device 660 may include a first support element 690 extending from a distal end of the shaft when the first loop 670 is in the expanded position. The first support element 690 may be an elongate element that extends to a free end 691. The first support element 690 is positioned with the free end 691 positioned within an area of the first loop 670 when viewing the first loop along the orientation OA that maximizes the area of the first loop 670. The first loop 670 has an effective diameter when in the expanded position while the first support element 690 extends into the area of the first loop so that the free end is positioned 0.05 to 0.30 times the effective diameter of the first loop within the first loop 670 when viewed along the orientation OA. A second support element 692 cooperating with the second loop 676 in the same manner may also be provided.

Referring to Fig. 11, the first loop and/or second loop may have at least one interconnecting element 695 extending from a first connection 696 to the loop to a second connection 697 on the same loop or the loop(s) may be substantially free of any such interconnecting elements depending upon the desired use. For example, a net-like material as shown in Fig. 11 may be provided or the loops may be free of interconnecting elements so that the open area is free. All discussion and limitation of the first loop are applicable to the first loop, the second loop and the third loop as well as discussion of the first support applicable to the second support. The first support may extend independently or simultaneously with the first loop. The first support helps to secure material within the first loop by extending into the opening area formed by the loop.

The first and second legs of the first and second loop(s) may be movable within the lumen. Alternatively, the first leg and the second leg of the first loop are coupled to an actuator extending through the lumen so that movement of the actuator moves the first leg and the second leg between the collapsed position and the expanded position. The first leg and the second leg of the second loop are coupled to an actuator extending through the lumen so that movement of the actuator moves the first leg and the second leg between the collapsed position and the expanded position. The first loop and/or the second loop may be positioned entirely distal to the distal opening in the expanded position. The first loop and the second loop may include a superelastic material within a superelastic range when in the collapsed position.

Referring to Fig. 12, a tissue manipulator 700 has a concave element 702 coupled to a first loop 704 to form a basket 706 to receive material. The concave element 702 may have one end 708 integrally formed with the first loop 704 with the other end 710 movable within a lumen 712 of a shaft 713 independent of a first leg 714 and a second leg 716 of the first loop 704. Cross-elements 715 are also integrally formed with the first loop 704 and may also be integrally formed with the concave element 702. Alternatively, both ends 708, 710 may be integrally formed with the loop 704.

Another tissue manipulator 700A is shown in Fig. 13 wherein the same reference numbers refer to the same or similar structure. A concave element 702A, which may be 2-3 concave elements 702A. The manipulator 700A has a first loop 704A with a first leg 714A and second leg 716A. A first end 708a of the concave element 702A may be integrally formed with the loop 704A while the second end 710A may be independently movable within a lumen 712A. The loop 704A and the concave element 702A may be made of ribbon-shaped material having a width to thickness ratio of more than 3 to 1 to create a more closed basket 706A compared to wire having a 1 to 1 ratio. Referring to Fig. 14, another tissue manipulator 700B is shown wherein the same or similar reference number refer to the same or similar structure. The manipulator 700B has a first loop 704B with a concave element 702B being a net 703. The net 703 may be integrally formed or a separate element attached to the loop 704B.

Referring to Fig. 15, another tissue manipulator 700C is shown wherein the same or similar reference number refer to the same or similar structure. The manipulator 700C has a first loop 704C with a concave element 702C, which may be 2-3 concave elements 702C, integrally formed at first end 708C and may have a second end 710C independently movable within a lumen 712C within shaft 713C. or a separate element attached to the loop 704B. The manipulator 700C is free of interconnecting elements between any two sides of the loop and may also include no interconnecting elements between the concave elements 702C.

Referring to Figs. 16 and 17, another tissue manipulator 700D is shown in Fig. 16 wherein the same reference numbers refer to the same or similar structure. The tissue manipulator 700D has a first loop 708D and a second loop 708 E with corresponding concave elements 708D and 708E, respectively. A first basket 706D and a second basket 706E are movable between a nested position of Fig. 17 and a position in which the two baskets oppose one another as shown in Fig. 16.

Referring to Fig. 12 again, the tissue manipulator 700 is described further and it is understood that all aspects described here are applicable to all of the other tissue manipulators 700A-D and are expressly incorporated for each. The loop 704 has an unbiased shape which bounds an area defined in an orientation OA that maximizes the area. The area has an effective diameter which is equal to the diameter of a circle having the same area. The first loop 704 moves toward the unbiased shape when moving from the collapsed position to the expanded position. The first loop 704 may have effective diameter of 4.5 mm to 6.5 mm or 5.0 mm to 6.0 mm. Of course, the various aspects of the invention may be carried out with different sizes. As used herein, the "area" of the loop is determined by the orientation OA which maximizes the area. The first loop is expanded with the first loop orientation being within 45 degrees of perpendicular to a longitudinal axis LA at a distal end of the shaft 713.

Referring again to Fig. 13, a rotating cutter 740 is shown which may be used with any of the device and methods described herein. The rotating cutter 740 has a cutting element 742 at a distal end 744 which may be a series of teeth 746, a sharpened edge, ridges spikes or any other suitable shape. Rotating as used herein may mean rotation in one direction and then back in the other without departing from the scope of the invention. The rotating cutter 740 may be independently positioned and moved for use as desired or may be fixed in a working position shown by dotted-line working position 750. The rotating cutter 740 is recessed from the distal end 751 of the shaft 713A when in the working position 750 so that the rotating cutter 740 is not exposed from an opening 754 at the distal end 744. The tissue manipulating devices of the present invention may be used to push, draw, squeeze or otherwise manipulate tissue into engagement with the rotating cutter 740. The rotating cutter 740 may further have a suction lumen 752 therein for suctioning material.

Referring now to Figs. 18A-18D and 19, a cutting device 800 for cutting material in the eye and, in a specific application, for cutting a whole lens while contained within a capsular bag is shown. The cutting device 800 has a shaft 802 with a first shaft part 804 and a second shaft part 806 which are movable relative to one another between a first position of Fig. 18A and a second position of Fig. 19. An elongate element 808 has a first end 810 coupled to the first shaft part 804 and a second end 812 coupled to the second shaft part 806. The cutting device 800 forms a loop 814 with at least part of the elongate element 808 forming the loop 814 together with the shaft 802. The loop 814 moves from a collapsed position of Fig. 18A to an expanded position of Fig. 19 when the first and second shaft parts 804, 806 move from the first position to the second position. The loop 814 may be expanded to advance the loop 814 between the capsular bag and the whole lens. Material is positioned in an open area 813 of the loop 814 and then cut by collapsing the loop 804.

The elongate element 808 expands in a manner which facilitates cutting the whole lens within the capsular bag. The elongate element 808 may have a first flexible portion 820 and optionally a second flexible portion 822 with an intermediate portion 824 therebetween. The elongate element 808 initially expands laterally outward as shown in Fig. 18C. When the first and second flexible portions 820, 822 begin to bend, the loop 814 has a proximal portion 826 and a distal portion 828 which extend proximally and distally, respectively, from the intermediate portion

824. The flexible portion may be at least 1.5 more stiff in bending than the intermediate portion. Furthermore, the elongate element 808 may be in an unbiased position when collapsed as shown in Fig. 18A with the elongate element 808 being deformed to deflect and expand the loop. Of course, the elongate element 808 may also have a preset shape which facilitates movement to the expanded position while requiring less force to deform the elongate element 808.

Referring now to Figs. 20A-C and 21A-B, another cutting device 900 is shown for cutting material in the eye and, in a specific application, for cutting a whole lens WL within a capsular bag CB through an opening OP (such as a capsulorhexis) that exposes an anterior surface of the lens (see Fig. 19). A shaft 902 has a first shaft part 904 and a second shaft part 906 movable relative to one another between the position of Fig. 20A and Fig. 21B so that a loop 908 formed by the device 902 moves from a collapsed position to an expanded position. An elongate element 910 has a first end 912 coupled to the first shaft part 904 and a second end 914 coupled to the second shaft part 906. The loop 908 is formed at least in part by the elongate element 910 with the loop 908 also being formed by a portion of the shaft 902.

The loop 908 is expanded so that the first end 912 has a longitudinal orientation LFE that changes by an angle CA at least 120 degrees with respect to the shaft 902 adjacent to the second end 914 of the elongate element 910 when the first and second shaft parts 904, 906 move from the first position to the second position. Fig. 21A shows the angle CA being about 180 degrees.

The 902 shaft may also include a flexible distal end 920 with the first end 912 of the elongate element 910 coupled to the flexible distal end 920 of the shaft 902. The flexible distal end 920 of the shaft 902 may contribute to the changing orientation of the first end 912 with respect to the longitudinal orientation of the shaft 902 adjacent the second end 914. The flexible distal end 920 may change in orientation by an angle CO of at least 30 degrees when the first and second shaft parts move from the first position to the second position.

The first end 912 of the elongate element 912 may be have a pinned connection so that the first end 912 rotates relative to the first shaft part 904 for an angle of at least 120 degrees and may be for 180 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position. The loop 908 has a distal portion 930 that advances distally beyond a distal end of the shaft 902 as the loop 908 moves from the collapsed position to the expanded position. The first end 912 of the elongate element changes orientation so that the loop 908 advances distally beyond a distal end of the shaft 902 as the loop 908 moves from the collapsed position to the expanded position. The second end 914 may also have a rotatable connection 932, such as a pinned connection 934, to the second shaft part 906. The second end 914 may rotate and change in orientation relative to the shaft adjacent the second end by 90 degrees +/- 45 degrees when the first and second shaft parts 904, 906 move from the first position to the second position. The elongate element 912 may be in an unbiased position in Fig. 20A with the elongate element 912 deformed into the positions of Fig. 21A and Fig. 21B. Of course, the elongate element 912 may also have a preset shape similar to Fig. 21B without departing from the scope of the invention.

Use of and discussion of all aspects of the first flexible portion or the first end are equally applicable to the second end and are specifically incorporated herein. Furthermore, a mixture of first end and second end are also expressly incorporated such as a flexible first end and a rotatable second end or the reverse. The elongate element may be without a preset shape although numerous aspects of the present invention may be practiced with a wholly or partially preset shape. The elongate element may not include a superelastic material in this and other embodiments which may reduce the cost of the device. The loop moves from an unbiased position toward a biased position, and an increasing the bias or load on the elongate element, when moving from the collapsed position to the expanded position.

Use of the terms "first" and "second" are used with reference to each specific application, however, the terms are interchangeable and, thus, the claims may define an aspect as the "second" even though it is described as the "first" elsewhere without departing from the scope of the invention. For example, the terms first and second may simply be interchanged. In another example, the "first" may be omitted so that the "second" becomes the "first."

Although embodiments of various methods and devices are described herein in detail with reference to certain versions, it should be appreciated that other versions, embodiments, methods of use, and combinations thereof are also possible within the scope of the invention. Therefore, the spirit and scope of the invention should not be limited to the description of the embodiments contained herein. Furthermore, although the various embodiments and description may specify certain anatomical locations, species, or surgical procedures, it should be appreciated that these embodiments apply to other locations, species, and surgical procedures. For example, the device may include a remote suction source while still providing for purging of the suction path. The device also includes no powered elements but a pneumatic source of power (pressurized canister) or a battery may be used without departing from numerous aspects of the present invention. Thus, as it can be seen, the invention has been described with respect to various independent aspects.

WHAT IS CLAIMED IS:

1. A device for removing material in a medical procedure, comprising:
a shaft having a lumen, the lumen extending through the shaft to an opening;
a suction source;
a suction path extending from the suction source to the opening and including the lumen, material is suctioned into the opening and through the lumen along the suction path by the suction source in use.
2. The device of claim 1, further comprising:
a disposal enclosure coupled to the suction path to receive material from the suction path.
3. The device of claim 1, further comprising:
an actuator positioned along the suction path, the actuator being operable by the user to an open position which exposes the opening to the suction source and a closed position which isolates the opening from the suction source.
4. The device of claim 1, wherein:
the actuator is movable to a first open position and a second open position, the first open position providing a different magnitude of suction than the second open position.
5. The device of claim 1, wherein:
the actuator is continuously variable between the first position and the second position to provide a continuously variable magnitude of suction selected by the user.
6. The device of claim 1, wherein:
the lumen has a deformable portion defining a portion of the suction path;
the actuator engaging the deformable portion of the suction path.
7. The device of claim 1, wherein:
the deformable portion of the suction path is variably deformable between the first position and the second position.
8. The device of claim 1, further comprising:
a valve positioned between the disposal enclosure and the suction path, the valve permitting material to move from the suction path to the disposal enclosure when open and isolating the disposal enclosure from the suction path when closed.
9. The device of claim 1, wherein:
the valve is a one-way valve positioned between the disposal enclosure and the suction path which permits material to move from the suction path to the disposal enclosure, the one-way valve isolating the disposal enclosure from the suction path when the suction source applies suction to draw material into the opening and through the suction path.
10. The device of claim 1, wherein:
the disposal enclosure is isolated from the suction path when the suction source draws material into the opening, the disposal enclosure being isolated so that the disposal enclosure is not under the influence of suction pressure from the suction path when the suction source draws material into the opening.
11. The device of claim 1, further comprising:
the disposal enclosure is configured to be supported independently, the disposal enclosure having a disposal lumen extending from the suction path to the disposal enclosure.
12. The device of claim 1, wherein:
the suction path is entirely hand-held
13. The device of claim 1, wherein:

the suction path is more than half non-manually deformable.

14. The device of claim 1, wherein:
the suction path is at least 90% non-manually deformable.

15. The device of claim 1, wherein:
the suction path has a length of less than 20 cm.

16. The device of claim 1, wherein:
the suction path has a volume of no more than 25 ml.

17. The device of claim 1, wherein:
the suction path has a volume of no more than 15 ml.

18. The device of claim 1, further comprising:
an actuator positioned along the suction path, the actuator being movable between an open position which and a closed position, the closed position preventing flow through the suction path;
the suction path having a proximal volume proximal to the actuator and a distal volume distal to the actuator, the distal volume being less than 2 ml.

19. The device of claim 1, wherein:
the proximal volume is less than 25 ml.

20. The device of claim 1, wherein:
the lumen is sized for introduction into the eye, the shaft having a longitudinal axis with a cross-sectional area of no more than 0.8 mm(2) measured from an outer diameter the shaft, the lumen having a cross-sectional area of at least 0.28 mm(2).

21. The device of claim 1, wherein:
the suction source is a movable element which is displaced in a direction to draw the material into the opening and through the suction path.

22. The device of claim 1, wherein:
the movable element is displaced in an opposite direction to the direction to move material in the suction path into the disposal enclosure.

23. The device of claim 1, wherein:
the movable element is part of hand held unit.

24. The device of claim 1, wherein:
the suction source is hand-held.

25. The device of claim 1, wherein:
the suction source includes no electronic control and no electric powered parts.

26. The device of claim 1, wherein:
a power source coupled to the suction source, the power source being powered by the user.

27. The device of claim 26, wherein:
the power source is a compressed spring which is compressed by the user

28. The device of claim 1, wherein:
the device is manually purged.

29. The device of claim 1, further comprising:
a purging mechanism coupled to the suction path, the purging mechanism moving the material from the suction path to the disposal enclosure.

30. The device of claim 29, wherein:
the purging mechanism moves the material through the suction path in an opposite direction to suction of material along the suction path.

31. The device of claim 29, wherein:
the purging mechanism has a movable element; and
the suction device also including the movable element to create suction pressure in the suction path.
32. The device of claim 31, wherein:
the movable element is coupled to a spring to load the movable element with a spring load.
33. The device of claim 31, wherein:
the movable element is spring loaded by the user.
34. The device of claim 31, wherein:
the movable element is manually spring loaded by the user.
35. The device of claim 1, further comprising:
a disposal enclosure;
means for purging the suction path, the purging means moving material in the suction path distally when moving the material in the suction path to the disposal enclosure.
36. The device of claim 1, wherein:
the suction source is a bellows.
37. The device of claim 36, wherein:
the bellows are compressed with a foot of the user.
38. The device of claim 36, wherein:
the bellows are compressed to move material in the suction path into a disposal enclosure.
39. The device of claim 36, wherein:
the bellows are compressed to move material within the bellows into the disposal enclosure.
40. The device of claim 1, wherein:
the suction source is a bladder.
41. The device of claim 40, wherein:
the bladder is deformed manually by the user.
42. The device of claim 40, wherein:
the bladder is compressed manually by the user, wherein compression is manually maintained on the bladder to stop suction, wherein reducing compression on the bladder produces suction to suction the material into the opening.
43. The device of claim 40, wherein:
the bladder is moved from an unbiased stated to a compressed state, the user releasing compressing from the compressed state to begin suctioning material into the opening.
44. The device of claim 40, further comprising:
a disposal enclosure coupled to the suction path;
the bladder being coupled to a disposal enclosure so that movement of the bladder from the unbiased state to the compressed state moves the material in the suction path into the disposal enclosure.
45. The device of claim 1, wherein:
the suction source is a venturi.
46. The device of claim 45, wherein:
the suction source include a source of pressurized gas, the source of pressurized gas being hand-held.

47. The device of claim 45, further comprising:
a disposal enclosure;
the venture directs the source of pressurized gas into the disposal enclosure together with material in the suction path.
48. The device of claim 1, further comprising:
an irrigation lumen having an irrigation outlet.
49. A method of aspirating an eye during a procedure on the eye, comprising:
introducing a lumen of a device into an eye, the lumen having an opening positioned in the eye, the device also having a suction path from a suction source to the opening in the lumen; and
exposing the opening to suction pressure from the suction source so that material in the eye enters the opening under the influence of the suction source, the material being drawn along the suction path by the suction source, the suction path defining a suction volume under the influence of the suction pressure by the suction source.
50. The method of claim 49, wherein:
the exposing is carried out with an actuator positioned along the suction path, the actuator being operable by the user to an open position which exposes the opening to the suction source and a closed position which isolates the opening from the suction source.
51. The method of claim 49, wherein:
the exposing is carried out with the actuator being movable to a first open position and a second open position, the first open position providing a different magnitude of suction than the second open position.
52. The method of claim 49, wherein:
the exposing is carried out with the actuator being continuously variable between the first position and the second position to provide a continuously variable magnitude of suction selected by the user.
53. The method of claim 49, wherein:
the exposing is carried out with the actuator engaging a deformable portion of the suction path.
54. The method of claim 49, wherein:
the exposing is carried out with the deformable portion of the suction path being variably deformable between the first position and the second position.
55. The method of claim 49, wherein:
the exposing is carried out with the suction path having a distal volume which is distal to the actuator of less than 2 ml.
56. The method of claim 49, wherein:
the exposing is carried out with the suction path having a proximal volume of less than 25 ml which is proximal to the actuator and between the suction source and the actuator, the proximal volume being a minimum working volume.
57. The method of claim 49, wherein:
the introducing is carried out with the device also including a disposal enclosure coupled to the suction path to receive material from the suction path.
58. The method of claim 49, wherein:
the introducing is carried out with a valve positioned between the disposal enclosure and the suction path, the valve permitting material to move from the suction path to the disposal enclosure when open and isolating the disposal enclosure from the suction path when closed.

59. The method of claim 49, wherein:
the introducing is carried out with the valve being a one-way valve positioned between the disposal enclosure and the suction path, the one-way valve permitting material to move from the suction path to the disposal enclosure.
60. The method of claim 49, wherein:
the introducing is carried out with the disposal enclosure being isolated from the suction path when the suction source draws material into the opening, the disposal enclosure being isolated so that the disposal enclosure is not under the influence of suction pressure from the suction path when the suction source draws material into the opening.
61. The method of claim 49, wherein:
the introducing is carried out with the device having a disposal enclosure configured to be supported independently, the disposal enclosure having a disposal lumen extending from the suction path to the disposal enclosure.
62. The method of claim 49, wherein:
the introducing is carried out with the device having the suction path is entirely hand-held
63. The method of claim 49, wherein:
the introducing is carried out with the device having the suction path is more than half non-manually deformable.
64. The method of claim 49, wherein:
the introducing is carried out with the device having the suction path is at least 90% non-manually deformable.
65. The method of claim 49, wherein:
the introducing is carried out with the device having the suction path having a length of less than 20 cm.
66. The method of claim 49, wherein:
the introducing is carried out with the device having the suction path has a volume of less than 25 ml.
67. The method of claim 49, wherein:
the introducing is carried out with the device having the suction path has a volume of less than 15 ml.
68. The method of claim 49, wherein:
the introducing is carried out with the device having a proximal volume under the influence of suction pressure by the suction source proximal to the actuator when the actuator is in the closed position, the proximal suction volume having a volume of less than 25 ml.
69. The method of claim 49, wherein:
the introducing is carried out with the device having a proximal volume under the influence of suction pressure by the suction source when the actuator is in the closed position, the proximal suction volume less than 25 ml.
70. The method of claim 49, wherein:
the introducing is carried out with the lumen being sized for introduction into the eye, the shaft having an outer perimeter having a cross-sectional area of no more than 0.8 mm(2), the lumen having a cross-sectional area of at least 0.28 mm(2).
71. The method of claim 49, wherein:
the introducing is carried out with the suction source including a movable element which is displaced in a direction to draw the material into the opening and proximally along the suction path.

72. The method of claim 49, wherein:
the introducing is carried out with the movable element being displacable in an opposite direction to the direction to move material in the suction path into the disposal enclosure.
73. The method of claim 49, wherein:
the introducing is carried out with the movable element being part of a hand held unit.
74. The method of claim 49, wherein:
the introducing is carried out with the device having the suction source is a hand-held unit.
75. The method of claim 49, wherein:
thc introducing is carried out with the suction source having no electronic control and no electric powered parts.
76. The method of claim 49, wherein:
the introducing is carried out with the device having a power source which is powered by the user.
77. The method of claim 76, wherein:
the introducing is carried out with the power source being a compressed spring which is compressed by the user.
78. The method of claim 49, further comprising:
purging the fluid path by moving the material into the disposal enclosure.
79. The method of claim 78, wherein:
the purging is carried out independent of suctioning.
80. The method of claim 49, wherein:
the purging is carried out with the device being manually purged.
81. The method of claim 49, wherein:
the purging is carried out with the device having a purging mechanism coupled to the suction path, the purging mechanism moving the material from the suction path to the disposal enclosure.
82. The method of claim 49, wherein:
the purging is carried out with the device moving the material through the suction path in an opposite direction to suction of material along the suction path.
83. The method of claim 82, wherein:
the purging is carried out with a purging mechanism having a movable element.
84. The method of claim 83, wherein:
the cxposing is carried out with the suction device also including the movable element to create suction pressure in the suction path.
85. The method of claim 83, wherein:
the exposing is carried out with the movable element being coupled to a spring to load the movable element with a spring load.
86. The method of claim 85, wherein:
the exposing is carried out with the movable element being spring loaded by the user.
87. The method of claim 83, wherein:
the cxposing is carried out with the movable element being manually spring loaded by the user to create suction pressure along the suction path.
88. The method of claim 49, wherein:
the exposing is carried out with the suction source being a bellows.
89. The method of claim 88, wherein:

the exposing is carried out with the bellows being compressed with a foot of the user.

90. The method of claim 88, wherein:

the exposing is carried out with the bellows being compressed to move material in the suction path into a disposal enclosure.

91. The method of claim 88, wherein:

the exposing is carried out with the bellows being compressed to move material within the bellows into the disposal enclosure.

92. The method of claim 49, wherein:

the exposing is carried out with the suction source being a bladder.

93. The method of claim 92, wherein:

the exposing is carried out with the bladder being deformed manually by the user and hand-held.

94. The method of claim 92, wherein:

the exposing is carried out with the bladder being compressed by the user, wherein compression is maintained on the bladder to stop suction, wherein reducing compression on the bladder produces suction to suction the material into the opening.

95. The method of claim 92, wherein:

the exposing is carried out with the suction source including a bladder which is movable from an unbiased stated to a compressed state, the user releasing compression from the compressed state to begin suctioning material into the opening.

96. The method of claim 92, wherein:

the exposing is carried out with the bladder being coupled to a disposal enclosure so that movement of the bladder from the unbiased state to the compressed state moves the material in the suction path into the disposal enclosure.

97. The method of claim 49, wherein:

the exposing is carried out with the suction source being a venturi.

98. The method of claim 97, wherein:

the exposing is carried out with the suction source including a source of pressurized gas, the source of pressurized gas being hand-held.

99. The method of claim 97, wherein:

the exposing is carried out with the venturi directing the source of pressurized gas to a disposal enclosure together with material in the suction path.

100. The method of claim 49, further comprising:

irrigating the eye through an irrigation lumen having an irrigation outlet.

101. A suction tip for a suction device used to suction material from an eye, comprising;

a shaft;

a lumen extending through the shaft;

a distal opening in the shaft, the distal opening having an area which is defined by an opening axis which maximizes a size of the opening, the opening area defining an effective diameter defined as the diameter equivalent to a circle having the same size as the opening area; and

a restrictor extending over the distal opening when viewed along the opening axis.

102. The suction tip of claim 101, wherein:

the restrictor has a support arm extending from the distal end of the shaft.

103. The suction tip of claim 101, wherein:

the restrictor has a stop attached to the support arm, the stop being spaced apart from the distal opening and positioned over the distal opening when viewed along the opening axis

104. The suction tip of claim 101, wherein:

the restrictor is spaced apart from the distal opening 0.80 to 1.10 times the effective diameter along the opening axis and aligned with the distal opening when viewed along the opening axis.

105. The suction tip of claim 101, wherein:

the restrictor is spaced apart from the distal opening 0.85 to 1.00 times the effective diameter.

106. The suction tip of claim 101, wherein:

the restrictor has a distal end that extends no more than 1.5 times the effective diameter from the distal opening measured along the opening axis from the distal opening.

107. The suction tip of claim 101, wherein:

the restrictor has an area of when viewed along the opening axis, the area of the restrictor being 0.1 to 1.2 times the opening area of the distal opening when viewed along the opening axis.

108. The suction tip of claim 101, wherein:

the restrictor has a support arm extending from the distal end, the support arm having an angular extent when viewed along the opening axis of no more than 90 degrees, the distal opening being free of obstruction apart from the support arm between the distal opening and the restrictor when viewed along the opening axis.

109. The suction tip of claim 101, wherein:

the restrictor forms a feed opening leading to the distal opening, the feed opening defining a surface extending between and defined by the restrictor and the distal end of the shaft

110. The suction tip of claim 101, wherein:

the restrictor forms the feed opening with the surface being an elongate surface with a length of 2.5-3.5 times the effective diameter.

111. The suction tip of claim 101, wherein:

the restrictor forms the feed opening with the surface having a width of 0.8 to 1.1 times the effective diameter.

112. The suction tip of claim 101, wherein:

the restrictor has a support arm that is movably coupled to the shaft.

113. The suction tip of claim 101, wherein:

the support arm is longitudinally movable relative to the shaft to adjust a longitudinal position of the support arm, the support arm being movable from a working position to a isplaced position, the working position being a position used when suctioning material into the distal opening.

114. The suction tip of claim 101, wherein:

the restrictor is formed with the support arm having the displaced position being longitudinally displaced relative to the working position.

115. The suction tip of claim 101, wherein:

the shaft has a longitudinal axis: and

the restrictor is formed with the support arm rotating relative to the longitudinal axis of the support shaft when in the displaced position.

116. The suction tip of claim 101, wherein:

the restrictor is formed with the displaced position being longitudinally displaced to move the support shaft in a proximal direction toward the distal opening.

117. The suction tip of claim 101, wherein:

the restrictor is formed so that the displaced position moves material between the restrictor and the distal opening toward the distal opening.

118. The suction tip of claim 101, wherein:

the restrictor is mounted over the shaft and is longitudinally slidable relative to the shaft, the restrictor being movable to a stored position in which the entire restrictor is positioned proximal to the distal opening.

119. The suction tip of claim 118, wherein:

the restrictor is deformed when in the stored position

120. The suction tip of claim 118, wherein:

the restrictor has a living hinge which is deformed when the restrictor is in the stored position.

121. The suction tip of claim 120, wherein:

the restrictor has a support arm which forms at least part of the living hinge.

122. The suction tip of claim 101, wherein:

the restrictor is longitudinally movable to a position which is at least two effective diameters of the distal opening measured along an orientation that maximizes an area of the distal opening.

123. A method of suctioning material from an eye, comprising;

positioning a distal end of shaft within an eye, the shaft having a lumen extending through the shaft, the shaft also having a distal opening in the shaft, the distal opening having an area which is defined by an opening axis having an orientation which maximizes a size of the opening, the opening area defining an effective diameter which is defined as the diameter equivalent of an equivalent circle having the opening area, wherein a restrictor extends over the distal opening when viewed along the opening axis in a working position; and

suctioning material into the distal opening and through the lumen.

124. The method of claim 123, wherein:

suctioning is carried out with the restrictor having a support arm extending from the distal end of the shaft.

125. The method of claim 123, wherein:

the suctioning is carried out with the restrictor having a stop attached to the support arm, the stop being spaced apart from the distal opening and positioned over the distal opening when viewed along the opening axis.

126. The method of claim 123, wherein:

the suctioning is carried out with the restrictor spaced apart from the distal opening 0.80 to 1.10 times the effective diameter along the opening axis and aligned with the distal opening along the opening axis in the working position.

127. The method of claim 123, wherein:

the suctioning is carried out with the restrictor being spaced apart from the distal opening 0.85 to 1.00 times the effective diameter in the longitudinal direction and longitudinally aligned with the distal opening in the working position.

128. The method of claim 123, wherein:

the suctioning is carried out with the restrictor having a distal end that extends no more than 1.5 times the effective diameter from the distal opening measured along the opening axis from the distal opening in the working position.

129. The method of claim 123, wherein:

the suctioning is carried out with the restrictor having an area when viewed along the opening axis, the area of the restrictor being 0.1 to 1.2 times the opening area of the distal opening in the working position.

130. The method of claim 123, wherein:

the suctioning is carried out with the restrictor having a support arm extending from the distal end, the support arm having an angular extent when viewed along the opening axis of no more than 90 degrees, the distal opening being free of obstruction apart from the support arm between the distal opening and the restrictor in the working position.

131. The method of claim 123, wherein:

the suctioning is carried out with the restrictor forming a feed opening leading to the distal opening, the feed opening defining a surface extending between the restrictor and the distal end of the shaft.

132. The method of claim 123, wherein:

the suctioning is carried out with the restrictor forming the feed opening with the surface being an elongate surface with a length of 2.5-3.5 times the effective diameter.

133. The method of claim 123, wherein:

the suctioning is carried out with the restrictor forming the feed opening with the surface having a width of 0.8 to 1.1 times the effective diameter.

134. The method of claim 123, wherein:

the suctioning is carried out with the restrictor having a support arm that is movably coupled to the shaft.

135. The method of claim 123, wherein:

the suctioning is carried out with the support arm being longitudinally movable relative to the shaft to adjust a longitudinal position of the support arm, the support arm being movable from the working position to a displaced position, the working position being a position used when suctioning material into the distal opening.

136. The method of claim 123, wherein:

the suctioning is carried out with the restrictor being formed with the support arm being movable to a displaced position which is longitudinally displaced relative to the working position.

137. The method of claim 123, wherein:

the suctioning is carried out with the shaft having a longitudinal axis, the restrictor being formed with the support arm being rotatable relative to the longitudinal axis of the support shaft.

138. The method of claim 123, wherein:

the suctioning is carried out with the restrictor being longitudinally movable to move the support shaft in a proximal direction toward the distal opening.

139. The method of claim 123, further comprising:

displacing the restrictor toward the distal opening to move material toward the distal opening.

140. The method of claim 123, further comprising:

displacing the restrictor longitudinally relative to the shaft, the restrictor being mounted over the shaft and being longitudinally slidable relative to the shaft, the restrictor being movable to a stored position in which the entire restrictor is positioned proximal to the distal opening.

141. The method of claim 123, further comprising:

storing the restrictor in a stored position, the restrictor being deformed when in the stored position.

142. The method of claim 141, wherein:

the storing is carried out with the restrictor having a living hinge which is deformed by the shaft when the restrictor is in the stored position.

143. The method of claim 141, wherein:

the storing is carried out with the restrictor having a support arm which forms at least part of the living hinge.

144. The method of claim 123, further comprising:

displacing the restrictor longitudinally to a position which is at least two effective diameters from the distal opening measured along an orientation that maximizes an area of the distal opening.

145. A tissue manipulator

a shaft having a lumen with a distal opening;

a first loop having a first leg and a second leg, at least one of the first and second legs extending through the lumen, the first loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the lumen and out the distal opening in the lumen; and

a second loop having a first leg and a second leg, at least one of the first and second legs extending through the lumen, the second loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the lumen and out the distal opening in the lumen.

146. The tissue manipulator of claim 145, wherein:

the shaft is sized for introduction of a distal end of the shaft into any eye.

147. The tissue manipulator of claim 145, wherein:

the first loop has an unbiased shape, wherein the unbiased shape of the first loop bounds an area defined in an orientation that maximizes the area, the area having an effective diameter which is equal to the diameter of a circle having the area, the first loop moving toward the unbiased shape when moving from the collapsed position to the expanded position.

148. The tissue manipulator of claim 145, wherein:

the effective diameter of the area of the first loop is 4.5 mm to 6.5 mm.

149. The tissue manipulator of claim 145, wherein:

the effective diameter of the area of the first loop is 5.0 mm to 6.0 mm.

150 The tissue manipulator of claim 145, wherein:

the first loop has an effective diameter of the expanded position being 4.5 to 6.5 mm.

151. The tissue manipulator of claim 145, wherein:

the first loop has an effective diameter of the expanded position being 5.0 to 6.0 mm.

152. The tissue manipulator of claim 145, wherein:

the effective diameter of the unbiased shape of the second loop being within 20% of an effective diameter of the expanded position of the second loop.

153. The tissue manipulator of claim 145, wherein:

the second loop has an unbiased shape, wherein the unbiased shape of the second loop bounds an area defined in an orientation that maximizes the area, the area having an effective diameter which is equal to the diameter of a circle having the area, the second loop moving toward the unbiased shape when moving from the collapsed position to the expanded position.

154. The tissue manipulator of claim 145, wherein:
the effective diameter of the area of the second loop is 4.5 mm to 6.5 mm.

155. The tissue manipulator of claim 145, wherein:
the effective diameter of the area of the second loop is 5.0 mm to 6.0 mm.

156. The tissue manipulator of claim 145, wherein:
the effective diameter of the unbiased shape of the second loop being within 20% of an effective diameter of the expanded position of the second loop.

157. The tissue manipulator of claim 145, wherein:
the shaft has a longitudinal axis at a distal end of the shaft;
the first loop has an orientation which maximizes an area of the first loop when in the expanded position when viewed along the orientation, the orientation being within 45 degrees of perpendicular to the longitudinal axis.

158. The tissue manipulator of claim 145, wherein:
the shaft has a longitudinal axis at a distal end of the shaft;
the second loop has an orientation which maximizes an area of the second loop when in the expanded position when viewed along the orientation, the orientation being within 45 degrees of perpendicular to the longitudinal axis.

159. The tissue manipulator of claim 145, wherein:
the first loop is spaced apart from the second loop to define a volume therebetween when the first and second loops are in the expanded position, the volume therebetween being 0.48 mm(3) to 0.84 mm(3).

160. The tissue manipulator of claim 145, wherein:
an intermediate element positioned between the first loop and the second loop.

161. The tissue manipulator of claim 145, wherein:
the intermediate element is a third loop positioned between the first loop and the second loop.

162. The tissue manipulator of claim 145, wherein:
the intermediate element includes an interconnecting element extending between the first loop and the second loop.

163. The tissue manipulator of claim 145, wherein:
the interconnecting element of the intermediate element is integrally formed with the first loop and the second loop.

164. The tissue manipulator of claim 145, wherein:
the interconnecting element is a flexible filament extending between the first loop and the second loop.

165. The tissue manipulator of claim 145, wherein:
the third loop formed by the intermediate element has a first leg and a second leg, at least one of the first and second legs extending through the lumen, the third loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the lumen and out the distal opening in the lumen.

166. The tissue manipulator of claim 145, wherein:

the third loop has an unbiased shape, wherein the unbiased shape of the third loop bounds an area defined in an orientation that maximizes the area, the area having an effective diameter which is equal to the diameter of a circle having the area, the third loop moving toward the unbiased shape when moving from the collapsed position to the expanded position.

167. The tissue manipulator of claim 145, wherein:
the effective diameter of the area of the third loop is 4.5 mm to 6.5 mm.

168. The tissue manipulator of claim 145, wherein:
the effective diameter of the area of the third loop is 5.0 mm to 6.0 mm.

169. The tissue manipulator of claim 145, wherein:
the shaft has a longitudinal axis at a distal end of the shaft;
the third loop has an orientation which maximizes an area of the first loop when in the expanded position when viewed along the orientation, the orientation being within 30 degrees of perpendicular to the longitudinal axis.

170. The tissue manipulator of claim 145, wherein:
the third loop is configured to cut material contained within the third loop when the third loop moves from the expanded position toward the collapsed position.

171. The tissue manipulator of claim 145, wherein:
the first loop and the second loop defining an exposed surface between the first loop and the second loop when the first and second loops are both in the expanded position.

172. The tissue manipulator of claim 145, wherein:
the exposed surface between the first loop and the second loop has an area of 15 mm(3) to 60 mm(3).

173. The tissue manipulator of claim 145, wherein:
the first loop has an unbiased shape, wherein the unbiased shape of the first loop bounds an area defined by an orientation that maximizes the area, the area having an effective diameter which is equal to the diameter of a circle having the area, the first loop moving toward the unbiased shape when moving from the collapsed position to the expanded position; and
the exposed surface between the first loop and the second loop is 3-10 times the effective diameter.

174. The tissue manipulator of claim 145, wherein:
the exposed surface between the first loop and the second loop having 2-8 independent cells.

175. The tissue manipulator of claim 145, wherein:
the exposed surface between the first loop and the second loop having 2-6 independent cells.

176. The tissue manipulator of claim 145, wherein:
the exposed surface between the first loop and the second loop having 2-4 independent cells.

177. The tissue manipulator of claim 145, wherein:
the exposed surface between the first loop and the second loop having 2 independent cells.

178. The tissue manipulator of claim 145, wherein:
the exposed surface has an area which is at least 4 times larger than an area of the intermediate element positioned between the first loop and the second loop when the exposed surface is viewed radially inward with respect to the first and second loops.

179. The tissue manipulator of claim 145, wherein:

the first loop has at least 80% of the loop being 1.5-3.5 mm from the second loop.

180. The tissue manipulator of claim 145, wherein:

the first loop is configured to cut material contained within the first loop when the first loop moves from the expanded position toward the collapsed position.

181. The tissue manipulator of claim 145, wherein:

the second loop is configured to cut material contained within the first loop when the first loop moves from the expanded position toward the collapsed position.

182. The tissue manipulator of claim 145, further comprising:

a first support element extending from a distal end of the shaft when the first loop is in the expanded position, the first support element being an elongate element that extends to a free end.

183. The tissue manipulator of claim 145, wherein:

the first support element is positioned with the free end positioned within an area of the first loop when viewing the first loop along an orientation that maximizes the area of the first loop.

184. The tissue manipulator of claim 145, wherein:

the first loop has an effective diameter when in the expanded position, the effective diameter being a diameter of a circle having the area of the first loop in the expanded position; and

the first support element extends into the area of the first loop so that the free end is positioned 0.05 to 0.30 times the effective diameter of the first loop.

185. The tissue manipulator of claim 145, further comprising:

a second support element extending from a distal end of the shaft when the second loop is in the expanded position, the second support element being an elongate element that extends to a free end.

186. The tissue manipulator of claim 145, wherein:

the second support element is positioned with the free end positioned within an area of the second loop when viewing the second loop along an orientation that maximizes the area of the second loop.

187. The tissue manipulator of claim 145, wherein:

the second loop has an effective diameter when in the expanded position, the effective diameter being a diameter of a circle having the area of the second loop in the expanded position; and

the second support element extends into the area of the second loop so that the free end is positioned 0.05 to 0.30 times the effective diameter of the second loop.

188. The tissue manipulator of claim 145, further comprising:

the first loop having at least one interconnecting element extending from a first connection to the first loop to a second connection to the first loop;

the second loop having at least one interconnecting element extending from a first connection to the second loop to a second connection to the second loop.

189. The tissue manipulator of claim 145, wherein:

the first loop is free of cross-elements extending between any two parts of the first loop.

190. The tissue manipulator of claim 145, wherein:

the second loop is free of cross-elements extending between any two parts of the second loop.

191. The tissue manipulator of claim 145, wherein:

the third loop is free of cross-elements extending between any two parts of the third loop.

192. The tissue manipulator of claim 145, further comprising:
a source of suction coupled to the lumen.

193. The tissue manipulator of claim 145, wherein:
the first leg and the second leg of the first loop are both movable within the lumen.

194. The tissue manipulator of claim 145, wherein:
the first leg and the second leg of the second loop are both movable within the lumen.

195. The tissue manipulator of claim PREV, wherein:
the first leg and the second leg of the first loop are coupled to an actuator extending through the lumen so that movement of the actuator moves the first leg and the second leg between the collapsed position and the expanded position.

196. The tissue manipulator of claim PREV, wherein:
the first leg and the second leg of the second loop are coupled to an actuator extending through the lumen so that movement of the actuator moves the first leg and the second leg between the collapsed position and the expanded position.

197. The tissue manipulator of claim PREV, wherein:
the first leg and the second leg of the third loop are coupled to an actuator extending through the lumen so that movement of the actuator moves the first leg and the second leg between the collapsed position and the expanded position.

198. The tissue manipulator of claim 145, wherein:
the first loop is positioned entirely distal to the distal opening in the expanded position.

199. The tissue manipulator of claim 145, wherein:
the second loop is positioned entirely distal to the distal opening in the expanded position.

200. The tissue manipulator of claim 145, wherein:
the first loop comprises a superelastic material within a superelastic range when in the collapsed position; and
the second leg comprises a superelastic material within a superelastic range when in the collapsed position.

201. The device of claim 145, further comprising:
a rotating cutter having a cutting element at a distal end, the rotating cutter having a working position adjacent the distal opening in the shaft.

202. The device of claim 145, wherein:
the working position of the rotating cutter has the cutting element positioned proximal to the distal opening.

203. The device of claim 145, wherein:
the rotating cutter is coupled to the shaft and is longitudinally movable relative to the shaft to move the cutting element into the working position.

204. The device of claim 145, wherein:
the rotating cutter includes a lumen through which material may be suctioned.

205. A method of manipulating tissue in the eye; comprising:
introducing a distal end of a shaft within an eye, the shaft having a lumen with a distal opening also positioned in the eye;
expanding a first loop from a collapsed position to an expanded position within the eye, the first loop having a first leg and a second leg, at least one of the first and second legs extending through the lumen, the first loop being movable from the collapsed position to the

expanded position when the at least one of the first and second legs is advanced through the lumen and out the distal opening in the lumen;

expanding a second loop from a collapsed position to an expanded position within the eye, the second loop having a first leg and a second leg, at least one of the first and second legs extending through the lumen, the second loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the lumen and out the distal opening in the lumen.

206. The method of claim 205, further comprising:

positioning material within the first loop; and

collapsing the first loop from the expanded position toward the collapsed position so that the first loop is collapsed around the material.

207. The method of claim 205, further comprising:

the positioning is carried out with the material also positioned within the second loop; and

collapsing the second loop from the expanded position toward the collapsed position so that the second loop is collapsed around the material.

208. The method of claim 205, wherein:

the first loop collapsing and the second loop collapsing are carried out simultaneously.

209. The method of claim 205, further comprising:

cutting the material during the first loop collapsing.

210. The method of claim 205, further comprising:

cutting the material during the second loop collapsing.

211. The method of claim 205, wherein:

the expanding the first loop and the expanding the second loop is carried out simultaneously.

212. The method of claim 205, wherein:

the first loop expanding is carried out with the first loop having an unbiased shape, wherein the unbiased shape of the first loop bounds an area defined in an orientation that maximizes the area, the area having an effective diameter which is equal to the diameter of a circle having the area, the first loop moving toward the unbiased shape when moving from the collapsed position to the expanded position.

213. The method of claim 205, wherein:

the first loop expanding is carried out with the effective diameter being 4.5 mm to 6.5 mm.

214. The method of claim 205, wherein:

the first loop expanding is carried out with the effective diameter being 5.0 mm to 6.0 mm.

215. The method of claim 205, wherein:

the second loop expanding is carried out with the second loop having an unbiased shape, wherein the unbiased shape of the second loop bounds an area defined in an orientation that maximizes the area, the area having an effective diameter which is equal to the diameter of a circle having the area, the second loop moving toward the unbiased shape when moving from the collapsed position to the expanded position.

216. The method of claim 205, wherein:

the second loop expanding is carried out with the effective diameter being 4.5 mm to 6.5 mm.

217. The method of claim 205, wherein:
the second loop expanding is carried out with the effective diameter being 5.0 mm to 6.0 mm.
218. The method of claim 205, wherein:
the introducing is carried out with the shaft having a longitudinal axis at the distal end of the shaft;
the first loop expanding is carried out with the first loop having an orientation which maximizes an area of the first loop when in the expanded position when viewed along the orientation, the orientation being within 45 degrees of perpendicular to the longitudinal axis.
219. The method of claim 205, wherein:
the introducing is carried out with the shaft having a longitudinal axis at the distal end of the shaft;
the second loop expanding is carried out with the second loop having an orientation which maximizes an area of the second loop when in the expanded position when viewed along the orientation, the orientation being within 45 degrees of perpendicular to the longitudinal axis.
220. The method of claim 205, wherein:
the second loop expanding is carried out so that the first loop and the second loop are spaced apart to define a volume therebetween when the first and second loops are in the expanded position, the volume therebetween being 0.48 mm(3) to 0.84 mm(3).
221. The method of claim 205, further comprising:
deploying an intermediate element between the first loop and the second loop.
222. The method of claim 205, wherein:
the deploying is carried out with the intermediate element being a third loop positioned between the first loop and the second loop.
223 The method of claim 205, wherein:
the deploying is carried out with the intermediate element including an interconnecting element extending between the first loop and the second loop, the deploying being carried out during at least one of the first loop expanding and the second loop expanding.
224. The method of claim 205, wherein:
the deploying is carried out with the interconnecting element of the intermediate element being integrally formed with the first loop and the second loop.
225. The method of claim 205, wherein:
the deploying is carried out with the interconnecting element being a flexible filament extending between the first loop and the second loop.
226. The method of claim 205, wherein:
the deploying is carried out with a third loop formed by the intermediate element having a first leg and a second leg, at least one of the first and second legs extending through the lumen, the third loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs of the third loop is advanced through the lumen and out the distal opening in the lumen.
227. The method of claim 205, wherein:
the deploying is carried out with the third loop having an unbiased shape, wherein the unbiased shape of the third loop bounds an area defined in an orientation that maximizes the area, the area having an effective diameter which is equal to the diameter of a circle having the area, the third loop moving toward the unbiased shape when moving from the collapsed position to the expanded position.

228. The method of claim 205, wherein:

the deploying is carried out with the effective diameter of the area of the third loop being 4.5 mm to 6.5 mm.

229. The method of claim 205, wherein:

the deploying is carried out with the effective diameter of the area of the third loop being 5.0 mm to 6.0 mm.

230. The method of claim 205, wherein:

the introducing is carried out with the shaft having a longitudinal axis at the distal end of the shaft;

the deploying is carried out with the third loop having an orientation which maximizes an area of the first loop when in the expanded position when viewed along the orientation, the orientation being within 30 degrees of perpendicular to the longitudinal axis.

231. The method of claim 205, further comprising:

collapsing the third loop from the expanded position toward the collapsed position, the third loop being configured to cut material contained within the third loop when the third loop moves from the expanded position toward the collapsed position.

232. The method of claim 205, wherein:

the second loop expanding defines an exposed surface between the first loop and the second loop when the first and second loops are both in the expanded position.

233. The method of claim 205, wherein:

the second loop expanding is carried out with the exposed surface between the first loop and the second loop having an area of 15 mm(3) to 60 mm(3).

234. The method of claim 205, wherein:

the first loop expanding is carried out with the first loop having an unbiased shape, wherein the unbiased shape of the first loop bounds an area defined by an orientation that maximizes the area, the area having an effective diameter which is equal to the diameter of a circle having the area, the first loop moving toward the unbiased shape when moving from the collapsed position to the expanded position;

the second loop expanding is carried out to define an exposed surface between the first loop and the second loop, the exposed surface being 3-10 times the effective diameter of the area of the first loop in the unbiased shape.

235. The method of claim 205, wherein:

the second loop expanding is carried out with the exposed surface between the first loop and the second loop having 2-8 independent cells.

236. The method of claim 205, wherein:

the second loop expanding is carried out with the exposed surface between the first loop and the second loop having 2-6 independent cells.

237. The method of claim 205, wherein:

the second loop expanding is carried out with the exposed surface between the first loop and the second loop having 2-4 independent cells.

238. The method of claim 205, wherein:

the second loop expanding is carried out with the exposed surface between the first loop and the second loop having 2 independent cells.

239. The method of claim 205, wherein:

the second loop expanding is carried out with the exposed surface being at least 4 times larger than an area of the intermediate element positioned between the first loop and the second loop.

240. The method of claim 205, wherein:

the second loop expanding is carried out with the first loop having at least 80% of the loop being 1.5-3.5 mm from the second loop.

241. The method of claim 205, further comprising:

extending a first support element from a distal end of the shaft, the first support element being an elongate element that extends to a free end.

242. The method of claim 205, wherein:

the extending is carried out with the first support element being positioned with the free end positioned within an area of the first loop when viewing the first loop along an orientation that maximizes the area of the first loop.

243. The method of claim 205, wherein:

the extending is carried out with the first loop having an effective diameter when in the expanded position, the effective diameter being a diameter of a circle having the area of the first loop in the expanded position; and

the first support extending is carried out so that the first support element extends into the area of the first loop so that the free end is positioned 0.05 to 0.30 times the effective diameter of the first loop when viewed along the orientation.

244. The method of claim 205, wherein:

the first support extending is carried out simultaneously with the first loop expanding.

245. The method of claim 205, further comprising:

extending a second support element from the distal end of the shaft, the second support element being an elongate element that extends to a free end.

246. The method of claim 205, wherein:

the second support element extending is carried out with the free end positioned within an area of the second loop when viewing the second loop along an orientation that maximizes the area of the second loop.

247. The method of claim 245, wherein:

the second support element extending is carried out with the second loop having an effective diameter when in the expanded position, the effective diameter being a diameter of a circle having the area of the second loop in the expanded position, the second support element extends into the area of the second loop so that the free end is positioned 0.05 to 0.30 times the effective diameter of the second loop.

248. The method of claim 245, wherein:

the second support element extending is carried out simultaneously with the second loop expanding.

249. The method of claim 205, further comprising:

the second loop expanding is carried out with the first loop having at least one interconnecting element extending from a first connection to the first loop to a second connection to the first loop, the interconnecting element being deployed during at least the second loop expanding, the second loop also having at least one interconnecting element extending from a first connection to the second loop to a second connection to the second loop.

250. The method of claim 205, wherein:

the first loop expanding is carried out with the first loop being free of cross-elements extending between any two parts of the first loop.

251. The method of claim 205, wherein:

the second loop expanding is carried out with the second loop being free of cross-elements extending between any two parts of the second loop.

252. The method of claim 205, wherein:

the deploying is carried out with the third loop being free of cross-elements extending between any two parts of the third loop.

253. The method of claim 205, further comprising:

suctioning the material into the lumen through the distal opening.

254. The method of claim 205, wherein:

the first loop expanding is carried out independently of the second loop expanding.

255. The method of claim 205, wherein:

the first loop expanding is carried out with the first leg and the second leg of the first loop being coupled to an actuator extending through the lumen so that movement of the actuator moves the first leg and the second leg between the collapsed position and the expanded position.

256. The method of claim 205, wherein:

the second loop expanding is carried out with the first leg and the second leg of the second loop being coupled to an actuator extending through the lumen so that movement of the actuator moves the first leg and the second leg between the collapsed position and the expanded position.

257. The method of claim 205, wherein:

the deploying is carried out with the first leg and the second leg of the third loop being coupled to an actuator extending through the lumen so that movement of the actuator moves the first leg and the second leg between the collapsed position and the expanded position.

258. The method of claim 205, wherein:

the first loop expanding is carried out with the first loop being positioned entirely distal to the distal opening in the expanded position.

259. The method of claim 205, wherein:

the second loop expanding is carried out with the second loop being positioned entirely distal to the distal opening in the expanded position.

260. The method of claim 205, wherein:

the first loop expanding is carried out with the first loop including a superelastic material within a superelastic range when in the collapsed position; and

the second loop expanding is carried out with the second loop including a superelastic material within a superelastic range when in the collapsed position.

261. The method of claim 205, further comprising:

cutting material with a rotating cutter having a cutting element at a distal end, the rotating cutter having a working position adjacent the distal opening in the shaft.

262. The method of claim 205, wherein:

the rotating cutter cutting is carried out with the working position having the cutting element positioned proximal to the distal opening.

263. The method of claim 205, wherein:

the rotating cutter cutting is carried out with is coupled to the shaft and is longitudinally movable relative to the shaft to move the cutting element into the working position.

264. The method of claim 205, wherein:

the rotating cutter cutting is carried out with the rotating cutter including a lumen.

265. The method of claim 205, further comprising:
suctioning material through the lumen in the rotating cutter.

266. The method of claim 265, wherein:
the suctioning with the rotating cutter is carried out during the cutting with the rotating cutter.

267. A tissue manipulator, comprising:
a first loop having a first leg and a second leg, at least one of the first and second legs extending through the lumen, the first loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through a lumen in a shaft and out a distal opening in the lumen; and
a concave element coupled to the first loop, the concave element and the loop forming a basket to receive material.

268. The tissue manipulator of claim 267, wherein:
the shaft is configured for introduction into the eye so that a distal end and the distal opening are positioned in the eye.

269. The tissue manipulator of claim 267, wherein:
the concave element is integrally formed with the loop.

270. The tissue manipulator of claim 267, wherein:
the concave element has a first end and a second end, the first end being integrally formed with the loop.

271. The tissue manipulator of claim 267, wherein:
the second end of the concave element is integrally formed with the loop.

272. The tissue manipulator of claim 267, wherein:
the second end of the concave element is movable within the lumen of the shaft.

273. The tissue manipulator of claim 267, wherein:
the first leg and the second leg are both movable within the lumen of the shaft.

274. The tissue manipulator of claim 267, wherein:
the second leg of the concave element is independently movable within the lumen of the shaft from the at least one of the first and second legs.

275. The tissue manipulator of claim 267, wherein:
the loop is made of a superelastic material.

276. The tissue manipulator of claim 267, wherein:
the concave element is made of a superelastic material.

277. The tissue manipulator of claim 267, wherein:
the shaft has a longitudinal axis at a distal end; and
the loop has an orientation which maximizes an area of the loop when in the expanded position, the orientation being within 30 degrees from perpendicular to the longitudinal axis.

278. The tissue manipulator of claim 267, wherein:
the loop is positioned entirely distal to the distal opening when in the expanded position.

279. The device of claim 267, further comprising:
a rotating cutter having a cutting element at a distal end, the rotating cutter having a working position adjacent the distal opening in the shaft.

280. The device of claim 267, wherein:
the working position of the rotating cutter has the cutting element positioned proximal to the distal opening.

281. The device of claim 267, wherein:
the rotating cutter is coupled to the shaft and is longitudinally movable relative to the shaft to move the cutting element into the working position.
282. The device of claim 267, wherein:
the rotating cutter includes a lumen through which material may be suctioned.
283. A method of manipulating tissue within an eye, comprising:
introducing a distal end of a shaft into an eye, the shaft having a lumen with a distal opening, a first loop having a first leg and a second leg being coupled to the shaft, at least one of the first and second legs extending through the lumen, the first loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the lumen and out the distal opening in the lumen, a concave element being coupled to the first loop, the concave element and the loop forming a basket to receive material;
expanding the loop from the collapsed position to the expanded position;
manipulating the basket to position material in the basket; and
collapsing the loop so that the material is held within the basket.
284. The method of claim 283, wherein:
the collapsing is carried out with the concave element being integrally formed with the loop.
285. The method of claim 283, wherein:
the collapsing is carried out with the concave element having a first end and a second end, the first end being integrally formed with the loop.
286. The method of claim 283, wherein:
the collapsing is carried out with the second end of the concave element being integrally formed with the loop.
287. The method of claim 283, wherein:
the collapsing is carried out with the second end of the concave element being movable within the lumen of the shaft.
288. The method of claim 283, wherein:
the introducing is carried out with the first leg and the second leg both movable within the lumen of the shaft.
289. The method of claim 283, wherein:
the introducing is carried out with the second leg of the concave element being independently movable within the lumen of the shaft from the at least one of the first and second legs.
290. The method of claim 283, wherein:
the introducing is carried out with the loop comprising made of a superelastic material.
291. The method of claim 283, wherein:
the introducing is carried out with the concave element comprising made of a superelastic material.
292. The method of claim 283, wherein:
the introducing is carried out with the shaft having a longitudinal axis at a distal end; and
the expanding is carried out with the loop having an orientation which maximizes an area of the loop when in the expanded position, the orientation being within 30 degrees from perpendicular to the longitudinal axis.
293. The method of claim 283, wherein:

the expanding is carried out with the loop being positioned entirely distal to the distal opening when in the expanded position.

294. The method of claim 283, wherein:
the collapsing cuts the material contained within the basket.

295. The method of claim 283, further comprising:
suctioning material into the lumen of the shaft.

296. The method of claim 283, further comprising:
cutting material with a rotating cutter having a cutting element at a distal end, the rotating cutter having a working position adjacent the distal opening in the shaft.

297. The method of claim 283, wherein:
the rotating cutter cutting is carried out with the working position having the cutting element positioned proximal to the distal opening.

298. The method of claim 283, wherein:
the rotating cutter cutting is carried out with is coupled to the shaft and is longitudinally movable relative to the shaft to move the cutting element into the working position.

299. The method of claim 283, wherein:
the rotating cutter cutting is carried out with the rotating cutter including a lumen.

300. The method of claim 283, further comprising:
suctioning material through the lumen in the rotating cutter.

301. The method of claim 300, wherein:
the suctioning with the rotating cutter is carried out during the cutting with the rotating cutter.

302. A tissue manipulator, comprising
a first shaft having a first lumen with a distal opening;
a second shaft extending through the first lumen of the first shaft;
a first loop having a first leg and a second leg, at least one of the first and second legs extending through the first lumen, the first loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the first lumen and out the distal opening in the first lumen; and
a second loop having a first leg and a second leg, at least one of the first and second legs extending through the first lumen, the second loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the lumen and out the distal opening in the lumen.

303. The tissue manipulator of claim 302, further comprising:
a first concave element coupled to the first loop, the first concave element and the first loop forming a first basket;
a second concave element coupled to the second loop, the second concave element and the second loop forming a second basket.

304. The tissue manipulator of claim 302, wherein:
the first concave element includes a first concave shaped loop; and
the second concave element includes a second concave shaped loop.

305. The tissue manipulator of claim 302, wherein:
the second shaft is rotatable relative to the first shaft so that the second basket is rotatable relative to the first basket between an open position and a closed position, the open position having the first basket and the second basket at least partially nested and the closed position having the first basket facing the second basket.

306. The tissue manipulator of claim 302, wherein:
the second shaft is rotatable to the closed position with the first basket and the second basket forming an enclosure.
307. The tissue manipulator of claim 302, wherein:
the first loop is configured to cut material when the first loop is moved from the expanded position to the collapsed position.
308. The device of claim 302, further comprising:
a rotating cutter having a cutting element at a distal end, the rotating cutter having a working position adjacent the distal opening in the shaft.
309. The device of claim 302, wherein:
the working position of the rotating cutter has the cutting element positioned proximal to the distal opening.
310. The device of claim 302, wherein:
the rotating cutter is coupled to the shaft and is longitudinally movable relative to the shaft to move the cutting element into the working position.
311. The device of claim 302, wherein:
the rotating cutter includes a lumen through which material may be suctioned.
312. A method of manipulating tissue, comprising:
introducing a device having a first shaft and a second shaft into an eye, the first shaft having a first lumen with a distal opening, the second shaft extending through the lumen of the first shaft, a first loop having a first leg and a second leg coupled to at least one of the first shaft and the second shaft, at least one of the first and second legs extending through the first lumen, the first loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the first lumen and out the distal opening in the first lumen, a second loop having a first leg and a second leg, at least one of the first and second legs extending through the lumen, the second loop being movable from a collapsed position to an expanded position when the at least one of the first and second legs is advanced through the second lumen and out the distal opening in the lumen, a first concave element coupled to the first loop, the first concave element and the first loop forming a first basket, a second concave element coupled to the second loop, the second concave element and the second loop forming a second basket;
expanding the first loop;
expanding the second loop; and
rotating the first loop and second loop relative to one another about a longitudinal axis of the the first shaft.
313. The method of claim 323, wherein:
the introducing is carried out with the first concave element including a first concave shaped loop and the second concave element includes a second concave shaped loop.
314. The method of claim 323, wherein:
the rotating is carried out with the second shaft being rotatable relative to the first shaft so that the second basket is rotatable relative to the first basket between an open position and a closed position, the open position having the first basket and the second basket at least partially nested and the closed position having the first basket facing the second basket.
315. The method of claim 323, wherein:
the rotating is carried out with the second shaft rotatable to the closed position with the first basket and the second basket forming an enclosure.

316. The method of claim 323, further comprising:

cutting the material by collapsing the first loop and the second loop to cut material when the first loop and the second loop are moved from the expanded position to the collapsed position.

317. The method of claim C, further comprising:

cutting material with a rotating cutter having a cutting element at a distal end, the rotating cutter having a working position adjacent the distal opening in the shaft.

318. The method of claim 323, wherein:

the rotating cutter cutting is carried out with the working position having the cutting element positioned proximal to the distal opening.

319. The method of claim 323, wherein:

the rotating cutter cutting is carried out with is coupled to the shaft and is longitudinally movable relative to the shaft to move the cutting element into the working position.

320. The method of claim 323, wherein:

the rotating cutter cutting is carried out with the rotating cutter including a lumen.

321. The method of claim 323, further comprising:

suctioning material through the lumen in the rotating cutter.

322. The method of claim 321, wherein:

the suctioning with the rotating cutter is carried out during the cutting with the rotating cutter.

323. A method of cutting a lens in a cataract procedure, comprising:

introducing a distal end of a device into an eye, the device having a shaft and an elongate element coupled to the shaft, the shaft having a first shaft part and a second shaft part, the first shaft part and the second shaft part being movable relative to one another between a first position and a second position, the elongate element having a first end coupled to the first shaft part and a second end coupled to the second shaft part, the device forming a loop with at least part of the elongate element forming the loop, the loop being movable from a collapsed position to an expanded position when the first shaft part and the second shaft part move from the first position to the second position;

expanding the loop from the collapsed position to the expanded position by moving the first and second shaft parts from the first position to the second position;

positioning the loop around material to be cut; and

cutting the material by collapsing the loop from the expanded position toward the collapsed position, the loop being collapsed by moving the first and second shaft parts from the second position toward the first position to cut the material positioned within the loop.

324. The method of claim 323, wherein:

the expanding is carried out with the loop advancing between a capsular bag and a whole lens contained within the capsular bag;

the positioning is carried out with the material being a whole lens, the loop being positioned around an anterior surface and a posterior surface of the lens; and

the cutting is carried with the whole lens being separated into at least a first fragment and a second fragment.

325. The method of claim 323, wherein:

the first flexible portion has a length of 20-60% of a length of the intermediate portion.

326. The method of claim 323, wherein:

the introducing is carried out with the elongate element having a first flexible portion at the first end, wherein an intermediate portion between the first end and the second end is at least 1.5 more stiff than the first flexible portion.

327. The method of claim 323, wherein:

the introducing is carried out with the elongate element having a second flexible portion at the second end, wherein the intermediate portion between the first end and the second end is at least 1.5 more stiff than the second flexible portion.

328. The method of claim 323, wherein:

the expanding is carried out with the first end having an orientation that changes an angular orientation by at least 120 degrees with respect to the shaft adjacent to the second end of the elongate element when the first and second shaft parts move from the first position to the second position.

329. The method of claim 323, wherein:

the expanding is carried out with the first end being coupled to a flexible distal end of the shaft, the flexible distal end of the shaft changing orientation with respect to the shaft adjacent the second end by at least 30 degrees when the first and second shaft parts move from the first position to the second position.

330. The method of claim 323, wherein:

the expanding is carried out with the first end being rotatably coupled to the shaft.

331. The method of claim 323, wherein:

the expanding is carried out with the first end being rotatable relative to the shaft for an angle of at least 120 degrees.

332. The method of claim 323, wherein:

the expanding is carried out with the first end being rotatably coupled to the shaft to rotate for 180 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position.

333. The method of claim 323, wherein:

the expanding is carried out with the loop advancing distally beyond a distal end of the shaft as the loop moves from the collapsed position to the expanded position.

334. The method of claim 323, wherein:

the expanding is carried out with the second end changing in orientation relative to the shaft adjacent the second end by 90 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position.

335. The method of claim 323, wherein:

the expanding is carried out with the second end being rotating relative to the shaft when the first and second shaft parts move from the first position to the second position.

336. The method of claim 323, wherein:

the expanding is carried out with the second end changing an orientation with respect to the shaft adjacent the second end being rotatably coupled to the shaft to rotate for 90 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position.

337. The method of claim 323, wherein:

the introducing is carried out with the elongate element being without a preset shape.

338. The method of claim 323, wherein:

the introducing is carried out with the elongate element not including a superelastic material.

339. The method of claim 323, wherein:

the expanding is carried out with the loop moving from an unbiased position toward a biased position when moving from the collapsed position to the expanded position.

340. A device for cutting material, comprising:

a shaft having a distal end, the shaft having a first shaft part and a second shaft part, the first shaft part and the second shaft part being movable relative to one another between a first position and a second position; and

an elongate elemcnt coupled to the shaft, the elongate element having a first end coupled to the first shaft part and a second end coupled to the second shaft part, at least part of the elongate element forming a loop, the loop being movable from a collapsed position to an expanded position when the first shaft part and the second shaft part move from the first position to the second position.

341. The device of claim 340, wherein:

the loop is advanced between a capsular bag and a whole lens contained within the capsular bag in in use when expanded from the collapsed position to the expanded position.

the loop being movable around an anterior surface and a posterior surface of the whole lens to separate the whole lens into at least a first fragment and a second fragment.

342. The device of claim 340, wherein:

the elongate element has a first flexible portion at the first end and a second flexible portion at the second end, wherein an intermediate portion between the first end and the second end is at least 1.5 more stiff in bending than the first and second flexible portions when expanding.

343. The device of claim 340, wherein:

the first flexible portion has a length of 20-60% of a length of the intermediate portion.

344. The device of claim 340, wherein:

the first end has an orientation that changes by at least 120 degrees with respect to the shaft at the second end of the elongate element when the first and second shaft parts move from the first position to the second position.

345. The device of claim 340, wherein:

the shaft has a flexible distal end coupled to the first end, the flexible distal end of the shaft changing orientation with respect to the shaft adjacent the second end by at least 30 degrees when the first and second shaft parts move from the first position to the second position; and

the first end of the elongate element being coupled to a flexible distal end of the shaft,

346. The device of claim 340, wherein:

the first end is rotatably coupled to the shaft.

347. The device of claim 340, wherein:

the first end is rotatable relative to the shaft for an angle of at least 120 degrees.

348. The device of claim 340, wherein:

the first end being rotatably coupled to the shaft to rotate for 180 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position.

349. The device of claim 340, wherein:

the loop formed at least in part by the elongate element advances distally beyond a distal end of the shaft as the loop moves from the collapsed position to the expanded position.

350. The device of claim 340, whcrein:

the second end changes in orientation relative to the shaft adjacent the second end by 90 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position.

351. The device of claim 340, wherein:

the second end rotates relative to the shaft when the first and second shaft parts move from the first position to the second position.

352. The device of claim 340, wherein:

the second end changes an orientation with respect to the shaft adjacent the second end and is rotatably coupled to the shaft to rotate for 90 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position.

353. The device of claim 340, wherein:

the first end of the elongate element is rotatably coupled to the shaft.

354. The device of claim 340, wherein:

the first end of the elongate element is rotatable relative to the shaft for an angle of at least 120 degrees.

355. The device of claim 340, wherein:

the first end of the elongate element is rotatably coupled to the shaft to rotate for 180 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position.

356. The device of claim 340, wherein:

the first end of the elongate element rotates so that the loop advances distally beyond a distal end of the shaft as the loop moves from the collapsed position to the expanded position.

357. The device of claim 340, wherein:

the second end of the elongate element is rotatably coupled to the shaft.

358. The device of claim 340, wherein:

the second end of the elongate element is rotatable relative to the shaft for an angle of at least 120 degrees when the first and second shaft parts move from the first position to the second position.

359. The device of claim 340, wherein:

the second end of the elongate element is rotatably coupled to the shaft to rotate for 180 degrees +/- 45 degrees when the first and second shaft parts move from the first position to the second position.

360. The device of claim 340, wherein:

the second end of the elongate element rotates relative to the shaft so that the loop advances proximally as the loop moves from the collapsed position to the expanded position.

361. The device of claim 340, wherein:

the elongate element is without a preset shape.

362. The device of claim 340, wherein:

the elongate element does not include a superelastic material.

363. The device of claim 340, wherein:

the loop formed at least in part by the elongate element moves from an unbiased position toward a biased position when moving from the collapsed position to the expanded position.

364. An ocular surgical device comprised of:

hand held piece

a suction mechanism manually activated by a user

a source of pressurized fluid

wherein the hand held piece is connected to the suction mechanism and the source of fluid
a user input on the hand held mechanism for controlling the flow of suction or fluid
a tip on the distal end of the hand held piece capable of providing both suction and delivery of fluid

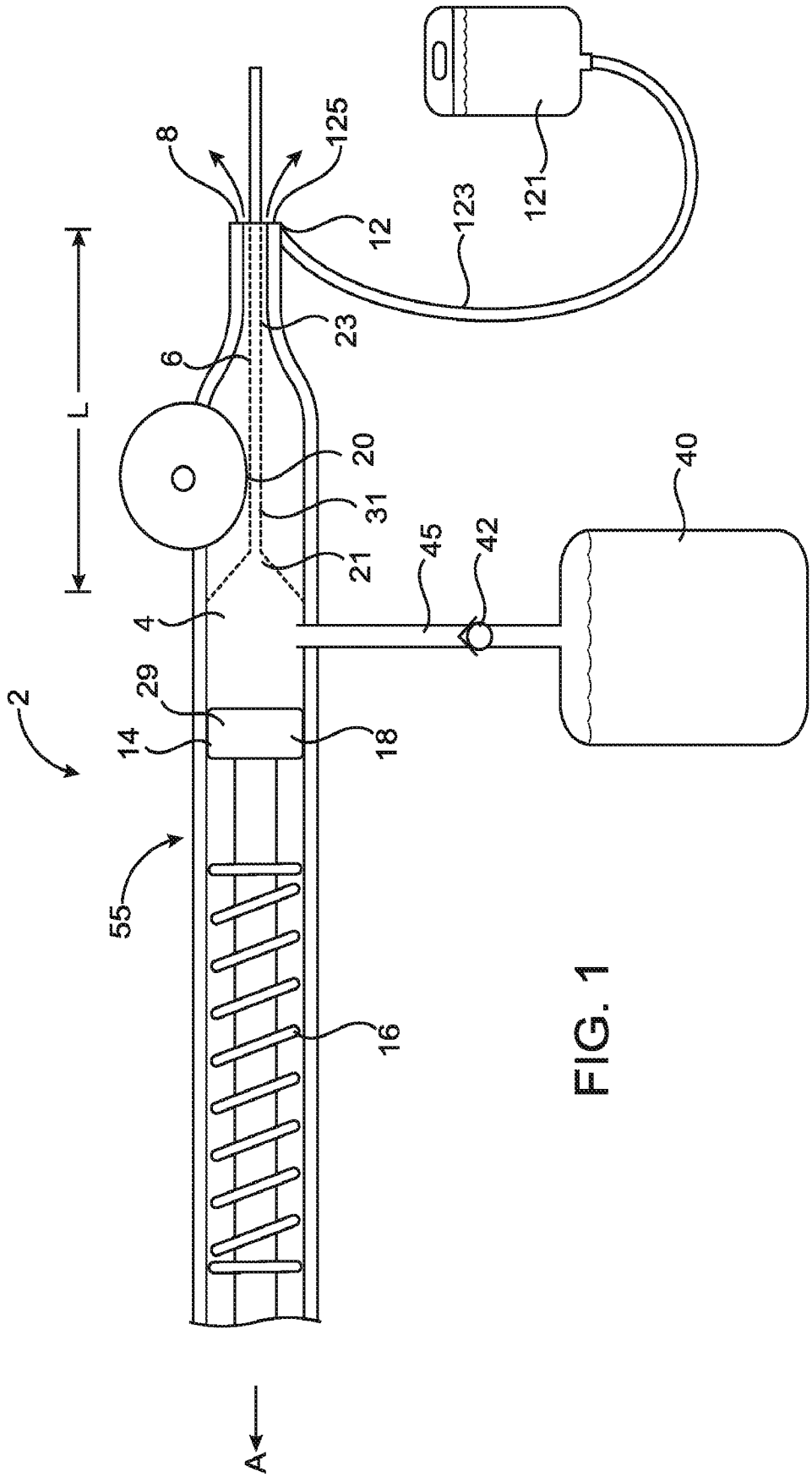


FIG. 1

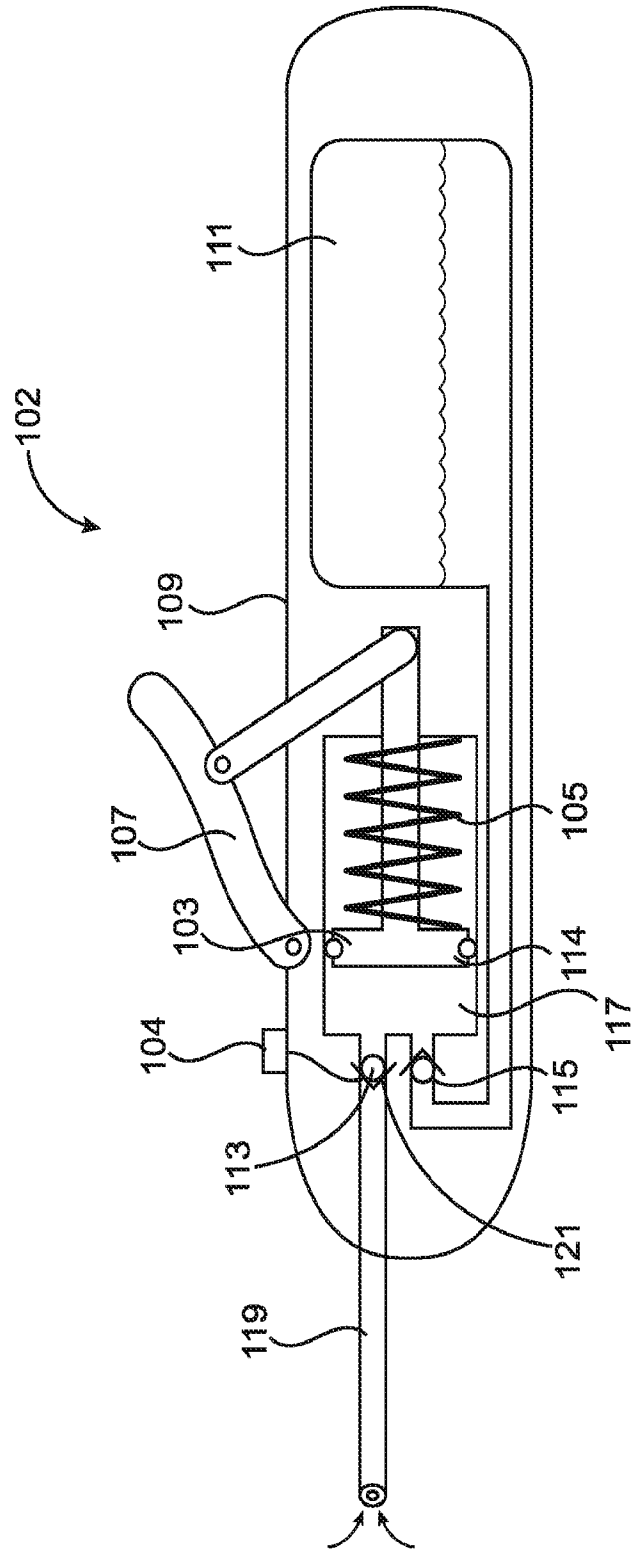


FIG. 2

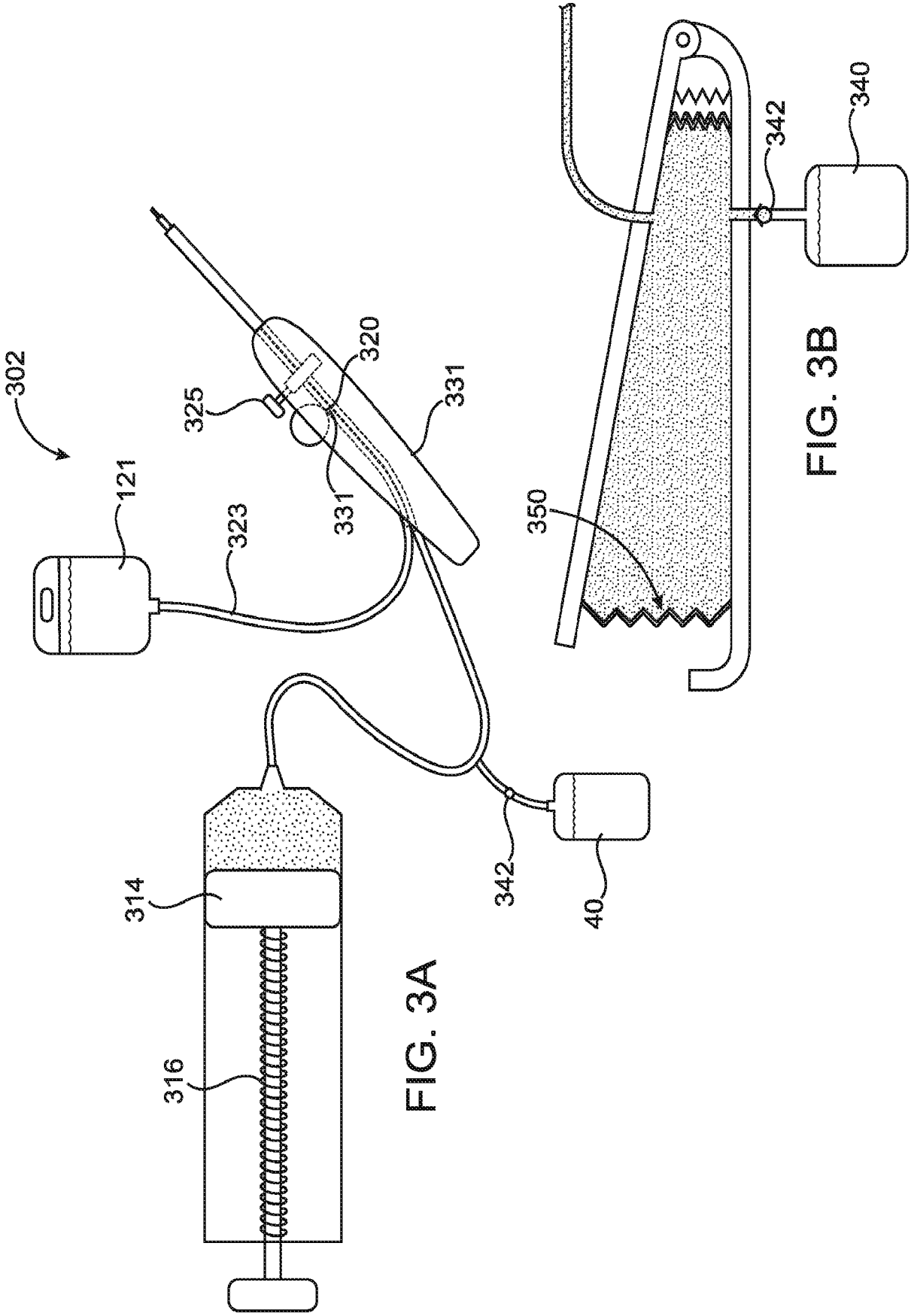


FIG. 3A

FIG. 3B

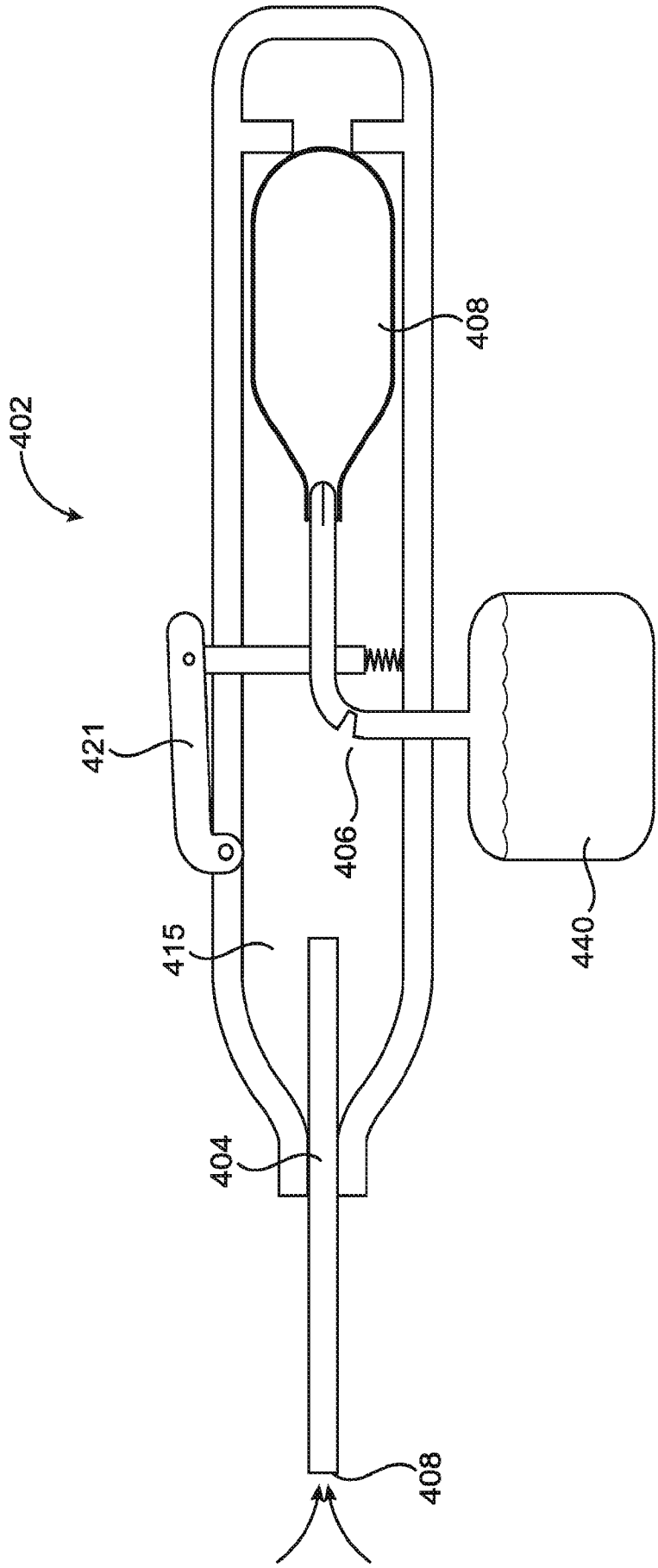


FIG. 4

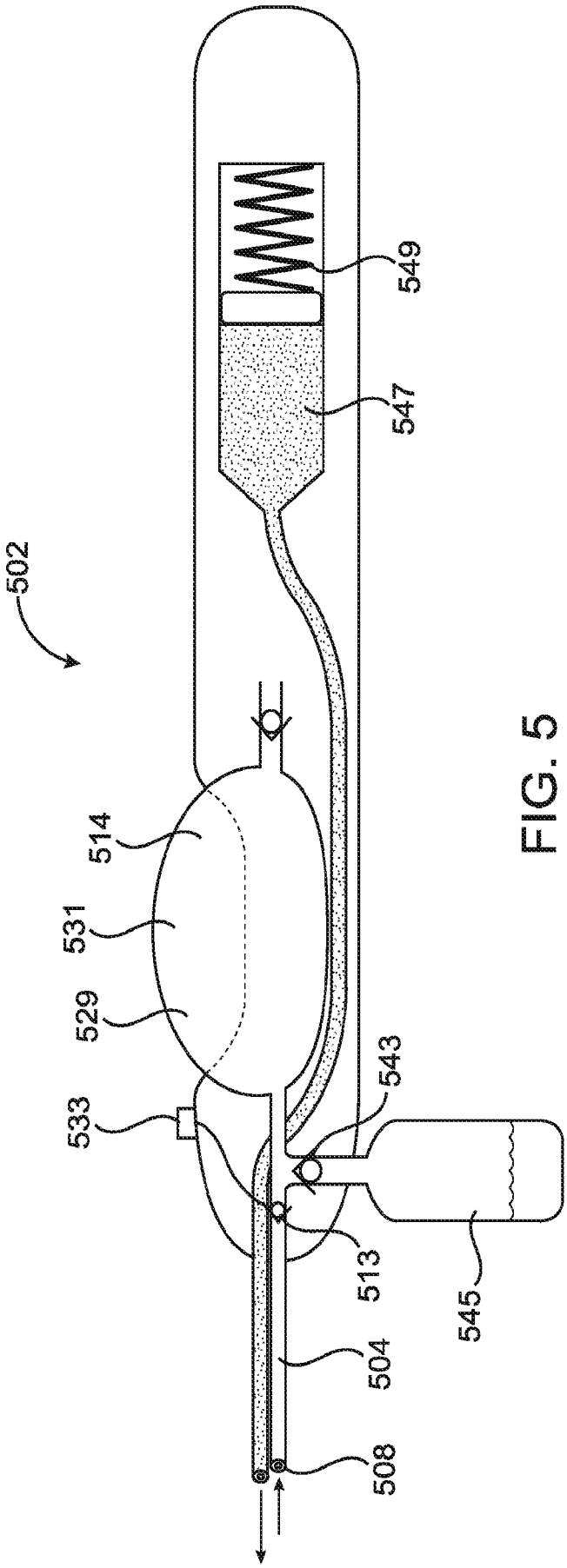


FIG. 5

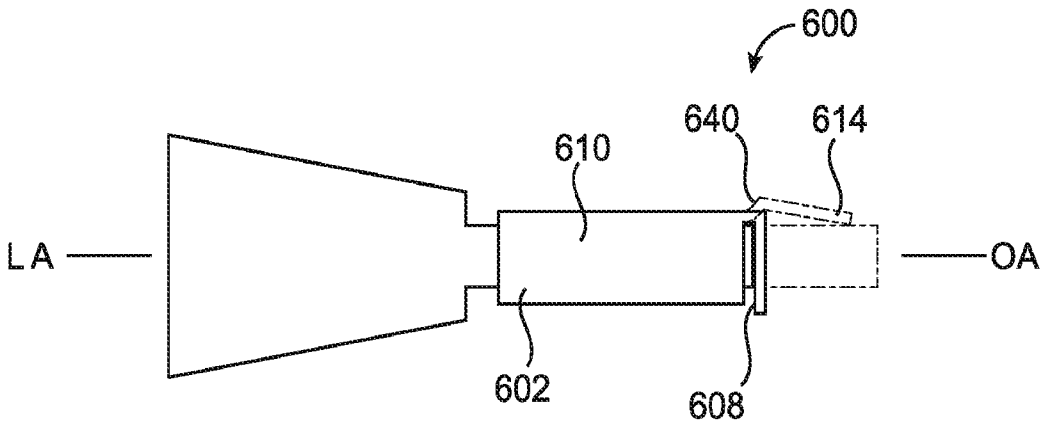


FIG. 6A

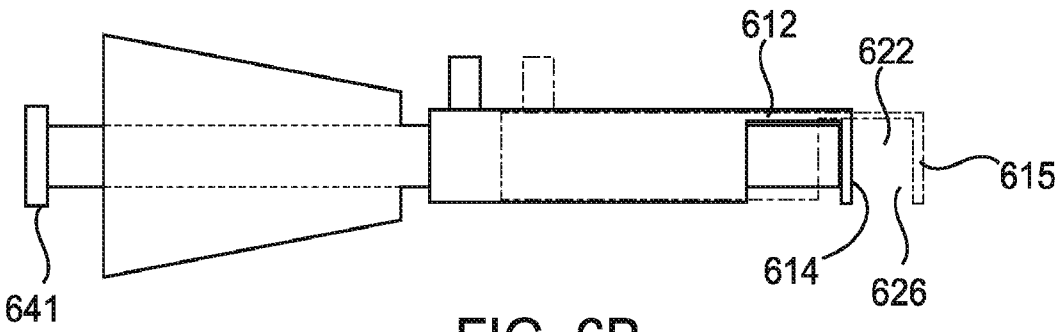


FIG. 6B

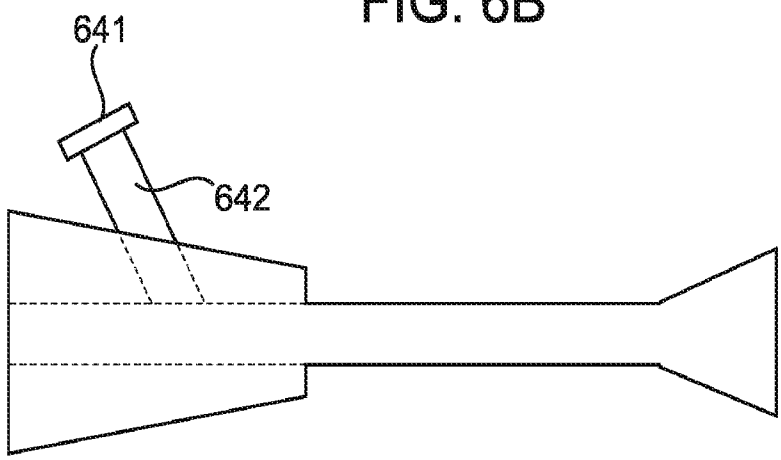


FIG. 6C

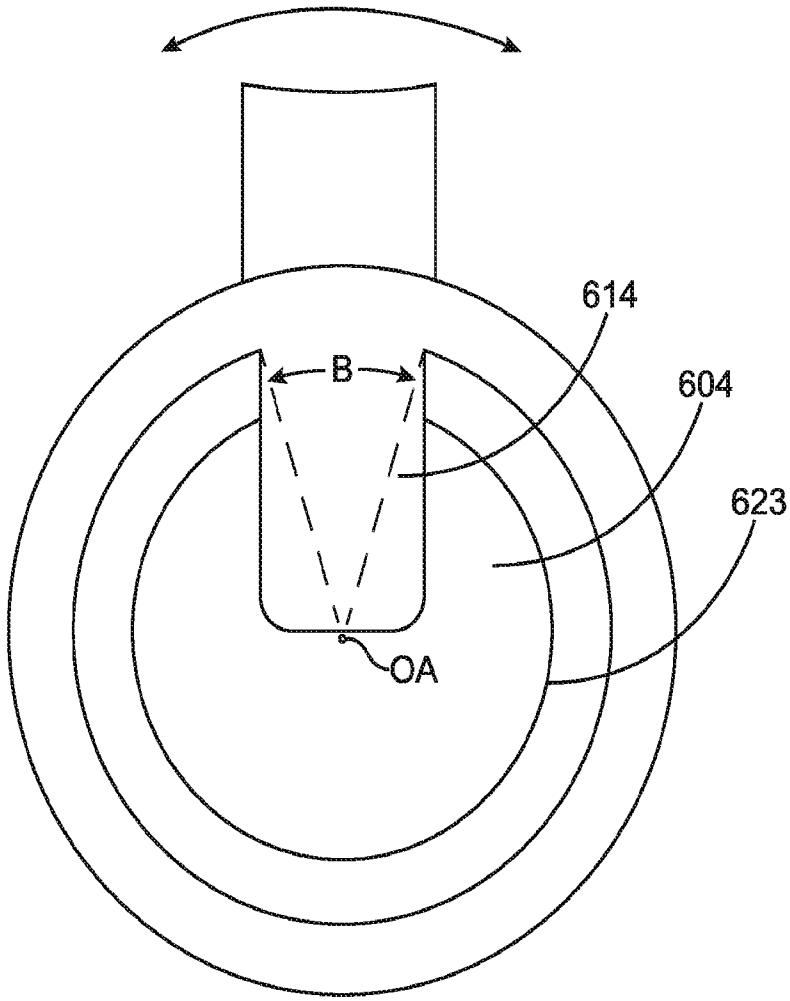


FIG. 7

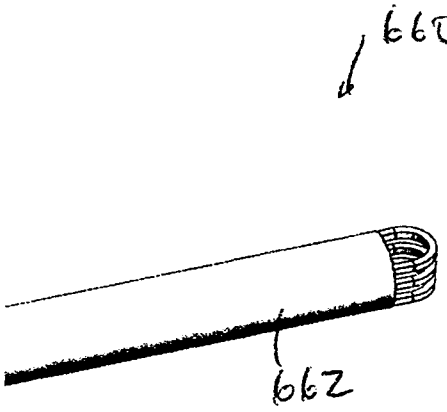


FIG 8A

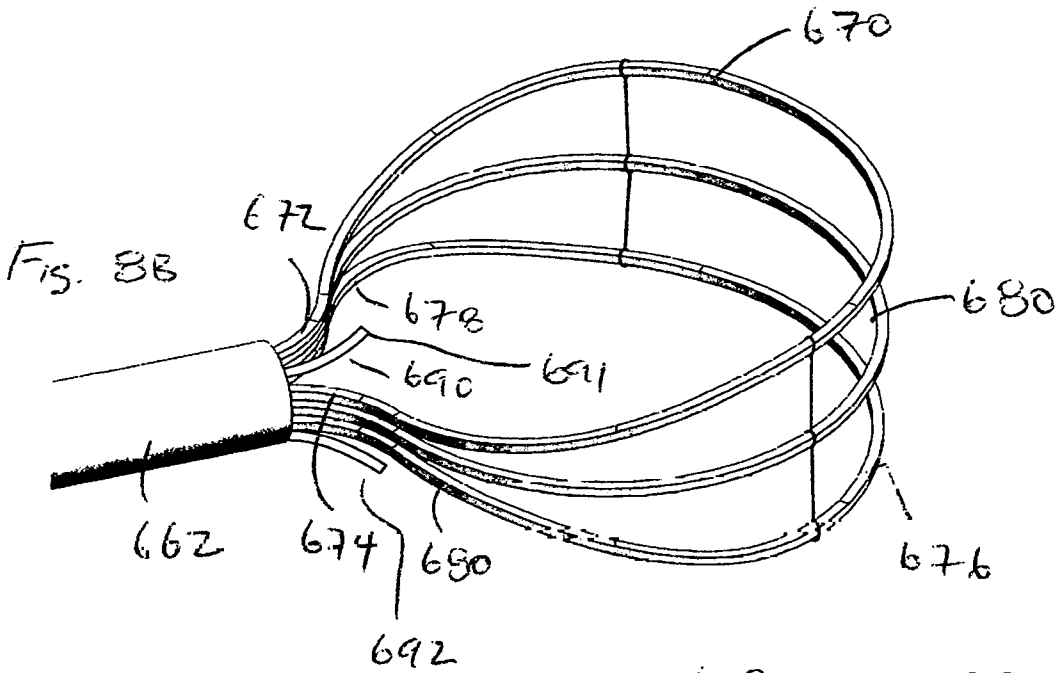


FIG. 8B

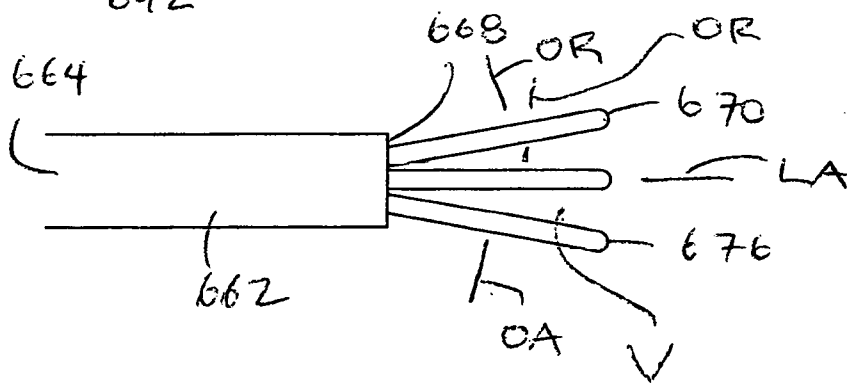


FIG 8C

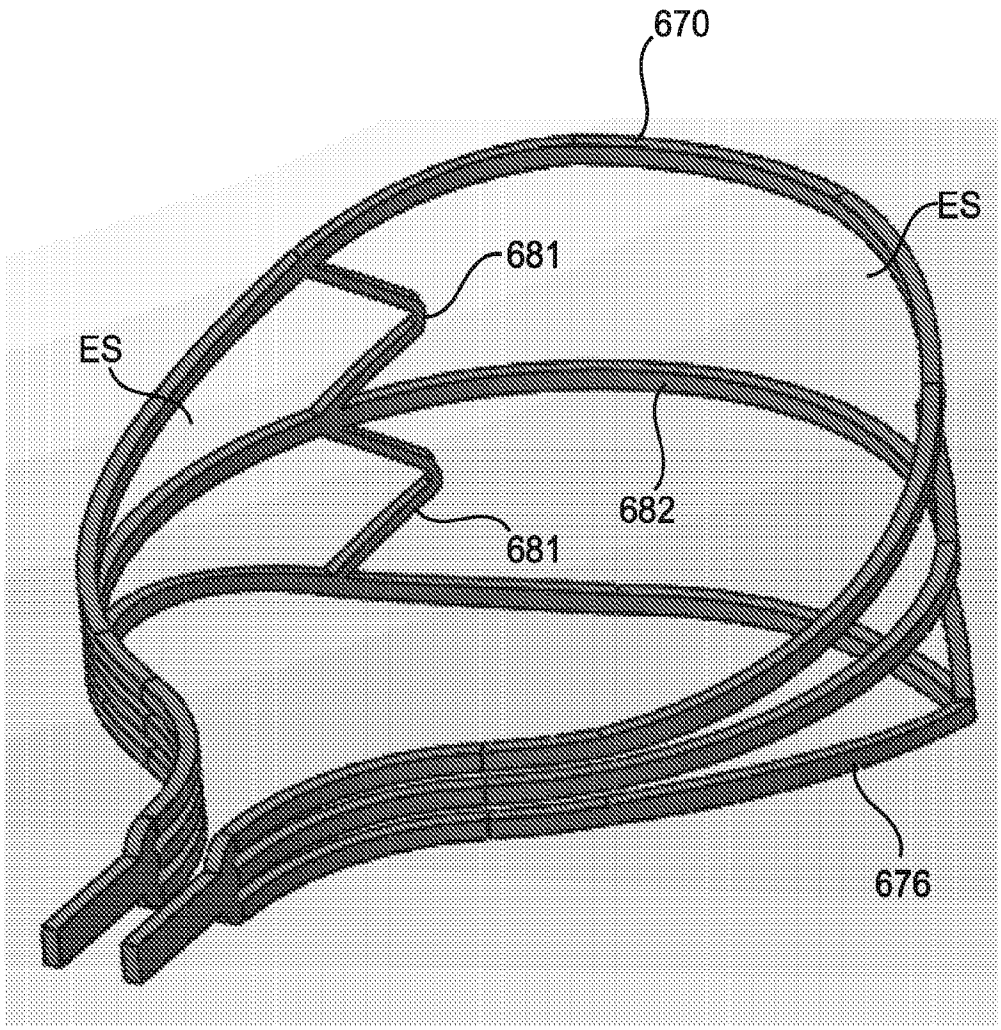


FIG. 9

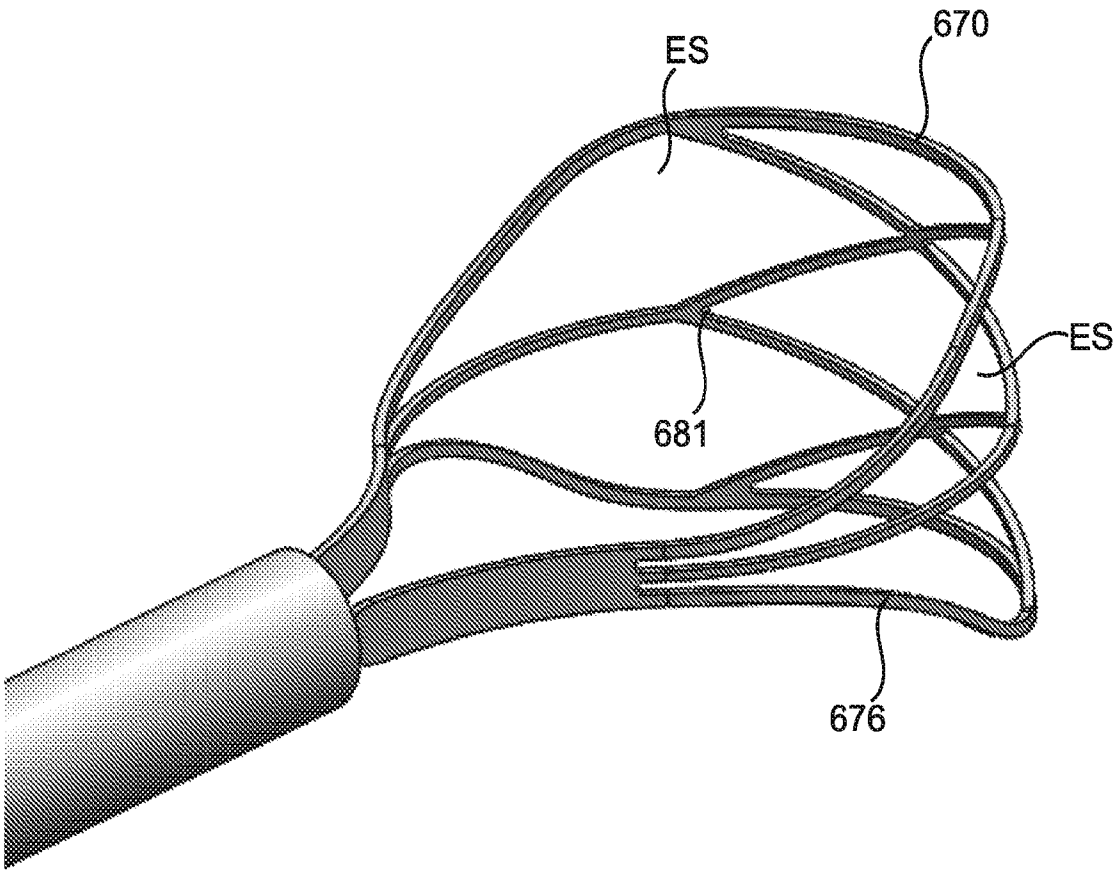


FIG. 10

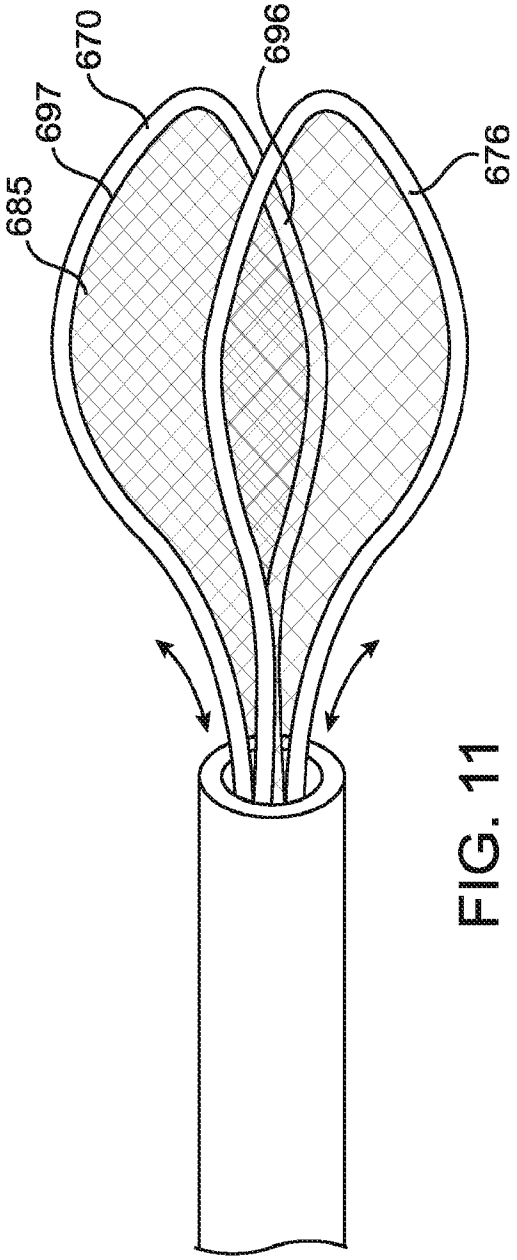

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FIG. 11

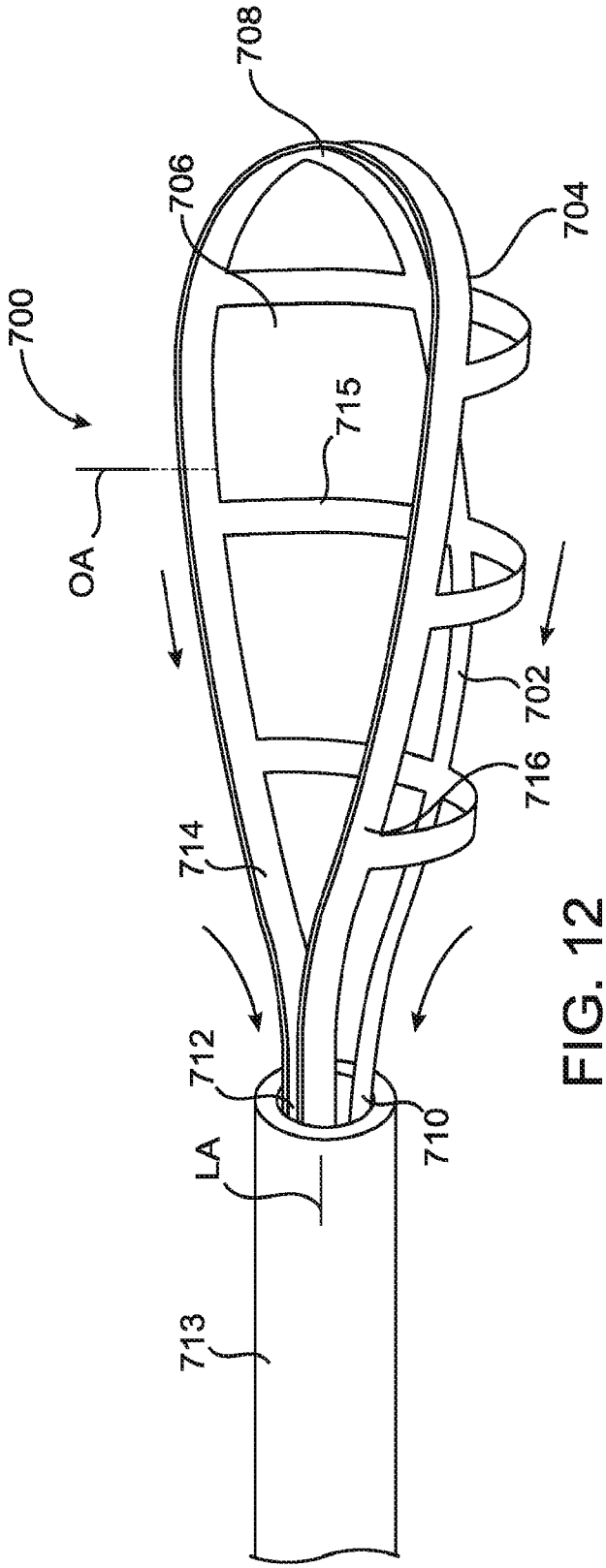

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FIG. 12

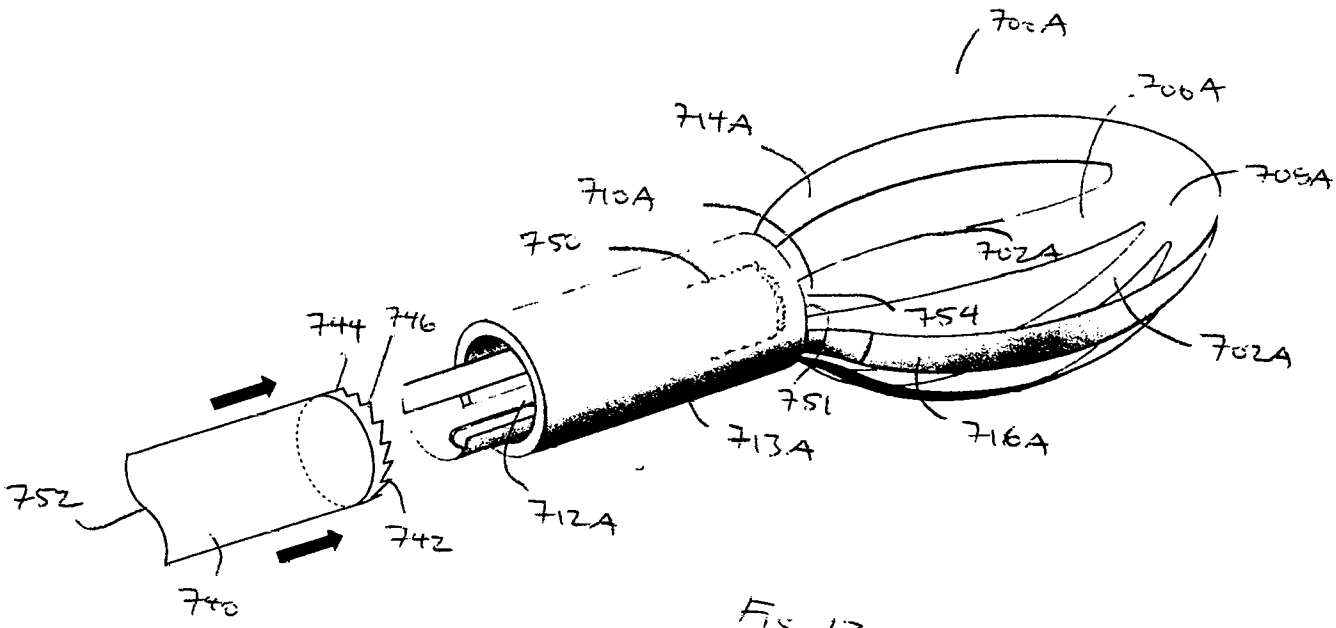

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Fig 13

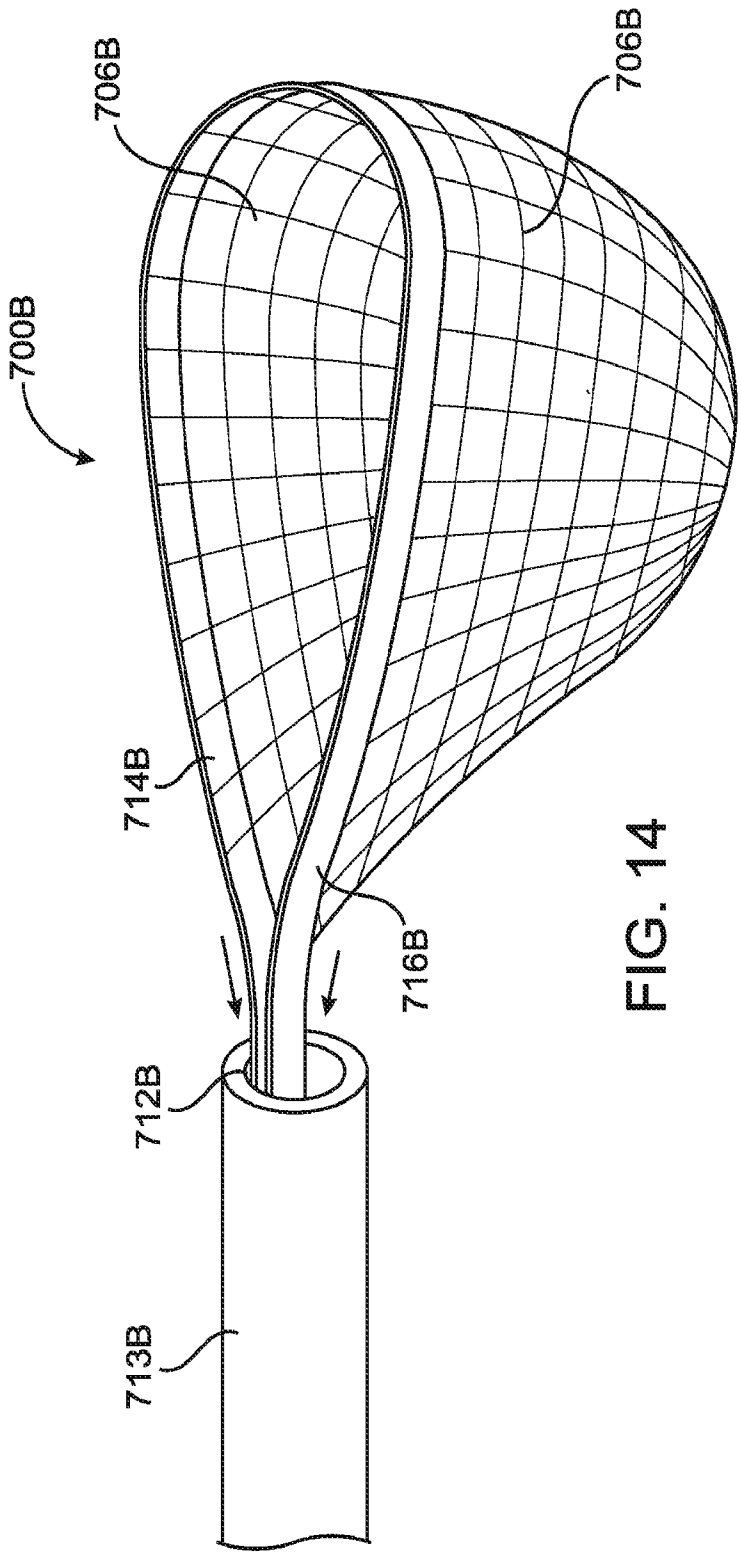


FIG. 14

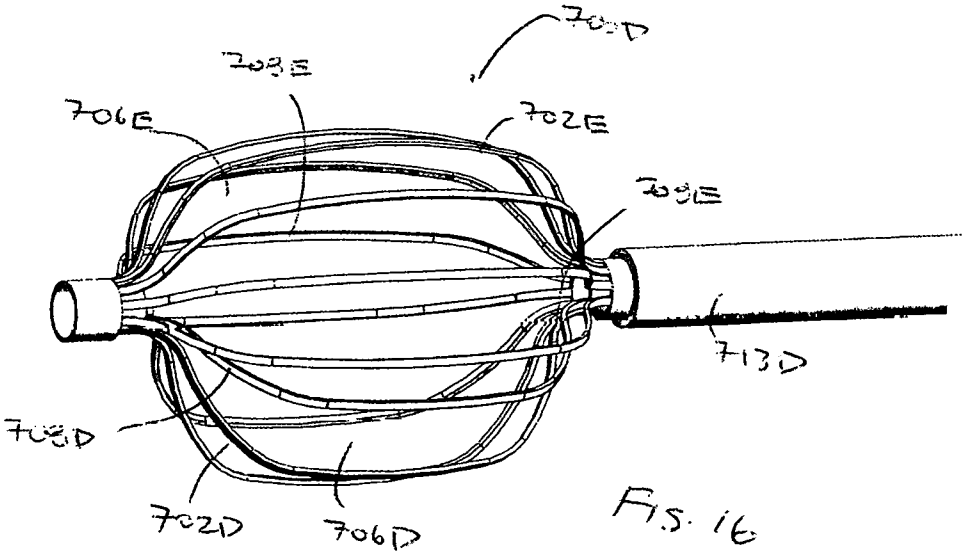

700D
708E
706E
702E
708E
713D
708D
702D
706D

FIG. 16

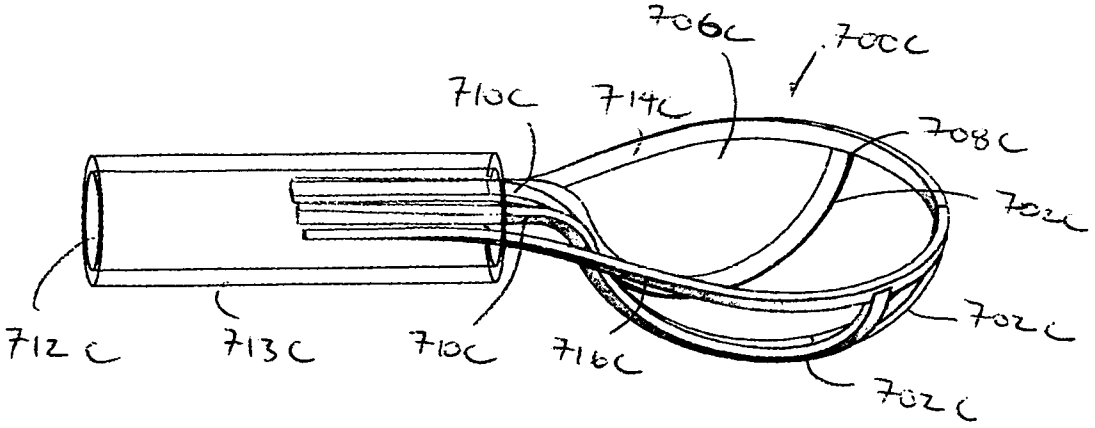

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FIG. 15

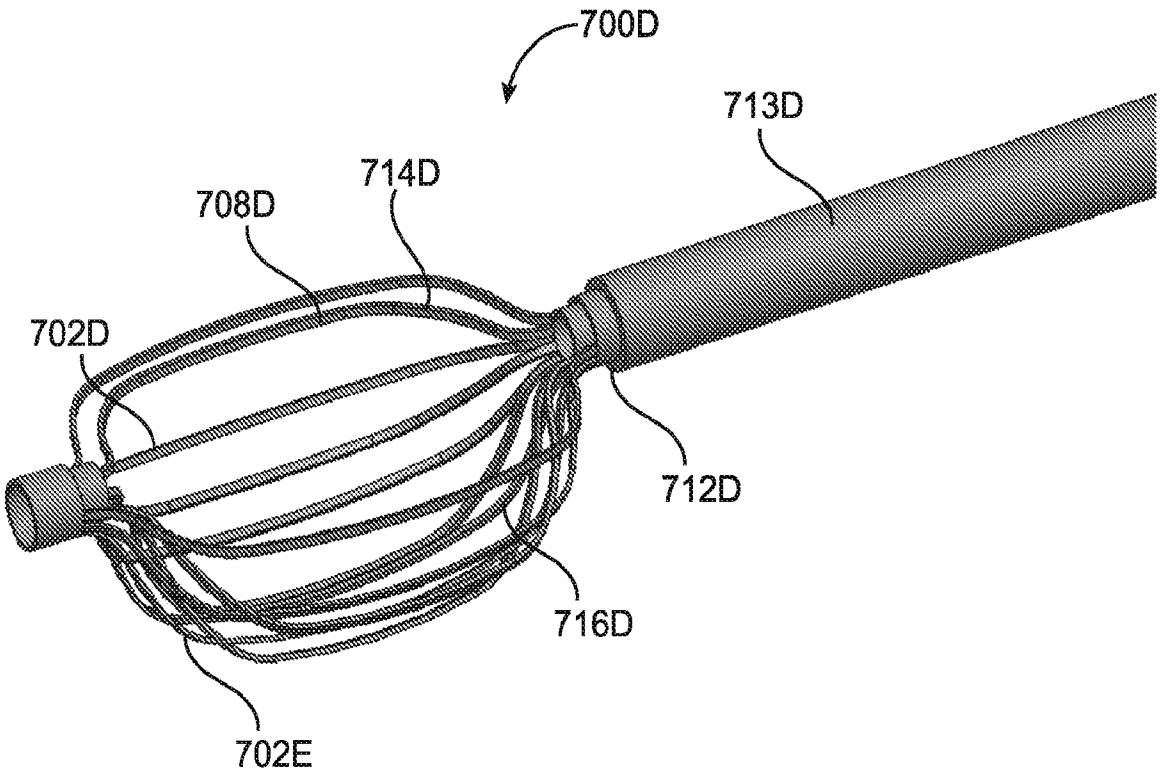


FIG. 17

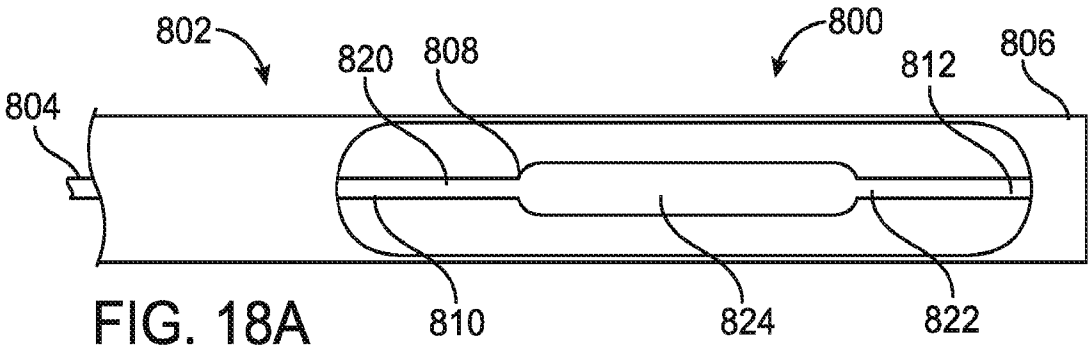


FIG. 18A

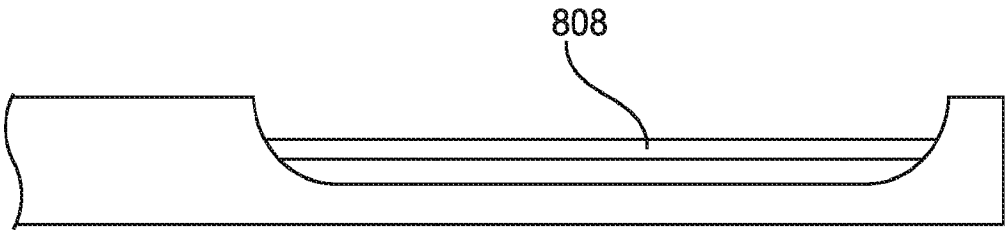


FIG. 18B

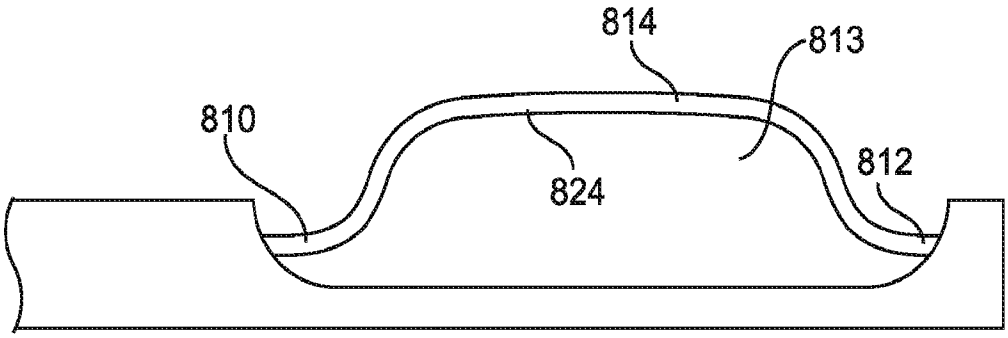


FIG. 18C

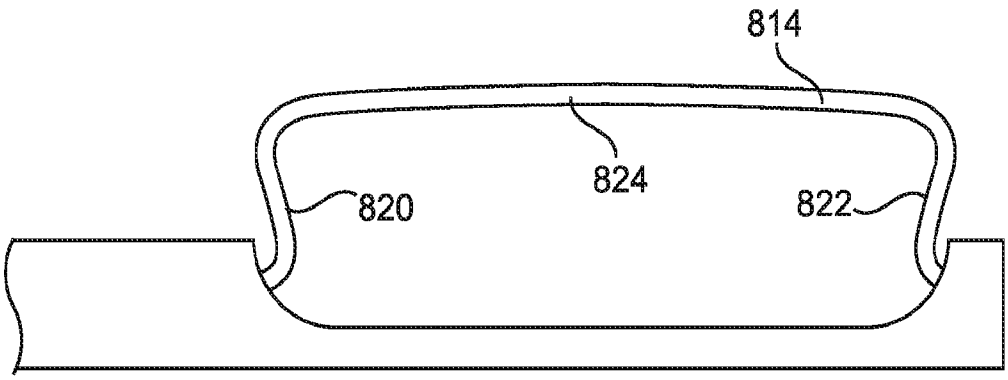


FIG. 18D

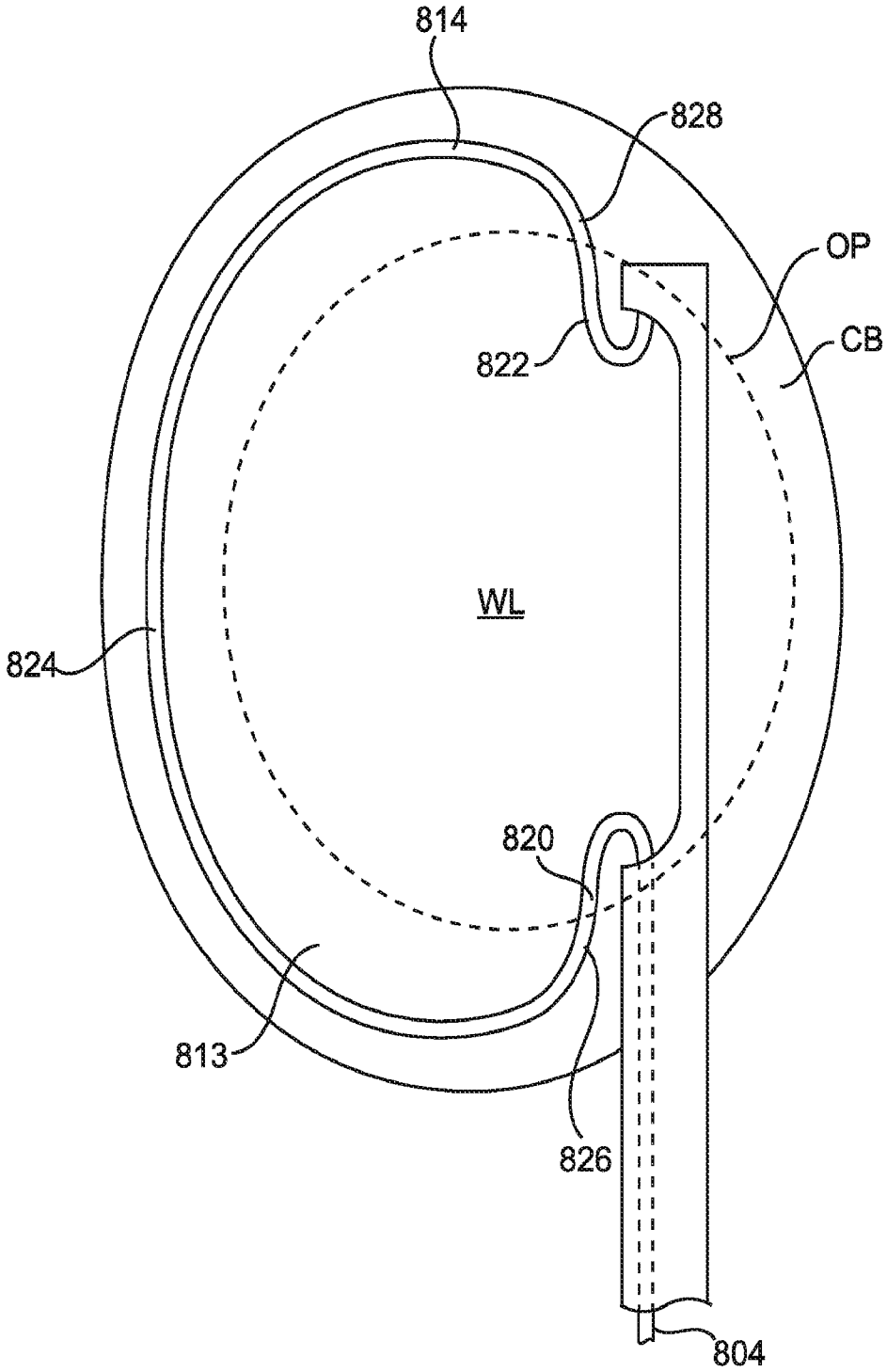


FIG. 19

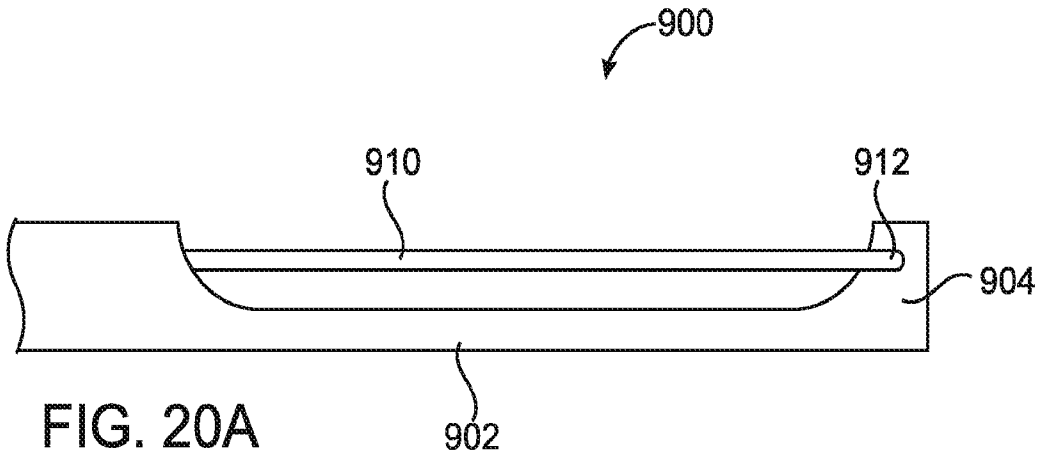


FIG. 20A

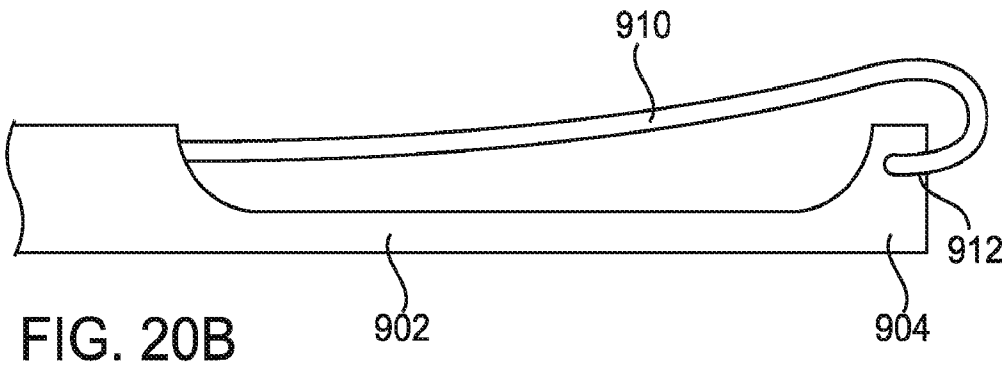


FIG. 20B

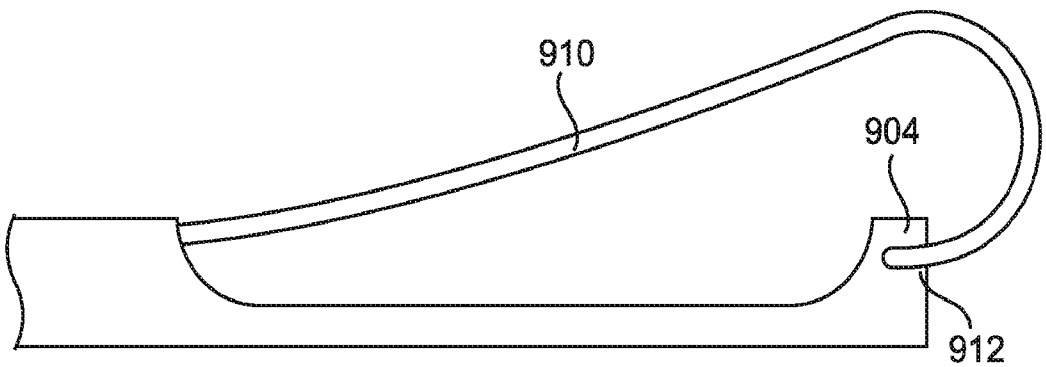


FIG. 20C

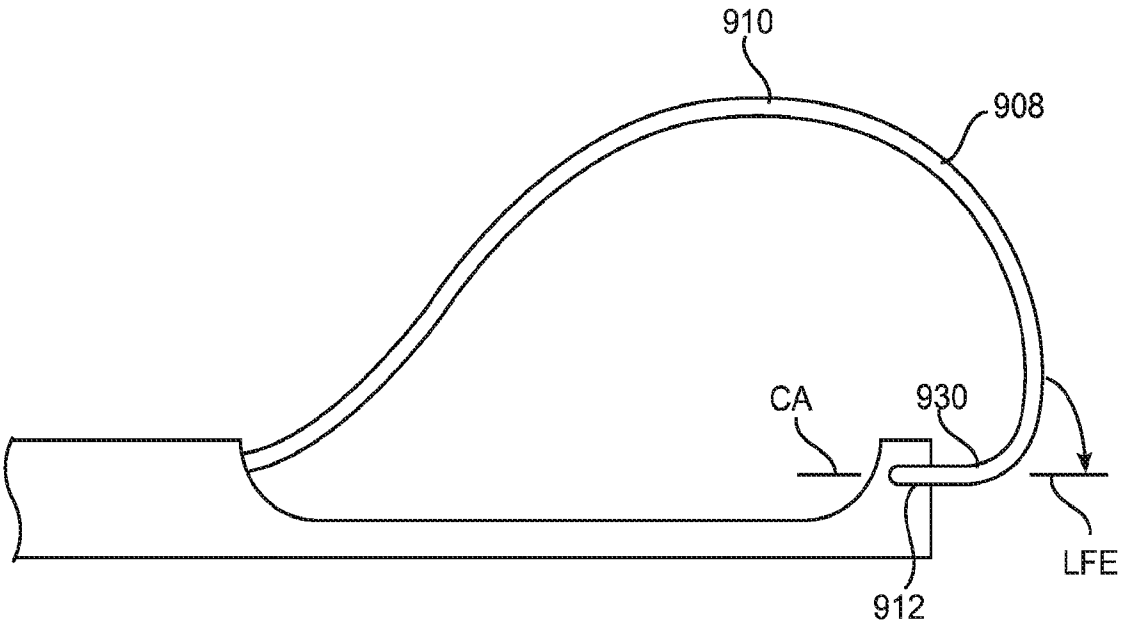


FIG. 21A

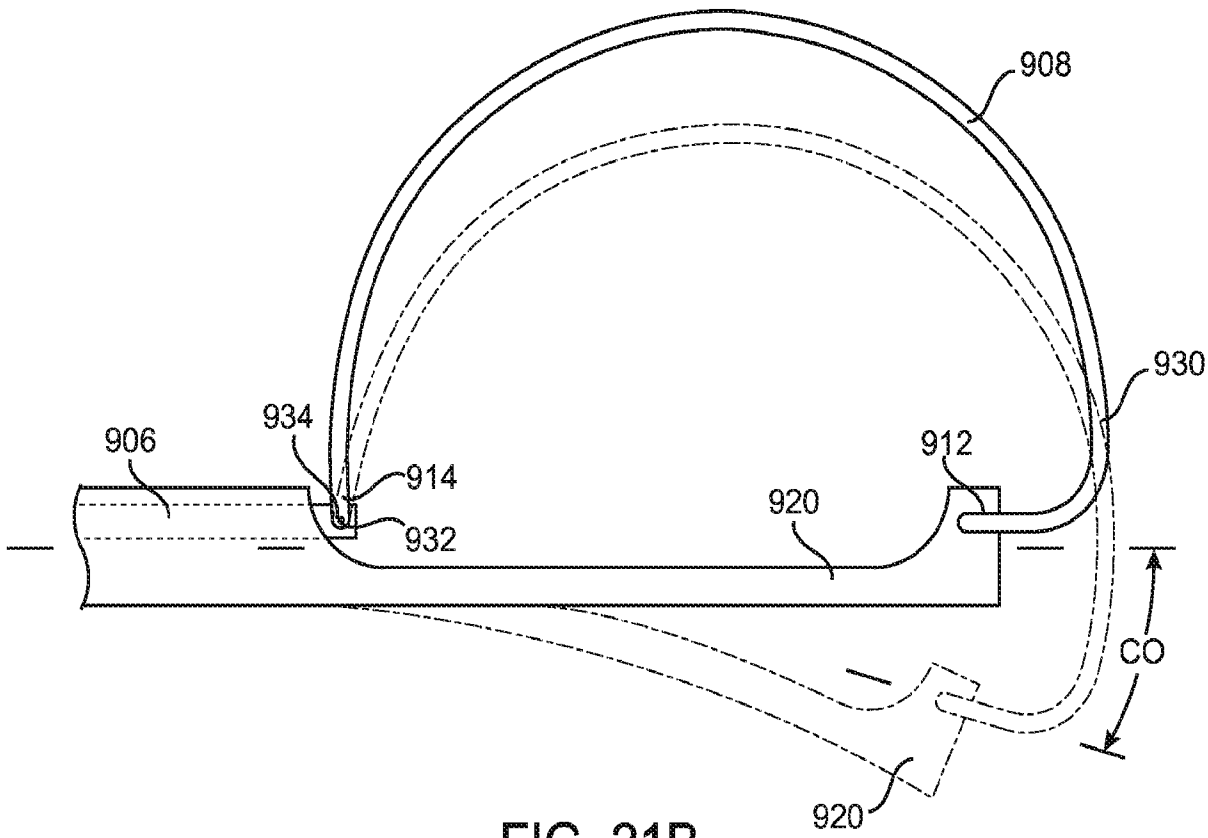


FIG. 21B