

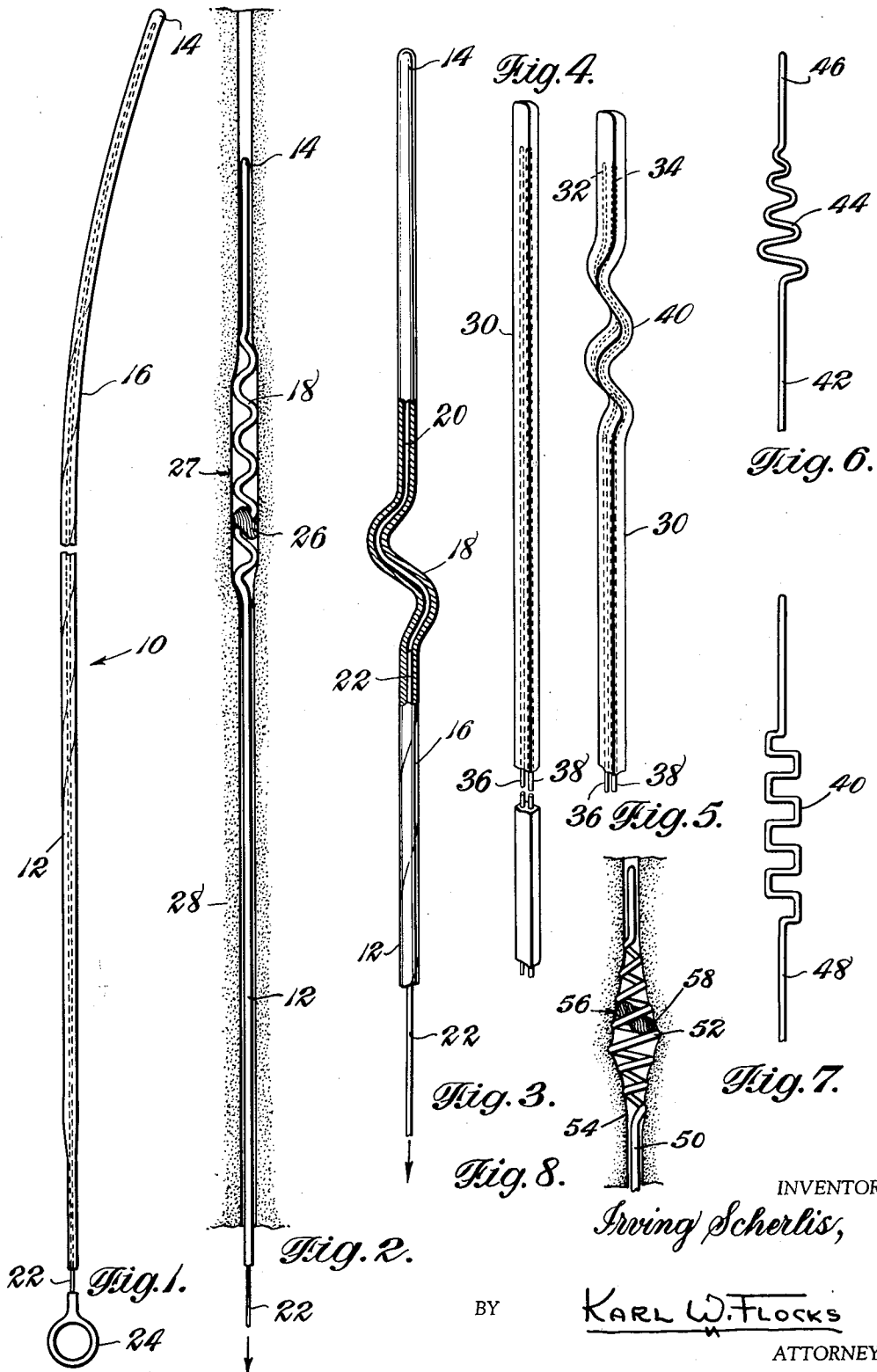
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SURGICAL INSTRUMENT

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SURGICAL INSTRUMENT

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The present invention relates to an article for dislodging foreign objects from a tubular body. More particularly, the present invention relates to a surgical instrument which is adapted to be employed in extracting kidney stones or calculi that may be lodged in the ureter.

The ureter is located between the kidney and the bladder and may, on occasion, become obstructed by a stone or calculus that has formed in the kidney and then passed therefrom to the ureter. However, in passing through the ureter, which generally has an irregular wall formation, the stone, which also may be formed irregularly, may become lodged therein. In these cases, unless the stone is removed from the ureter promptly, the general function of the kidney can often become impaired due to the back pressure of the urine. In addition, the stone in the ureter will also cause the patient to have intense pain and discomfort. In these situations, it is frequently necessary to resort to surgery in order to remove the stone. However, before surgery is resorted to, it has become the practice in many cases to first attempt to remove the stones from the ureter by the use of a cystoscopic instrument. Prior to the instant invention, many types of cystoscopic instruments for use in dislodging and delivering stones from the ureter have been employed, the success of the instrument depending upon the physical circumstances involved and the professional skill of the user. One type of the heretofore known stone dislodging instruments or catheters is the spiral dislodger which employs an elongated metal tube that is formed in a series of tightly wound fixed rigid spirals. At the proximal end of the instrument are formed several open rigid and fixed spirals that are adapted to engage the stone when the instrument is inserted within the ureter passage and thereby remove the stone when the instrument is retracted therefrom.

The use of this instrument has been limited by the rigidity of the fixed spirals and to the extreme difficulty experienced in inserting the elongated tube into the ureter passage without causing damage to the sensitive walls of the ureter. Inasmuch as the rigid system must be rotated in order to engage the stone, surgical complications oftentimes result.

Another of the cystoscopic instruments known heretofore consists of a tubular body having a cord threaded through the body. The cord projects through a hole at the proximal end of the body thereof and is formed in a loop when it is pulled, the tip of the tubular body bending toward the rearmost end thereof. In the use of this instrument, the kidney stone or calculus lodged in the ureter is snared by the loop as the tubular body is withdrawn therefrom. However, a large kidney pelvis (the funnel portion above the ureter) is needed to form the loop. Moreover, by using this instrument, a double thickness of catheter and the stone must traverse the ureter. Furthermore, it is obvious that such an instrument may not be successful in all cases of removing stones, since the loop may slip by the stone without engaging it, or if the stone is engaged, it is not subsequently retained

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within the loop during the retracting of the instrument from the ureter.

Still another of the heretofore known cystoscopic instruments or ureteral stone dislodgers comprises an elongated tube having as its working element a body portion which includes an open spindle consisting of a plurality of fine spring wires. In operating this instrument, manipulation of an actuating element causes the wire bands to spring outwardly, thereby forming a basket-like arrangement, the basket being adapted to receive the kidney stone therein. In a modification of this instrument, the actuating element is not utilized, the open spindle of fine flexible spring steel wire being pushed to the level of or beyond the position of the stone. This type of instrument has met with moderate success but it is considered dangerous in use, for the wires have been known to perforate the walls of the ureter, thereby complicating the patient's condition. Moreover, there are many times when the basket or spindle of wires becomes incarcerated in the ureter and a surgical operation is necessary to remove both the instrument and the stone from the ureter.

Still another of the stone dislodgers known heretofore is of the type wherein the catheter wall itself is deformed to form a basket-like effect to receive the kidney stone. This instrument utilizes an external operator for causing the deformation of the catheter walls after the instrument has been inserted into the ureter tube. However, this latter instrument has not met with success as there is no positive manner in engaging the kidney stone within the ureter tube and, therefore, the extraction of the stone is not always assured. Moreover, the deformation catheter wall into the basket-like effect may damage the irregular ureter walls when the catheter is removed from the ureter.

It is therefore an object of the present invention to provide an article for dislodging foreign objects from the passage of a tubular body in an efficient manner and without causing serious injury to the tubular body passage.

Another object of the present invention is to provide a surgical instrument for dislodging kidney stones or calculi from the ureter whereby these stones are grasped and removed from the ureter tube with a minimum of effort, thereby resulting in both less pain on the part of the patient and trauma to the walls of the ureter.

Still another object of the present invention is to provide a catheter for use in removing kidney stones or calculi from the ureter whereby a portion of the catheter body is deformed in a series of preformed undulations or helical spirals, the preformed spirals or undulations being adapted to engage a kidney stone or calculus for the removal thereof from the ureter.

Still another object of the present invention is to provide a catheter for use in removing kidney stones from the ureter, whereby the catheter is formed with a portion thereof being preformed in a plurality of helical spirals or undulations, an elongated rod being received in the catheter for causing the preformed helical spirals of the catheter to conform to the rod configuration during the insertion of the catheter into the ureter.

Still another object of the present invention is to provide a catheter for removing kidney stones or the like, wherein an elongated rod is removed from the catheter during the stone removing operation, thereby causing a preformed portion of the catheter to assume a series of helical spirals around or above the stone for the removal thereof.

Still another object of the present invention is to provide a catheter for the removal of kidney stones or the like, the catheter being formed in any convenient geometric cross-sectional configuration, and the lumen thereof being formed in any convenient geometric cross-sectional configuration and being adapted to receive a

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rod or stylet having a similar cross-sectional geometric configuration.

Still another object of the present invention is to provide a catheter for use in removing a foreign body from the ureter whereby a helical flexible member exerts a firm but limited force near the outer surface of the enclosed foreign body, thereby imparting a rolling motion to the body.

Still another object of the present invention is to provide a flexible enclosure for removing ureteral calculi, the flexible enclosure yielding when an inordinately large force is required to remove the calculi, such as in those cases where the stone is firmly embedded or lodged in the ureter, thereby providing an instrument that can be delivered from the ureter and will not become incarcerated in the ureter alongside the stone.

Still another object of the present invention is to provide an article for moving an object in a tubular body by removing means disposed in a passage in said article, thereby causing a portion of said article to assume a preformed undulated shape.

Other objects and the nature and advantages of the instant invention will be apparent from the following description taken in conjunction with the accompanying drawing, wherein:

Fig. 1 is an elevational view of one form of the instrument embodied in the present invention, illustrating a catheter prior to the insertion thereof in the ureter, the preformed spiral portion of the catheter conforming to a flexible rod or stylet introduced into the lumen of the catheter;

Fig. 2 is a sectional view of a passage such as, for example, a ureter, illustrating the catheter shown in Fig. 1 positioned therein after the stylet has been removed from the preformed portion of the catheter;

Fig. 3 is an enlarged view of a portion of Fig. 2 illustrating the removal of the stylet from the catheter passage or lumen;

Fig. 4 is a perspective view of a modified catheter embodied in the present invention;

Fig. 5 is a perspective view of the modified catheter shown in Fig. 4 illustrating the removal of stylets from the catheter passages;

Fig. 6 is an elevational view of another modification of a catheter tube with the stylet removed therefrom;

Fig. 7 is still another modified form of a catheter tube illustrating the stylet removed therefrom; and

Fig. 8 is still another modification of the present invention illustrating a catheter tube engaging a stone in a ureter and having a decreasing spiral formation in both directions of the tube.

Referring now to the drawing, and particularly Figs. 1 to 3, one form of the present invention is illustrated and comprises a stone dislodging instrument or catheter generally indicated at 10. The catheter 10 includes an elongated tubular body 12 which is formed of a suitable flexible material that may be preformed in shape. Formed integral with the body 12 on the proximal end thereof is a tip portion 14 which may be rounded, thereby being adapted to guide the catheter into a passage. Although the tip portion 14 is not shown as being removable, such a construction is within the spirit of the present invention. Moreover, the body 12 could be modified to receive any shape or size tip portion now commercially produced for use with the heretofore known catheters. It is contemplated that if the tip portion is not made removable, it may be formed in any shape or size such as is now commercially produced for use with the heretofore known catheters and instruments. Spaced from the tip portion 14 and extending along a portion of the body 12 is a preformed portion 16 that is provided with a plurality of continuous helical spirals or undulations 18 (Fig. 2). The helical spirals or undulations 18 may be preformed in the tubular body 12 in any convenient manner such as, for example, by wind-

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ing the tubular body on a heated mandrel. Assuming that the tubular body 12 is formed of a thermoplastic material, then a mandrel about which the tubular body is wound and to which heat has been applied for a predetermined length of time forms the tubular body into a series of permanent spirals. The number and size of the permanently formed spirals will depend upon the diameter of the mandrel and the number of winds of the tubular body about the mandrel.

Where possible, the tip of the catheter or the preformed coiled portion thereof, or the entire catheter itself, may be made opaque to X-ray radiation, thereby aiding the operator in placing the catheter in the proper position in the ureter for the dislodging of the stone. Moreover, appropriate size openings may be formed at various points along the wall of the catheter for communicating with the lumen of the catheter as is the general practice in the art.

Formed in the body 12 of the catheter is a passage or lumen 20 (Fig. 3) which extends from the rearmost end of the catheter to the tip portion 14. As shown in the drawing, the passage 20 extends substantially to the end of the catheter body, thereby forming a relatively small tip portion 14. However, if it is desired, the passage 20 may extend through the tip portion 14 or it may terminate at any predetermined point from the tip portion 14, for example, at the endmost portion of the preformed portion 16. A somewhat longer tip portion will thereby be formed which will further assist in the insertion of the catheter into the ureter past the stone to be dislodged. As shown in Fig. 1, the lumen or passage 20 is adapted to receive an elongated flexible rod or stylet 22 which may be provided with an operating ring 24 secured to the rearmost end thereof. The stylet 22 may be formed of any suitable material but is preferably formed of a flexible metal so that the tortuous path of the ureteral passage may be followed when the tubular body 12, which includes the stylet 22, is inserted therein. The stylet must also have sufficient rigidity so that when inserted into the tubular body 12, the helical spiral or preformed portion 16 of the body will conform to the configuration of the stylet.

Referring to Fig. 1, in particular, the stylet 22 is inserted into the catheter, the preformed portion 16 thereby conforming to the solid body of the stylet 22. The body 12 is thus formed with an uninterrupted surface, which thereby allows the catheter to be readily inserted into a passage, such as, for example, the ureter. After the catheter has been inserted into the ureter, it is then necessary to withdraw the stylet 22 from the catheter body and for this purpose the operating ring 24 may be provided, in which case it is secured to the rearmost end of the stylet 22.

In illustrating the operating of the present invention, it will be assumed that a kidney stone or calculus, for example, such as that shown at 26 in Fig. 2, is lodged in a passage 28 that represents the ureter. The catheter 10 with the stylet 22 positioned within the body thereof is inserted into the ureter 28 and moved through the ureter 28 until the tip portion 14 is sufficiently beyond the location of the stone 26. With the catheter in this position, the operating ring 24 is grasped and the stylet 22 is slowly removed from the catheter body 12. As shown in Fig. 3, as the stylet 22 is removed from the body 12 of the catheter, the preformed portion 16 deforms to form the continuous helical spirals or undulations 18. When the stylet 22 has been fully removed from the preformed portion 16 of the catheter body, the continuously formed helical spirals or undulations 18, as shown in Fig. 2, are formed and will engage the stone 26. If the spirals do not engage the stone 26, then the catheter body can be maneuvered until contact is made. When the preformed portion 16 of the catheter deforms to form the helical spirals, the portion of the ureter in which the spirals are located will be somewhat enlarged, as shown at 27 in

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Fig. 2. In order to remove the stone 26, the catheter body 12 is slowly retracted from the ureter 24, which movement will cause the stone 26 to be withdrawn from its lodged position within the ureter. It is apparent that since the preformed spirals, or helical spirals 18 in the catheter body 12, are of a relatively small dimension, and since they present no sharp edges to the wall of the ureter, the removal of the catheter body from the ureter will not likely tear or rupture the ureteral walls, thereby reducing pain on the part of the patient and practically eliminating the trauma to the ureter normally associated with the heretofore known stone dislodging instruments. Moreover, unlike heretofore known instruments, the likelihood of this instrument to become incarcerated within the ureter against the stone is greatly reduced for the helical spirals or undulations will yield and straighten out when an inordinately large force is required to remove the stone such as, for example, in those cases where the stone is firmly embedded or lodged in the ureter.

Referring now to Figs. 4 and 5, a modified form of the present invention is illustrated and includes a ribbon-shaped catheter 30. It is apparent that the catheter embodied in the present invention may assume a tubular-like configuration illustrated in Figs. 1 to 3, or a ribbon-like configuration illustrated in Figs. 4 and 5, or may have any other geometric configuration that is desired. As shown in Fig. 5, the ribbon-shaped catheter 30 has parallel passages or lumens 32, 34 formed therein which are circular in cross section. Inserted within the parallel passages or lumens 32, 34 of the catheter 30 are a pair of rod-like stylets 36, 38, respectively, which are adapted to be withdrawn from the catheter 30 when a foreign object is to be dislodged from a tubular body, such as the ureter. The catheter 30 is also formed with a preformed body portion that is adapted to form a series of continuous spirals or undulations 40 when the stylets 36, 38 are withdrawn from the lumens 32, 34. Referring again to Fig. 5, the stylets 36, 38 are shown being withdrawn from the lumens 32, 34 thereby resulting in the formation of the continuous spiral or undulations 40 along the catheter body. As discussed above in connection with Figs. 1-3, the catheter 30, when inserted into the ureter, and upon removal of the stylets 36, 38, will engage a stone or the like lodged in the ureter. Upon withdrawal of the catheter, the spirals or undulations 40 will remove the stone from the ureter.

Referring now to Fig. 6, another modification of the present invention is illustrated wherein a tubular catheter 42 is shown after an associated stylet such as shown in Figs 1-3 has been removed from the body thereof. A preformed portion of the catheter 42 in the modification illustrated in Fig. 6 is formed in a series of reducing spirals 44, which spirals terminate in a tip portion 46 and are adapted to engage a foreign object lodged in the ureter for the removal thereof. It is apparent that the reducing spirals may start or terminate in increasing calibre in either direction, as desired. The operation of the catheter 42 is similar to that described in connection with Figs. 1-3 and 4-5.

Fig. 7 shows a further modification of the present invention and comprises a tubular catheter 48 which includes a preformed portion formed in a series of square spirals 40. A suitable stylet is adapted to be inserted into the catheter 48 and withdrawn therefrom after the catheter has been inserted in the ureter, thereby enabling a stone lodged in the ureter to be withdrawn therefrom.

Referring now to Fig. 8, another modified catheter is shown at 50 in the position after the stylet has been withdrawn therefrom. The helical spirals 52, which have been preformed, are illustrated as decreasing in size in both the direction of the tip portion and toward the rear-most portion of the catheter. As shown in Fig. 8, the catheter 50 has been inserted into a ureter 54 thereby causing the portion 54 to enlarge when the stylet is withdrawn from the catheter lumen. A stone 58 is thereby

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engaged and will be withdrawn from the ureter upon removal of the catheter therefrom.

It is apparent from the above description of the present invention that the elongated member or catheter described herein, which is formed with a preformed portion, is adapted to be deformed into a plurality of helical spirals or undulations after the removal of a stylet therefrom. The preformed portion may be suitably deformed so that the helical spirals or undulations may assume any configuration necessary in order to remove a foreign object from a tubular body. By forming the preformed portion with a plurality of helical spirals or undulations, the removal of the foreign object from the tubular body will be assured and, in case of a kidney stone or calculus, the stone or calculus may be removed from the ureter with a minimum of pain and damage to the ureter walls.

It is apparent that this invention may also be used to dilate strictures or narrowings of the ureter.

It is also apparent that the present invention may be applied whenever it is necessary to remove a foreign object from a tubular body, and the size and shape of the deformable elongated member, including the flexible rod inserted therein, may vary with the conditions present.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit of the invention and, therefore, the invention is not limited to what is shown in the drawing and described in the specification but only as indicated in the appended claims.

What is claimed is:

1. In an article for dislodging foreign objects from a tubular body, an elongated flexible element adapted to be inserted within said tubular body, said elongated flexible element including a tip portion for guiding said flexible element within said tubular body, and a hollow body portion integrally formed with said tip portion, said body portion being preformed along a portion thereof in a series of helical spirals, an actuating rod extending into said elongated element and passing through the length of said body portion, being restrained from further movement by said tip portion, said actuating rod causing the preformed spiral portion of said flexible element to assume a relatively straight configuration when inserted therein and being withdrawn from said flexible element after said flexible element has been inserted into said tubular body, thereby causing the preformed portion of said flexible element to assume the series of spirals, said spirals engaging a foreign object lodged within said tubular body and extracting said foreign object upon removal of said flexible element from said tubular body.

2. In an article for moving an object in a tubular body, an elongated element adapted to be inserted within said tubular body, said elongated element including a tip portion for guiding said elongated element within said tubular body, and a body portion integrally joined to said tip portion, said body portion having a portion preformed in a plurality of spirals along the length thereof, a rod extending into said elongated element and adapted to be withdrawn therefrom, said preformed portion assuming a straight position when said rod is inserted in said elongated element and assuming the spiral configuration when said rod is withdrawn from said elongated element.

3. In an article for moving an object in a tubular body as set forth in claim 2, wherein said elongated element comprises a tubular member.

4. In an article for moving an object in a tubular body as set forth in claim 2, wherein the preformed spirals formed on said body portion are formed in a diminishing helix.

5. In an article for dislodging foreign objects from a tubular body as set forth in claim 2, wherein the spirals formed on said body portion are square-shaped.

6. In an instrument for removing foreign bodies from

a tubular body, a catheter comprising an elongated element having a tip portion and a body portion, said body portion including a portion being preformed in a plurality of continuous spirals, said preformed portion being caused to be relatively straight by means of a stylet which is in the lumen thereof, said preformed portion therefore being relatively straight when inserted into said tubular body and assuming the spiral configuration when said stylet is withdrawn from said preformed body and thereby being adapted to remove said foreign bodies from said tubular body as the catheter is removed from said tubular body.

7. In an instrument for removing foreign bodies from a tubular body as set forth in claim 6, wherein the preformed spirals formed on said body portion are formed in a diminishing helix.

8. In an instrument for removing foreign bodies from a tubular body as set forth in claim 6, wherein said elongated element comprises a tubular member.

9. In an instrument for removing foreign bodies from a tubular body as set forth in claim 6, wherein the spirals formed on said body portion are square-shaped.

10. In an instrument for removing calculi from the ureter, a catheter comprising an elongated element having a tip portion and a body portion, said body portion having a passage formed therein and a preformed portion extending along the length thereof, a rod extending into said passage and adapted to be withdrawn therefrom, said elongated element with said rod positioned therein being inserted into said ureter when a calculus is to be removed therefrom, said preformed portion of said body assuming a plurality of spirals around said calculus when said rod is removed from said body portion, said catheter being removed from said ureter and withdrawing said calculus therewith.

11. In an instrument for removing foreign bodies from a tubular body, an elongated element having passage means formed therein, a portion of said elongated element being preformed in a plurality of continuous spirals, rod means extending into said passage means and causing said preformed spirals to assume an unspiraled configuration thereby permitting said elongated element to be inserted into said tubular body, said rod means being withdrawn from said elongated element to cause the preformed portion to assume said continuous spirals within said tubular body, whereupon removal of said elongated element from said tubular body will remove a calculus lodged therein.

12. In an instrument as set forth in claim 11, wherein said elongated element comprises a tubular member.

13. In an instrument as set forth in claim 11, wherein said elongated element comprises a ribbon-shaped body.

14. In an instrument as set forth in claim 13, wherein said passage means includes a plurality of passages formed therein, each of said passages receiving a rod means, said rod means being withdrawn from said ribbon-shaped body to deform the preformed portion of said body into said spiral configuration.

15. In an article for dislodging foreign objects from a tubular body, an elongated element having a ribbon-like

configuration and formed with passage means therein, a portion of said elongated element being preformed in a continuous spiral, rod means extending into said passage means and causing said elongated element to have an unspiraled effect, said rod means being withdrawn from said passage means after said elongated element has been inserted into said tubular body, thereby causing said preformed body portion to effect said continuous spiral, whereupon removal of said elongated element from said tubular body extracts a foreign object lodged therein.

16. In an article for dislodging foreign objects from a tubular body as set forth in claim 15, wherein said passage means includes a plurality of passages, each of said passages receiving a rod means, said rod means being withdrawn simultaneously from said ribbon-shaped element to deform the preformed portion of said element into said continuous spiral.

17. In an instrument for dilating a tubular body, a hollow tubular element having a body portion formed with a passage therein, a portion of said body portion being preformed in a plurality of spirals, a stylet extending into said passage, said stylet being withdrawn from said passage after said element has been inserted into said tubular body, thereby causing said preformed portion to assume the spiral configuration, said spiral configuration dilating the tubular body.

18. In an article for moving an object in a tubular body, an elongated element disposed within said tubular body, said elongated element having a preformed spiral portion extending longitudinally along the body thereof, a passage formed in said elongated element, a member extending into said passage for causing said preformed spiral portion to assume a substantially straight configuration, said member being removed from said passage to cause said preformed portion of the elongated element to assume a spiral configuration, said spiral portion engaging said object, whereby movement of said elongated element causes movement of said object.

19. In an article for moving an object in a tubular body, an elongated element adapted to be disposed within said tubular body, said elongated element being formed with a passage therein and including a preformed undulated portion extending longitudinally along the body thereof, means located in said passage for causing said elongated element to assume a straight configuration, said means being removable from said passage after said element has been inserted into said tubular body to cause said preformed portion to assume the undulated configuration, whereupon movement of said elongated element causes movement of said object.

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