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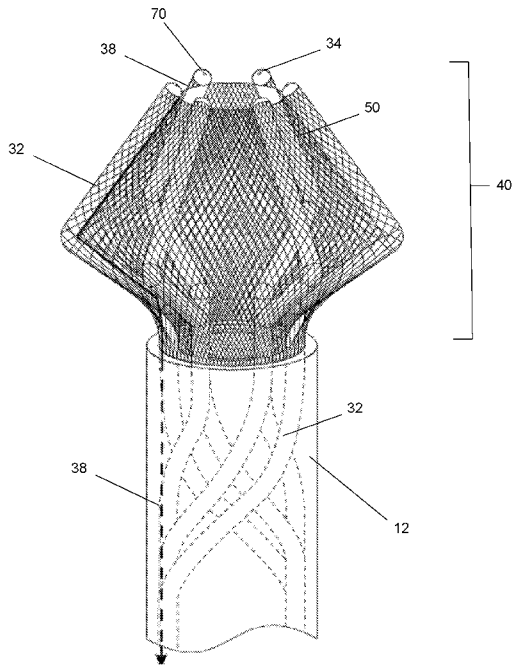

FIG. 6A

(57) Abstract: The invention provides a ureteral catheter with the same functionality as an access sheath, and providing entrapment and flushing capabilities for kidney stones. The catheter includes a reinforced, flexible tube with a retractable, claw-like mechanism. A mesh is stretched on the outside of the plurality of claw rods to form a capture cage. The claw can be clamped closed by a drawstring or any alternative method. The catheter may also include a hollow tube directed to the top or past the top of the claw, which serves to irrigate the enclosed area of the catheter. The tube may be in fluid communication with one or more of the rods when the rods are tube-shaped.

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RENAL STONE ENTRAPMENT CAGE AND FLUSHING CATHETER

CROSS REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims the benefit of priority under 35 U.S.C. § 119(e) of U.S. Serial No. 62/424,150, filed November 18, 2016, the entire content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0002] The invention relates generally to kidney stones, and more specifically to a medical catheter configured to capture a kidney stone during a procedure to break the stone into smaller pieces and irrigate the surrounding area to flush the pieces from the area.

BACKGROUND INFORMATION

[0003] Urolithiasis is a condition in which crystals, or mineral deposits, in the urine combine to form stones. The stones, also referred to as calculi or uroliths, can be found anywhere in the urinary tract or bladder and result in the obstruction of the urethra. Urolithiasis is caused by an imbalance of calcium and phosphorus in the diet. The stones cause irritation, discomfort, can result in a secondary infection and in some cases has led to death. The types of stones for the urolithiasis condition include kidney stones, cystine kidney stones, struvite stones, urate stones, calcium oxalate stones, gall stones, urinary stones, bladder stones, cystine stones, xanthine stones, calcium phosphate stones, endemic bladder stones, oxylate stones, renal stones, uric acid stones and uric acid plus calcium stones, among others.

[0004] The incidence of hospitalization for the removal of urinary calculi has been estimated at 200,000 cases per year. A vast majority of these patients pass their stones spontaneously; however, in the remainder, the kidney stone(s) become impacted in the ureter, a muscle tube joining the kidney to the bladder. An impacted kidney stone is a source of intense pain and bleeding, a source of infection and, if a stone completely blocks the flow of urine for any extended length of time, can cause the loss of a kidney.

[0005] Larger stones often need to be shattered because their size prohibits non-surgical removal from the body. Shattering a stone (by, for example, light, chemical, or physical energy) can disperse the resulting stone fragments from the original location of the stone. Sone fragments that are not removed from the body can form the nuclei for the formation of new stones. The dispersal of the fragments caused by the shattering process can cause fragments to move into inaccessible or unknown areas of the body, thus preventing or interfering with the capture and removal of fragments.

[0006] Recently, various methods have been developed for shattering a stone into smaller fragments. One such method is stone dusting. Stone dusting is used by some urologists to fragment and evacuate stones from a kidney and is often performed with a ureteroscope. Intense light energy from a laser within the ureteroscope breaks the stone into increasingly smaller pieces. However, in some cases, the stone and/or the stone fragments may be pushed away from the ureteroscope by the laser, thus making it impossible to continue to break the stone or stone fragments into smaller fragments without repositioning the ureteroscope.

[0007] Further, while dusting generates small fragments that are capable of being passed naturally, these fragments often are not passed naturally. For example, the stone fragments may collect in an area of the kidney where they are less likely to flow out naturally, such as the lower calyx of the kidney. Thus, the application of suction may be employed to remove the stone dust. Breaking up a stone and providing suction requires a working channel with a sufficient internal cross-sectional area to receive a laser fiber and a lumen with sufficient internal cross-sectional area to allow stone fragments and/or dust to pass through without clogging. However, the combined cross-sectional areas of these two elements may make a device too large to reach the target kidney stone. For example, the kidney stone may be within the kidney, or, specifically, within the lower calyx of the kidney. Often, the space within the kidney and/or lower calyx of the kidney is more limited than the space within the ureter and this space may not be large enough to accommodate both a working channel for a laser fiber and a lumen for applying suction.

[0008] While recent advances in stone destruction have improved the degree of success of these procedures, the methods of removing the resulting debris have not kept pace with the advances in primary stone destruction. Thus, a need exists for a device that enables capture of the stone before destruction, and removal of the stone while keeping the device in place.

SUMMARY OF THE INVENTION

[0009] The present invention is directed to a medical catheter having a retractable catch mechanism configured to entrap a kidney stone and to irrigate the surrounding area while providing working space and preservation of current surgical techniques for operations such as laser lithotripsy. The device is designed to entrap moderate to small sized stones, foreign objects, or other materials from a body cavity, such as a kidney stone.

[0010] Accordingly, in one aspect, the invention provides a medical catheter configured to facilitate stone removal procedures from a subject. The medical catheter includes an inner body having an outer surface, an inner surface, a proximal end and a distal end, wherein the inner surface defines a first lumen extending along an axis, an outer body having an outer surface, an inner surface, a proximal end and a distal end, wherein the outer body surrounds the inner body along the axis thereof, a plurality of rods slidingly disposed between the inner body and the outer body, each rod having a proximal end and a distal end, wherein when the plurality of rods extends beyond the distal ends of the inner and outer bodies, each of the plurality of rods independently bends away from the axis of the inner body, a looped drawstring having a distal end and a proximal end, the distal end being disposed within a through-hole provided at the distal end of each rod, wherein when pulled at the proximal end thereof, the drawstring causes each rod to bend toward the axis of the inner body, thereby forming a claw, and an irrigation tube disposed within the inner sheath and extending along the axis thereof, and configured to irrigate the claw. The medical catheter may further include a mesh disposed on a surface of each of the plurality of rods and configured to capture an object. In various embodiments, the mesh forms a capture bag/cage such that when the drawstring is pulled, the capture bag/cage cinches around an object to be captured.

[0011] In various embodiments, the outer body further comprises an expandable section configured to occlude a portion of a ureter or ureteropelvic junction. The catheter may include 3, 4, 5, 6, 7, 8, 9, or 10 rods disposed between the inner body and the outer body. As described herein, each rod may be slidingly disposed in a concentric spiral around the exterior surface of the inner body relative to the axis thereof. In various embodiments, each rod is formed from a metal alloy having shape memory characteristics, such as stainless steel or nickel titanium (nitinol). Likewise, the drawstring may be formed from stainless steel or nitinol, and optionally, is coated with a polymer.

[0012] The irrigation tube may extend in conjunction with the plurality of rods such that the distal end of the irrigation tube extends to the claw when so formed, and wherein the irrigation tube is configured to irrigate the claw. In various embodiments, one or more of the plurality of rods is a hollow tube and further comprises an irrigation port at the distal end thereof, wherein the hollow tube is in fluid communication with the irrigation tube such. In various embodiments, the exterior surface of the outer body is coated with one or more of a lubricant, antibacterial agent, and anti-inflammatory agent.

[0013] In another aspect, the invention provides a medical catheter configured to facilitate kidney stone removal procedures. The medical catheter includes a tubular sheath suitable for insertion into the urinary system with an open proximal end and a retractable, mesh-enclosed claw-like mechanism providing entrapment capabilities while allowing ample space for insertion and removal of other medical instruments through the lumen, a fluid inflow device, with an outflow component consisting of the catheter lumen, a claw-like mechanism allowing a grab functionality and entrapment capability for small objects within a body cavity such as kidney stones within the kidney calyx, a mesh stretching between each rod allowing entrapment of smaller particles of a diameter specified by the diameter of the holes in the mesh, and a wire connecting the rods of the claw arms which can be pulled to allow for closing capabilities. In various embodiments, the claw-like mechanism is affixed to the sheath in a way that allows it to extend and retract. In various embodiments, the system can be fully controlled by the user through a series of mechanical controls outside the body of the patient.

[0014] In yet another aspect, the invention provides a method of removing a kidney stone from a subject. The method includes inserting the medical catheter described herein into an orifice of a subject, capturing a kidney stone by extending the rods of the catheter in a distal direction and pulling the drawstring in a proximal direction to form the claw around the kidney stone, performing a procedure to break the captured kidney stone into a plurality of pieces, irrigating the claw and captured pieces with fluid, and aspirating the plurality of pieces and fluid, thereby removing the kidney stone. The step of inserting the medical catheter may include inserting the catheter into a urethra and into a bladder of a patient, guiding the catheter through a ureter and into a kidney.

[0015] In various embodiments, the procedure may include use of shock waves, lasers, and/or ultrasound to break the kidney stone into a plurality of smaller pieces. Exemplary procedures include, but are not limited to shock wave lithotripsy (SWL), ureteroscopy, percutaneous nephrolithotomy, and percutaneous nephrolithotripsy. In various embodiments, the procedure may include inserting a tool through the lumen of the catheter, breaking the stone into a plurality of pieces, and removing the tool prior to irrigating. In various embodiments, the method may further include the step of occluding a ureter of the subject by expanding an expandable section of the outer body of the medical catheter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Figures 1A and 1B are pictorial diagrams showing a perspective view of the medical catheter with mesh and rods shown in a retracted position (Figure 1A), and in an extended position forming the claw (Figure 1B).

[0017] Figure 2 is a pictorial diagram showing a perspective view of the distal end of an exemplary embodiment of the medical catheter with mesh and rods shown in a retracted position.

[0018] Figure 3 is a pictorial diagram showing a perspective view of the distal end of an exemplary embodiment of the medical catheter with the rods extended to capture a kidney stone.

[0019] Figure 4 is a pictorial diagram showing a perspective view of the distal end of an exemplary embodiment of the medical catheter with the rods forming a claw after pulling the drawstring.

[0020] Figure 5 is a pictorial diagram showing a partial cross-sectional view of the distal end of the same exemplary embodiment of Figure 4 showing the rods disposed in a spiral around the inner body.

[0021] Figure 6A is a pictorial diagram showing a perspective view of the distal end of an exemplary embodiment of the medical catheter with mesh surrounding the rods to form a cage for capturing a stone.

[0022] Figure 6B is a pictorial diagram showing a perspective view of the distal end of an exemplary embodiment of the medical catheter with a captured kidney stone within the cage.

[0023] Figure 7 is a pictorial diagram showing a plan view of the distal end of an exemplary embodiment of the medical catheter with rods and mesh in the retracted position.

[0024] Figures 8A and 8B are pictorial diagrams showing insertion of an exemplary embodiment of the medical catheter through the ureter of a patient and into the kidney such that the distal end of the catheter is in close proximity to a kidney stone (Figure 8A), and capture of the kidney stone within the cage of the catheter (Figure 8B).

DETAILED DESCRIPTION OF THE INVENTION

[0025] The present invention is directed to a medical catheter allowing entrapment and fluid flow while providing working space and preservation of current surgical techniques for operations such as laser lithotripsy. The device is designed to entrap moderate to small sized objects (such as kidney stones, gall stones, and other natural or foreign objects) found in the body of a patient.

[0026] Before the present compositions and methods are described, it is to be understood that this invention is not limited to particular compositions, methods, and experimental conditions described, as such compositions, methods, and conditions may vary. It is also to

be understood that the terminology used herein is for purposes of describing particular embodiments only, and is not intended to be limiting, since the scope of the present invention will be limited only in the appended claims.

[0027] As used in this specification and the appended claims, the singular forms "a", "an", and "the" include plural references unless the context clearly dictates otherwise. Thus, for example, references to "the method" includes one or more methods, and/or steps of the type described herein which will become apparent to those persons skilled in the art upon reading this disclosure and so forth.

[0028] The term "comprising," which is used interchangeably with "including," "containing," or "characterized by," is inclusive or open-ended language and does not exclude additional, unrecited elements or method steps. The phrase "consisting of" excludes any element, step, or ingredient not specified in the claim. The phrase "consisting essentially of" limits the scope of a claim to the specified materials or steps and those that do not materially affect the basic and novel characteristics of the claimed invention. The present disclosure contemplates embodiments of the invention compositions and methods corresponding to the scope of each of these phrases. Thus, a composition or method comprising recited elements or steps contemplates particular embodiments in which the composition or method consists essentially of or consists of those elements or steps.

[0029] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the invention, the preferred methods and materials are now described.

[0030] As used herein, the term "ablate" refers to removing, clearing, destroying or taking away a biological material. Thus, "ablation" as used herein refers to a removal, clearance, destruction, or taking away of the biological material.

[0031] As used herein, the term "subject" as used herein refers to any individual or patient to which the subject methods are performed. Generally the subject is human,

although as will be appreciated by those in the art, the subject may be an animal. Thus other animals, including mammals such as rodents (including mice, rats, hamsters and guinea pigs), cats, dogs, rabbits, farm animals including cows, horses, goats, sheep, pigs, etc., and primates (including monkeys, chimpanzees, orangutans and gorillas) are included within the definition of subject.

[0032] Ureteral access sheaths are commonly used to reduce operating room time during kidney stone removal. Most ureteral access sheaths consist of a simple, flexible tube, often reinforced with stainless steel and coated with some form of lubricant. However, these access sheaths lack any additional modifications to aid the surgeon in providing a more efficient and effective surgery to the patient. In some kidney stone removal surgeries, particularly laser lithotripsy, the approach of entrapping a stone before breaking it down is beneficial since it allows greater control over the stone debris generated during laser lithotripsy. The present invention therefore provides an access sheath with stone entrapment capabilities to prevent dispersion of stone fragments and expedite the removal procedure.

[0033] As shown in Figures 1-7, the present invention provides a medical catheter adapted for insertion into the urethra of a subject and capturing a kidney stone prior to ablation. Referring now to Figures 1A and 1B, the medical catheter 10 includes an outer body 12 having an outer surface 14, an inner surface 16, a proximal end 18 and a distal end 20. In various embodiments, outer body 12 may be flexible, adapted for flexible steering within bodily lumens, as understood in the art. For example, outer body 12 can include a steering system (not shown) to move at least a portion (e.g., distal end 20) up/down and/or side-to-side. Additional degrees of freedom, provided for example via rotation, translational movement of outer body 12, or additional articulation of bending sections, may also be implemented. Examples of such steering systems may include one or more of pulleys, control wires, gearing, and electrical actuators. In various embodiments, outer body 12 may include one or more expandable sections 68 configured to form a pressure seal with the interior surfaces of the ureter 62 or to seat in a utereopelvic junction, thereby preventing any fluids from draining out of the interior of the kidney and/or bladder. Expandable section 68 may thus be formed as an occlusion balloon of any shape positioned

near the distal end 20 of outer body 12. Expandable section 68 may assume a regular or irregular, symmetrical or asymmetrical shape. For example, expandable section 68 may be irregularly shaped to seal a particular ureteropelvic junction and/or may be formed from a flexible material that naturally forms fits to the contours of the ureter or a junction when expanded by air or fluid.

[0034] Referring now to Figure 2, there is shown a detailed perspective view of the distal end 20 of catheter 10. Disposed within the outer body 12 of the catheter 10 is an inner body 22 having an outer surface 24, an inner surface 26, a proximal end (not shown) and a distal end 28, wherein the inner surface 26 defines a first lumen 30 extending along an axis X. Thus, the outer body surrounds the inner body along the axis thereof. Slidingly disposed between the inner body 22 and the outer body 12 is a plurality of rods 32, each rod having a proximal end (not shown) and a distal end 34. While the exemplary embodiments of the medical catheter 10 shown in Figures 1-7 have six rods 32, it should be understood that the medical catheter 10 may include any number of rods 32 suitable to form a claw 40 around a kidney stone 60. For example, the catheter 10 may include 3, 4, 5, 6, 7, 8, 9, 10, or more rods.

[0035] Each rod 32 has a through-hole 36 provided in close proximity to the respective distal end 34 thereof. Looped through each through-hole 36 is a drawstring 38, such that the distal ends 34 of the plurality of rods 32 are interconnected therewith. In various embodiments, a hollow irrigation tube 42 is also disposed between the inner body 22 and the outer body 12, and may extend with the plurality of rods 32. The irrigation tube 42 is configured to deliver an inflow of irrigation fluid which will drain through lumen 30 of the inner body 22, thereby providing flushing capability to clear debris and/or particles of an ablated stone. In various embodiments, irrigation tube 42 is interconnected to each of the plurality of rods 32 at the distal end of the catheter. In such a configuration, any one or more of the plurality of rods 32 may be a tube in fluid communication with the irrigation tube 42 and configures to flow irrigation fluid therethrough. When so configured, any of the rods 32 may include an irrigation port 70.

[0036] In various embodiments, outer body 12, inner body 12, and/or irrigation tube 42 may be formed of any suitable material having sufficient flexibility to traverse body cavities and tracts. In general, outer body 12, inner body 12, and/or irrigation tube 42 may be made of any suitable material that is compatible with living tissue or a living system. That is, outer body 12, inner body 12, and/or irrigation tube 42 may be non-toxic or non-injurious, and should not cause immunological reaction or rejection. Exemplary materials from which outer body 12, inner body 12, and/or irrigation tube 42 may be made include polymetric elastomers, rubber tubing, and/or medically-approved polyvinylchloride tubing. Polymeric elastomers may be, for example, EVA (Ethylene vinyl acetate), silicone, polyurethane, and/or C-Flex.

[0037] Outer body 12 may be circular, ovoidal, irregular, and/or any shape suitable to enter a bodily orifice. Further, outer body 12 may have a uniform shape along its length, or may having a varying shape, such as a taper at the distal end 20 to facilitate insertion within the body. In some embodiments, the distal end 20 of outer body 12 and/or the distal end 28 of inner body 22 may be configured to include visualization devices such as a camera and/or a light source. These devices may attach to the distal ends (20, 28) using known coupling mechanisms. Alternatively, the visualization devices may be detachably introduced into lumen 30, when required.

[0038] In various embodiments, outer body 12, inner body 12, and/or irrigation tube 42 may include any suitable coating and/or covering. For example, the outer surface 14 of outer body 12 may include a layer of lubricous material (*i.e.,* lubricant) to facilitate insertion through a body lumen. Further, any one or more of outer body 12, inner body 12, and/or irrigation tube 42 may be coated with a biocompatible material such as Teflon. To inhibit bacterial growth in the body cavity, outer body 12, inner body 12, and/or irrigation tube 42 may be coated with an antibacterial coating (*i.e.,* antibacterial agent). Further, an anti-inflammatory agent may also be applied to the outer surface 14 of outer body 12 and/or the plurality of rods 32, if required.

[0039] As shown in Figure 3, the plurality of rods 32 are configured to extend beyond the distal ends (20, 28) of the inner body 22 and the outer body 12, when extended by a user

during a surgical procedure. When so extended, each rod 32 independently bends away from the axis X of the inner body 22. In various embodiments, each of the plurality of rods 32 may be disposed in a concentric spiral relative to the axis X of the inner body 12 (Figure 5). In certain embodiments, the rods 32 may be formed from a metal alloy, such as stainless steel, nickel titanium (nitinol), or any other alloy having shape memory characteristics.

[0040] As shown in Figure 4, when a user pulls on the drawstring 38 at the proximal end 18 of the catheter 10, the drawstring 38 causes each rod 32 to bend toward the axis X of the inner body 22, thereby forming a claw 40 configured to capture an object 60 (e.g., kidney stone) within the lumen of an organ. Thus, the distal end 44 of the irrigation tube 42 will extend in close proximity to the claw 40, thereby providing irrigation to the claw 40. In various embodiments, drawstring 38 may be made of a stiff, thin, and strong wire to allow for maximal working space, such as, for example, solid stainless steel or nitinol core wires, or solid core wire wrapped in a smaller wire coil or braided wire. In certain embodiments, drawstring 38 may be coated with a polymer, such as silicone or polytetrafluoroethylene (PTFE), to increase lubricity thereof.

[0041] As shown in Figures 6A and 6B, the catheter 10 may further include a flexible mesh 50 disposed on a surface of each rod 32, thereby forming a bag or cage within which the kidney stone 60 or stone particles is captured for ablation and removal. In various embodiments, mesh 50 is an expandable element which allows fluid flow therethrough and may be formed of a deformable net material, or of braided or woven fibers or metal wires. Exemplary materials include, but are not limited to, polymer fibers, such as nylon. Referring now to Figure 7, there is shown a plan view of the distal end 20 of the catheter 10. As shown, mesh 50 retracts into the space between the inner body 22 and outer body 12.

[0042] The catheter may be used in conjunction with existing methods of kidney stone removal as it provides comparable working space to the access sheath. Incorporation of the ureteral catheter into existing methods of kidney stone removal is expected to greatly reduce operating times since stone debris remains contained in the cage and is rapidly flushed away.

[0043] Thus, in another aspect, the invention provides a method of removing a kidney stone from a subject. The method includes inserting the catheter 10 into an orifice of a subject. With reference now to Figures 8A and 8B, a user (e.g., a doctor or other medical professional) may insert the catheter 10 into the patient's urethra, through the urinary bladder, through the ureter 62 and into the kidney calyx 66 at the location of the kidney stone 60, such that the distal end 20 of outer body 12 of the catheter 10 is in close proximity to the kidney stone 60. The user then extends the plurality of rods 32, while adjusting the position of the distal end 20 of the catheter 10 as necessary, and pulls drawstring 38 such that claw 40 is formed, thereby capturing the kidney stone 60 within the claw 40 (Figure 8B). Optionally, the user may expand an expandable section 68 of the outer body 12 of the catheter 10 to occlude the urethra, ureter 62 or bladder of the subject. Optionally, the user may initiate the introduction of fluid into kidney 64 through irrigation tube 42, if necessitated by the ablation procedure. The introduction of fluid into the kidney 64 may at least partially inflate the kidney 64, thus providing additional space to perform the desired procedure. Further, the introduction of fluid as an initial step may ensure that the pressure within the kidney 64 remains at a sufficient level, e.g., the kidney 64 will not collapse, once suction is applied to the kidney 64 through lumen 30 of inner body 22 (as described above).

[0044] An ablation procedure is thereafter performed on the captured kidney stone 60 to break the kidney stone 60 into a plurality of pieces. In various embodiments, the ablation procedure includes inserting a medical device/tool through the lumen 30 of the catheter 10 to deliver light, chemical, physical, or other type of energy to the captured stone 60. Exemplary ablation procedures include, but are not limited to, Shock Wave Lithotripsy (SWL), ureteroscopy, percutaneous nephrolithotomy, and percutaneous nephrolithotripsy. However, the medical catheter may be used in conjunction with any procedure known in the art for breaking stones into smaller pieces.

[0045] The user then initiates the introduction of fluid into kidney 64 through irrigation tube 42 to maintain capture of the plurality of pieces within mesh 50 of claw 40. Optionally, the medical device/tool used for the ablation procedure is removed from the lumen 30 of the catheter 10. An operator may then initiate a vacuum source to apply suction through lumen 30 to the distal end 28 of inner body 22. Suction into lumen 30 may

pull the plurality of pieces of kidney stone 60 through lumen 30, thereby aspirating the plurality of pieces through lumen 30 to remove the kidney stone from the patient. This provides a more efficient method of object removal and thus reduces operating room time.

[0046] Once kidney stone 60 has been removed from the patient's body, the user may retract the claw 40 into the distal end 20 of the catheter reposition the distal 20 such that it is proximate to another kidney stone 60 to be removed. The above process may then be repeated for securing, breaking up stone 60, irrigating the kidney 64, aspirating the plurality of pieces and irrigation fluid through lumen 30, and retracting claim 40. An operator may reposition the catheter 10 and/or repeat any of the above described steps any number of times. Once the user determines no more kidney stones 60 can and/or should be broken apart and/or no more stone fragments/dust can and/or should be removed, catheter 10 may be removed from the patient's body.

[0047] The medical catheter may further be used in conjunction one or more additional instruments useful in kidney stone surgical procedures. Exemplary instruments include, but are not limited to, cameras, probes, basket catheters, and lasers. As such, the medical catheter will aid the surgeon in reducing operating room time, reducing future surgeries, and increasing and improving the rate of material removal.

[0048] Although the invention has been described with reference to the above disclosure, it will be understood that modifications and variations are encompassed within the spirit and scope of the invention. Accordingly, the invention is limited only by the following claims.

What is claimed is:

1. A medical catheter comprising:
   (a) an inner body having an outer surface, an inner surface, a proximal end and a distal end, wherein the inner surface defines a first lumen extending along an axis;
   (b) an outer body having an outer surface, an inner surface, a proximal end and a distal end, wherein the outer body surrounds the inner body along the axis thereof;
   (c) a plurality of rods slidingly disposed between the inner body and the outer body, each rod having a proximal end and a distal end, wherein when actuated by a user, the plurality of rods extends beyond the distal ends of the inner and outer bodies and each of the plurality of rods independently bends away from the axis of the inner body;
   (d) a looped drawstring having a distal end and a proximal end, the distal end being disposed within a through-hole provided at the distal end of each rod, wherein when pulled at the proximal end thereof, the drawstring causes each rod to bend toward the axis of the inner body, thereby forming a claw; and
   (e) an irrigation tube disposed within the inner sheath and extending along the axis thereof, and configured to irrigate the claw.

2. The medical catheter of claim 1, further comprising a mesh disposed on a surface of each of the plurality of rods and configured to capture an object.

3. The medical catheter of claim 1, wherein the outer body further comprises an expandable section configured to occlude a portion of a ureter or ureteropelvic junction.

4. The medical catheter of claim 1, wherein the catheter comprises 3, 4, 5, 6, 7, 8, 9, or 10 rods disposed between the inner body and the outer body.

5. The medical catheter of any one of claims 1-4, wherein each rod is slidingly disposed in a concentric spiral relative around the exterior surface of the inner body relative to the axis thereof.

6. The medical catheter of claim 5, wherein each rod is formed from a metal alloy having shape memory characteristics.

7. The medical catheter of claim 6, wherein the metal alloy is stainless steel or nickel titanium (nitinol).

8. The medical catheter of claim 7, wherein one or more of the plurality of rods is a hollow tube and further comprises an irrigation port at the distal end thereof, wherein the hollow tube is in fluid communication with the irrigation tube.

9. The medical catheter of any one of claims 1-7, wherein the irrigation tube extends in conjunction with the plurality of rods such that the distal end of the irrigation tube extends to the claw when so formed, and wherein the irrigation tube is configured to irrigate the claw.

10. The medical catheter of any one of claims 1-9, wherein the exterior surface of the outer body is coated with one or more of a lubricant, antibacterial agent, and anti-inflammatory agent.

11. The medical catheter of any one of claims 1-10, wherein the drawstring is formed from stainless steel or nitinol.

12. The medical catheter of claim 11, wherein the drawstring is coated with a polymer.

13. A method of removing a kidney stone from a subject comprising:
    (a) inserting the medical catheter of any of claims 1-12 into an orifice of a subject;
    (b) capturing a kidney stone by extending the rods of the catheter in a distal direction and pulling the drawstring in a proximal direction to form the claw around the kidney stone;
    (c) performing a procedure to break the captured kidney stone into a plurality of pieces;
    (d) irrigating the claw with fluid; and

(e) aspirating the plurality of pieces and fluid, thereby removing the kidney stone.

14. The method of claim 13, wherein inserting the medical catheter comprises inserting the catheter into a urethra and into a bladder of a patient, guiding the catheter through a ureter and into a kidney.

15. The method of claim 13, wherein the procedure is selected from the group consisting of shock wave lithotripsy (SWL), ureteroscopy, percutaneous nephrolithotomy, and percutaneous nephrolithotripsy.

16. The method of claim 15, wherein the procedure includes inserting a tool through the lumen of the catheter, breaking the stone into a plurality of pieces, and removing the tool prior to irrigating.

17. The method of any one of claims 13-16, further comprising occluding a ureter of the subject by expanding an expandable section of the outer body of the medical catheter.

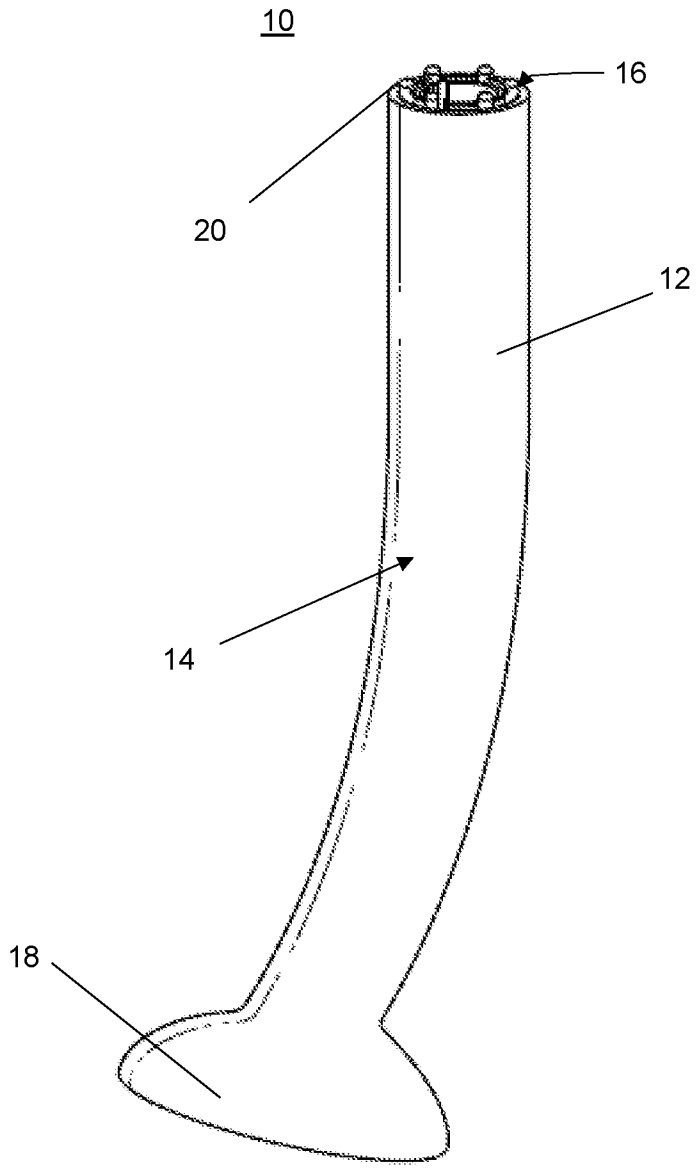

FIG. 1A

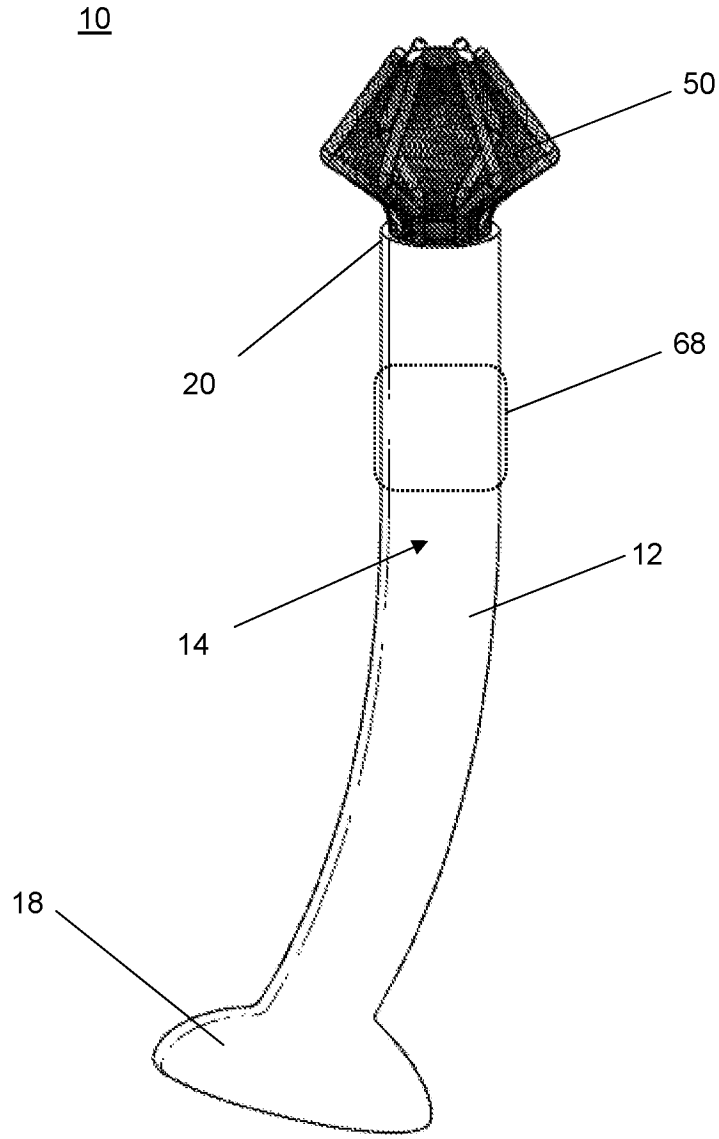

FIG. 1B

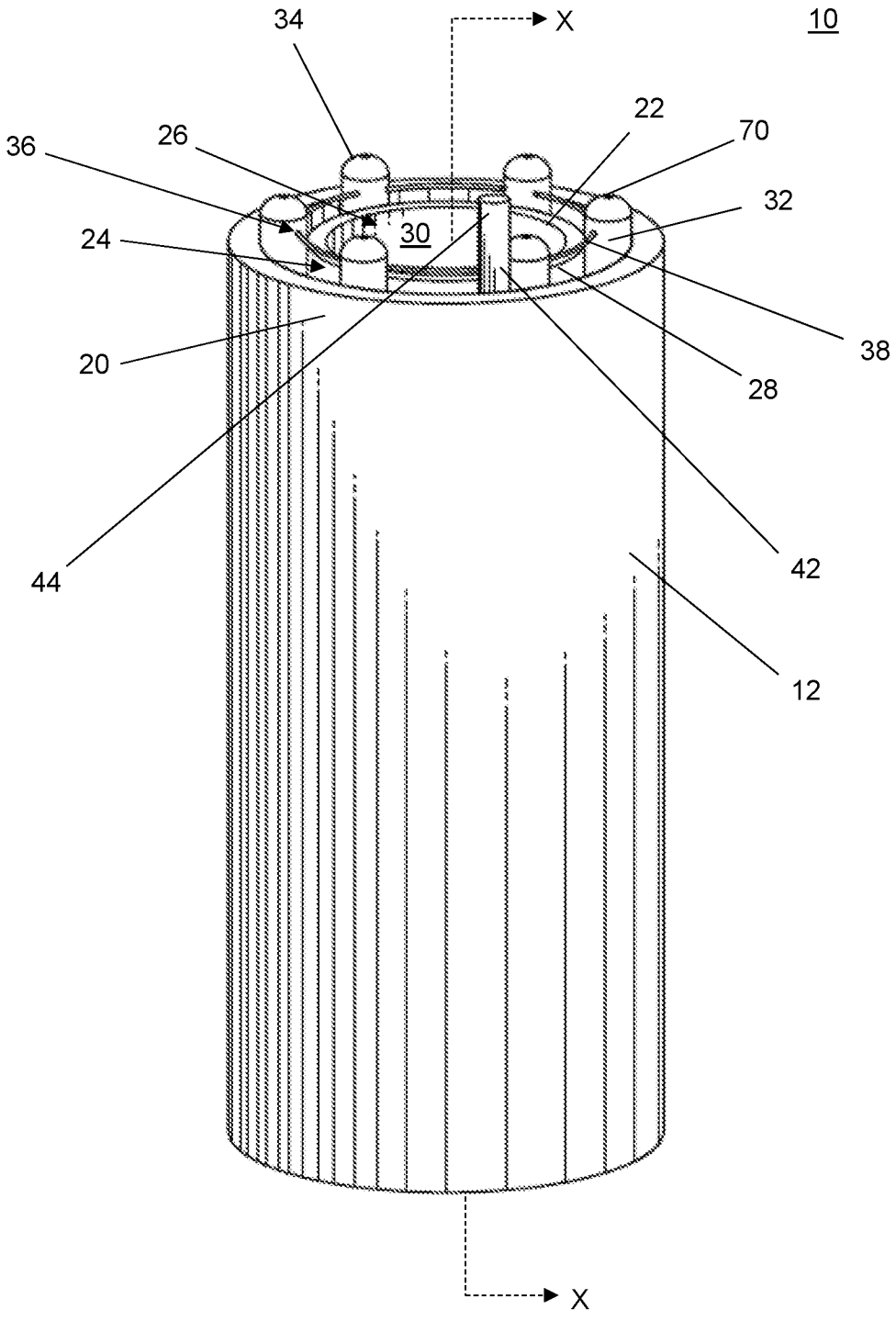

FIG. 2

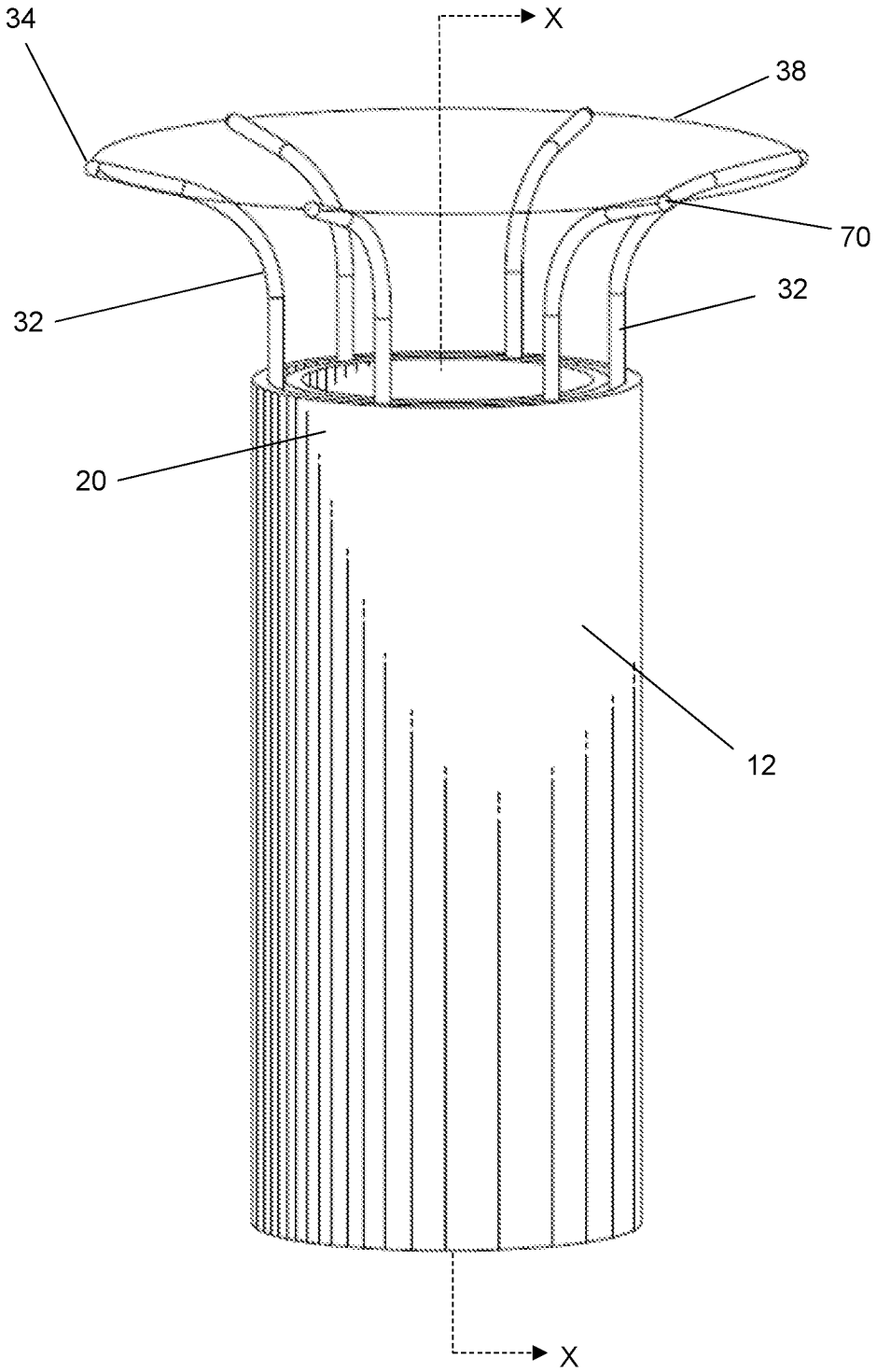

FIG. 3

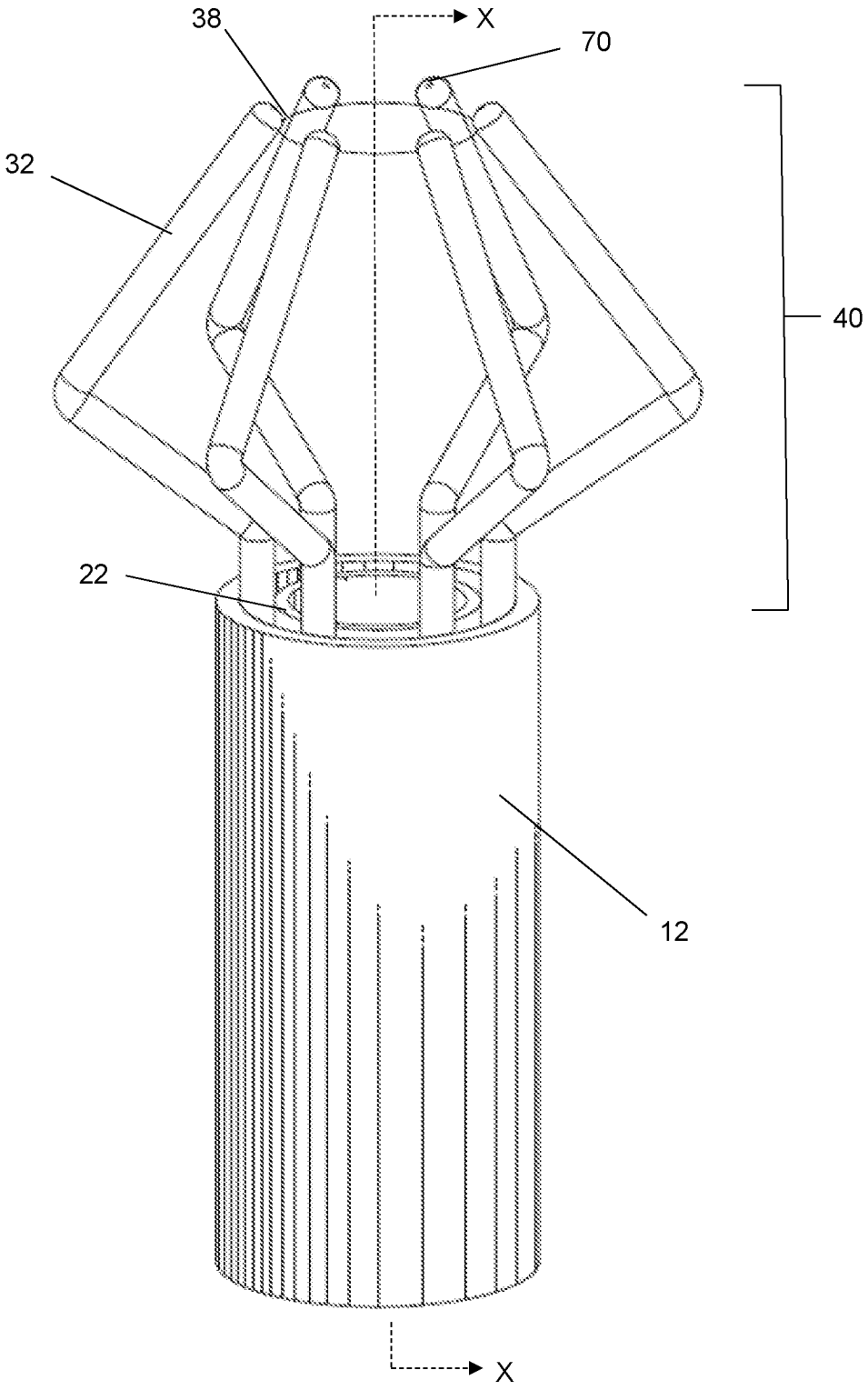

FIG. 4

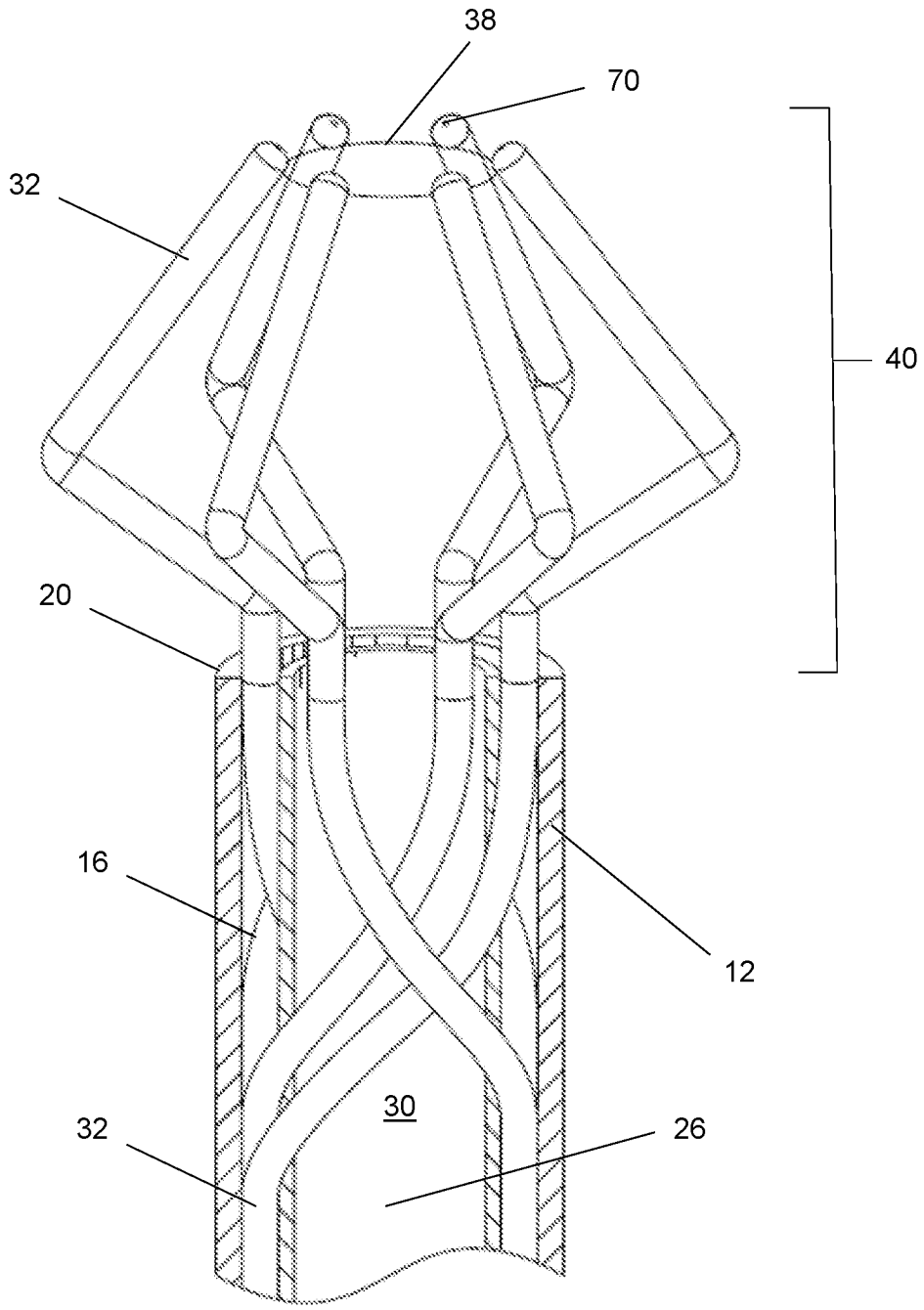

FIG. 5

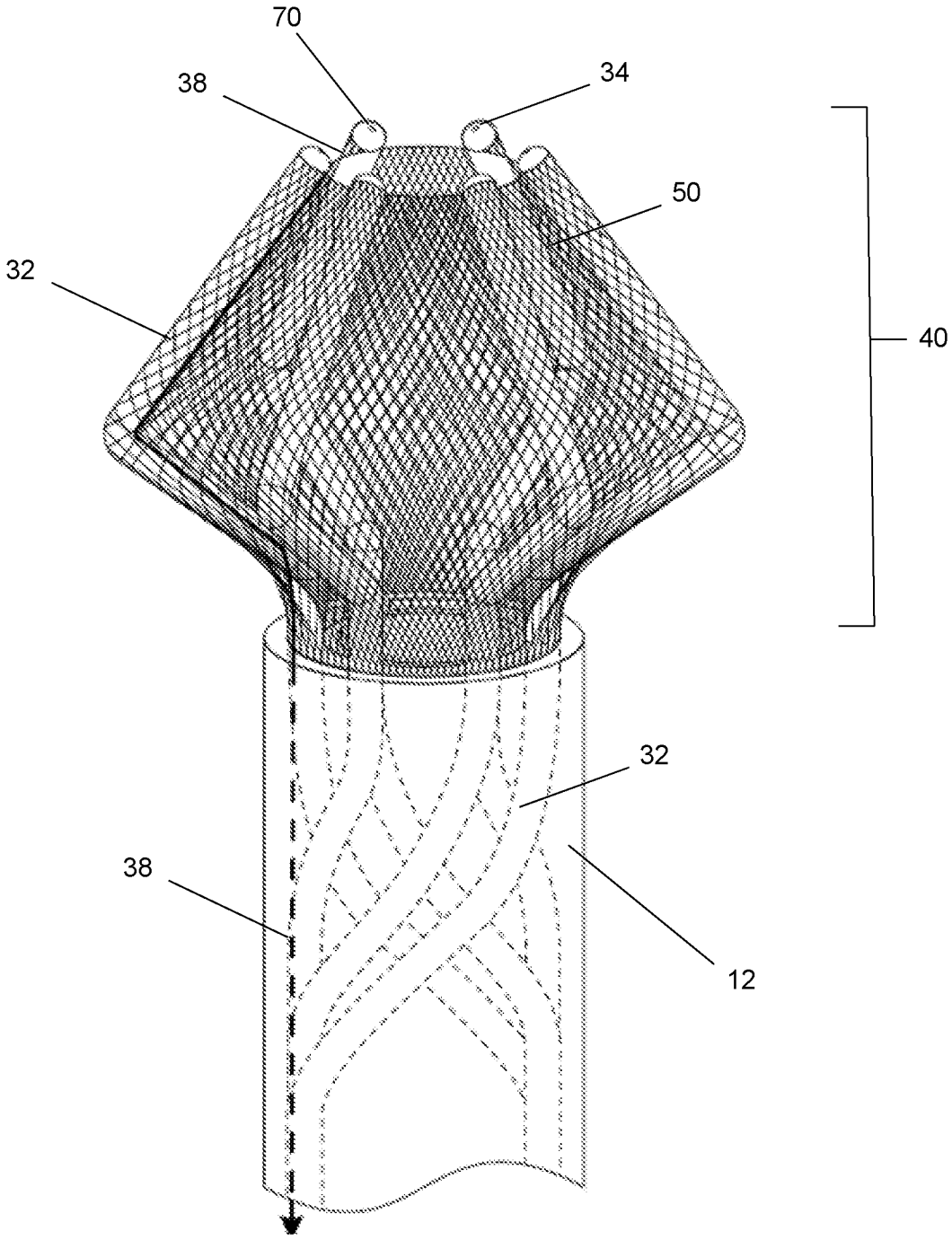

FIG. 6A

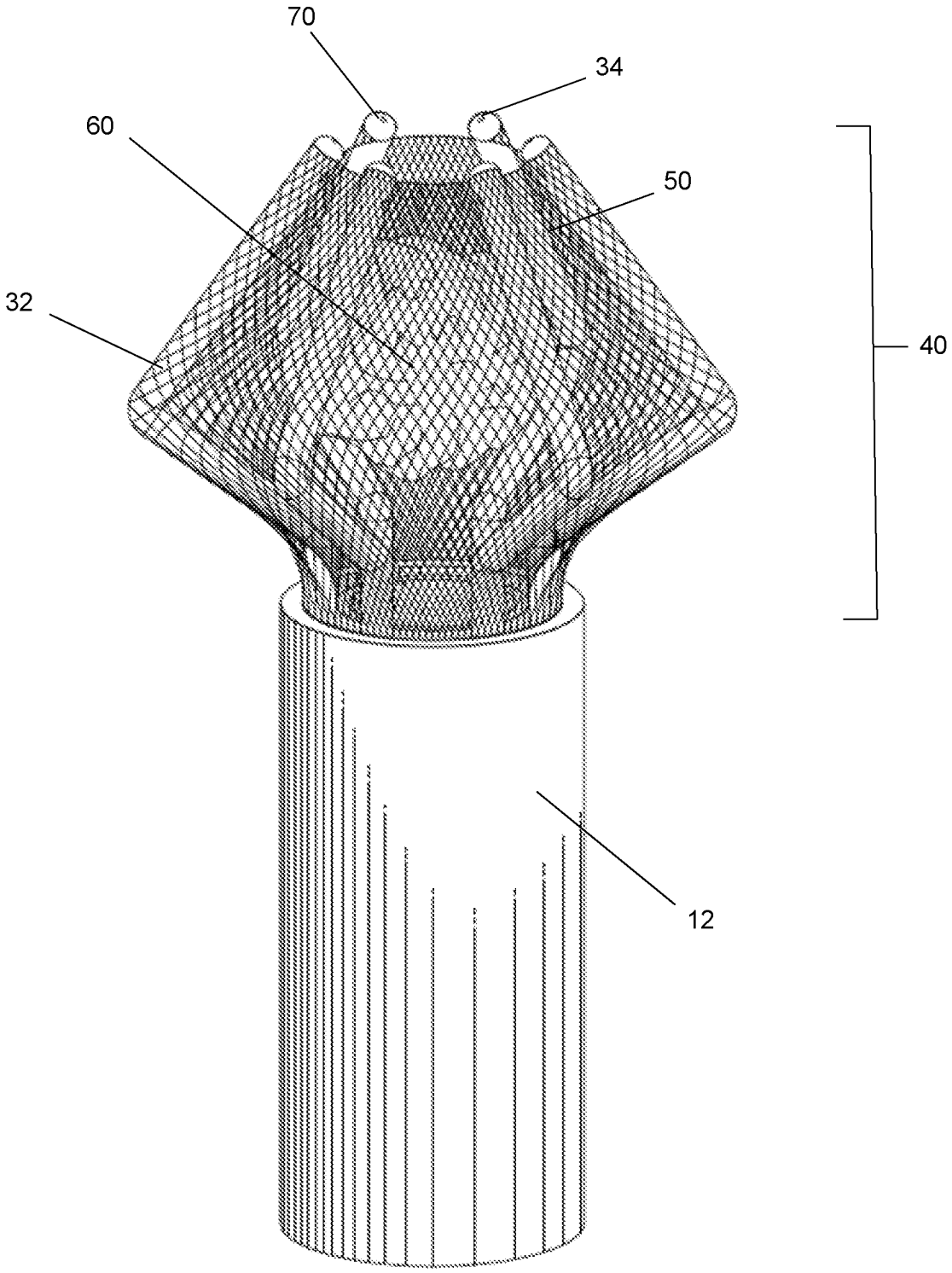

FIG. 6B

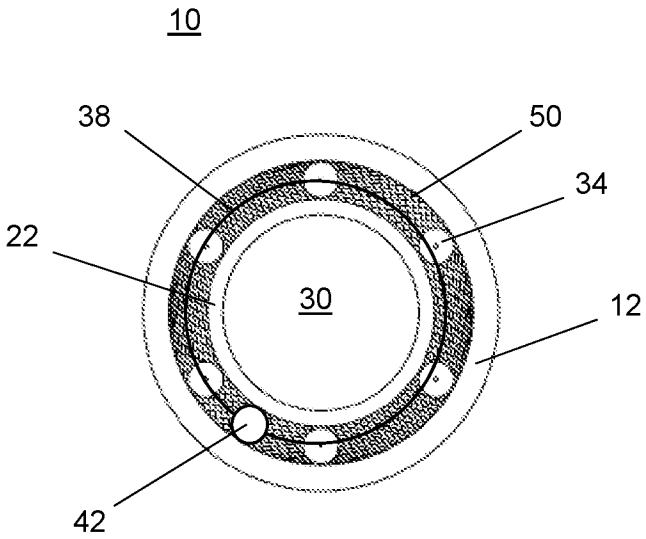

FIG. 7

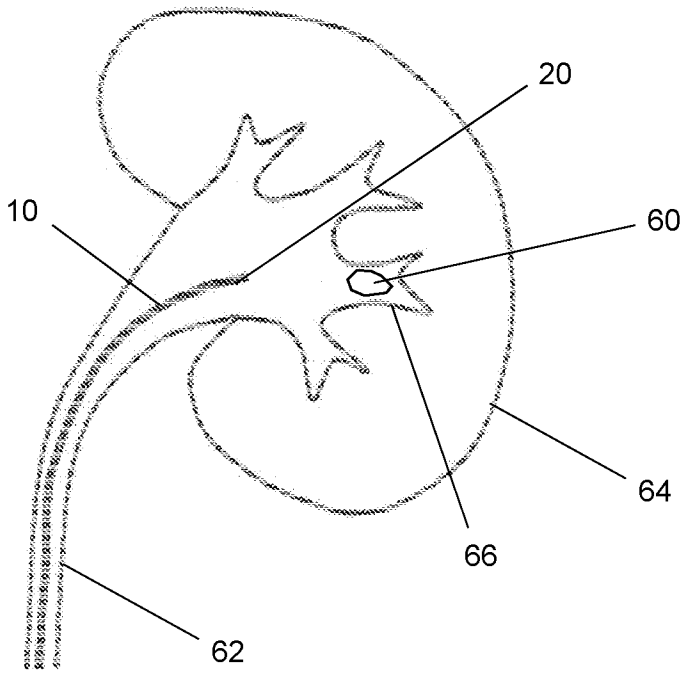

FIG. 8A

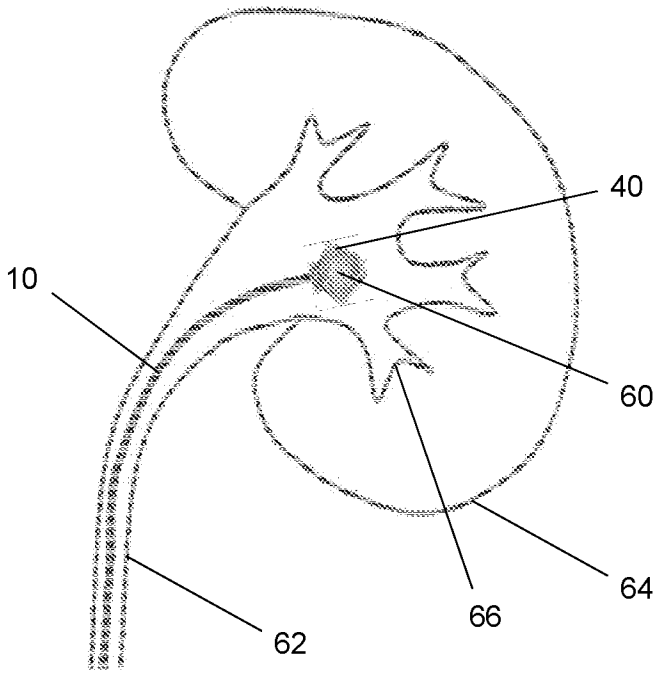

FIG. 8B