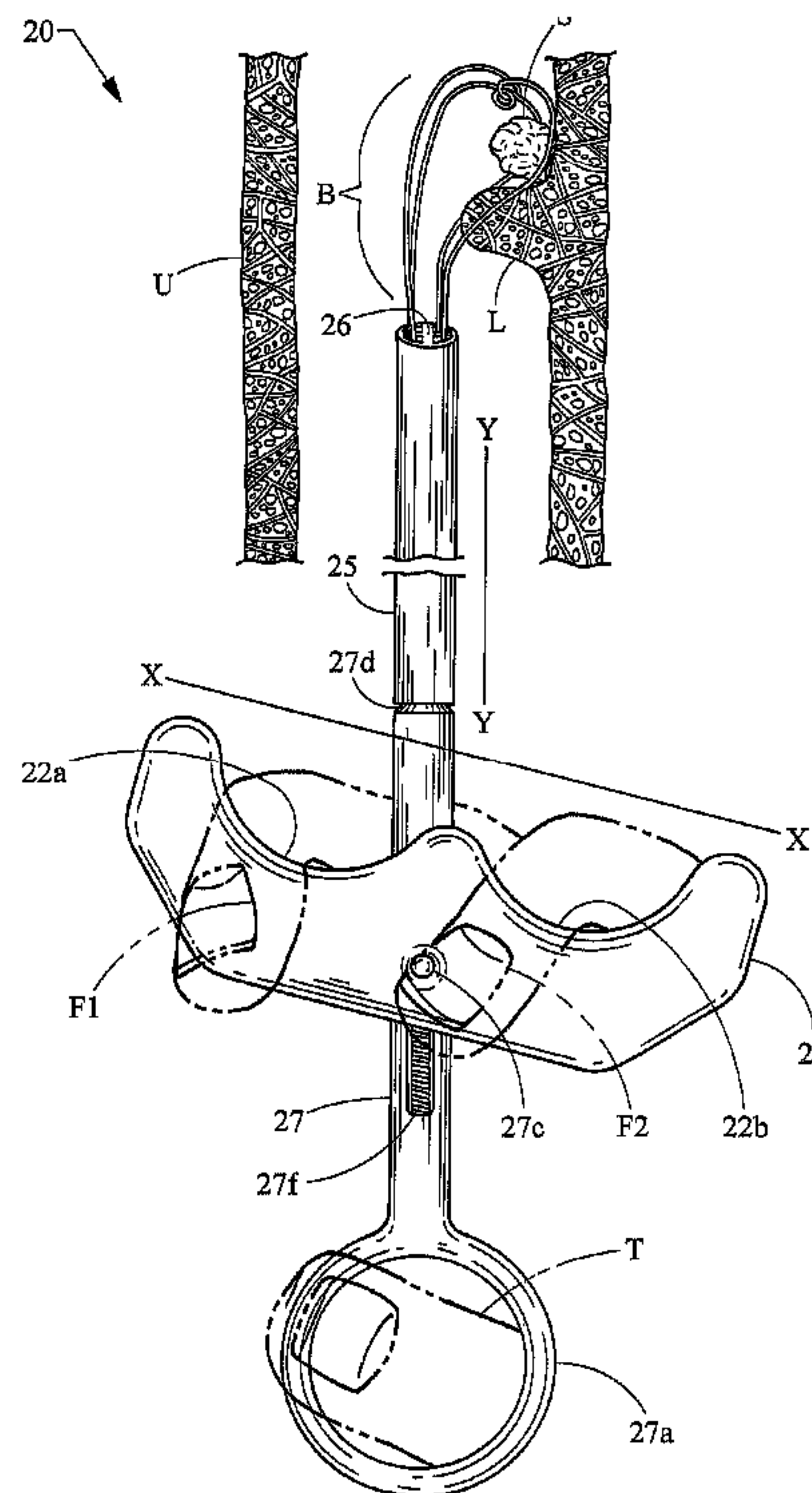




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(57) **Abbrégé/Abstract:**

A retrieval device is provided for retrieving stones, calculi and other objects from a body. The device may comprise a body (17), a slide assembly (161) slidably attached to the body, an articulator (13) rotatably attached to the body and in communication with the slide assembly, and wires (11a, 11b) attached to the articulator and distally to a basket (B), such that moving the slide assembly can retract and extend the basket longitudinally while operating the articulator moves it transversely.



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*[Continued on next page]*

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## ARTICULATING BASKET WITH SIMULTANEOUS BASKET EXTENSION OR BASKET RETRACTION

### FIELD OF THE INVENTION

**[0002]** This invention relates to medical retrieval devices used in minimally invasive surgery, particularly those used to retrieve stones and calculi from a patient.

### BACKGROUND OF THE INVENTION

**[0003]** Stone retrieval devices are often employed in order to remove a stone from a ureter or kidney. Removal of a stone from a ureter or kidney is a difficult process because the area within which the medical professional works is small and narrow. Often a stone is not located directly in front of the retrieval basket. The location of the stone makes it difficult to retrieve. In an attempt to retrieve the object, the medical professional will attempt to bend the basket, causing the basket to bend-over partially onto itself. This movement will allow one side of the basket to expand and be more open than the opposite side. When the basket is at least partially bent-over on itself, the medical professional will attempt to maneuver the basket so that it encapsulates the object. However, the basket cannot be extended or retracted while bent. Thus, stones that are not directly in front of the device cannot be easily captured.

**[0004]** The medical professional has little control of the basket because the basket cannot be bent while being extended or retracted. Thus, during the interim period between when the basket surrounds the stone and when the basket is retracted, the stone can shift, move, or dislodge, making the capture attempt a failure, causing the medical professional to start the procedure over.

## BRIEF SUMMARY OF THE INVENTION

**[0005]** A medical device is provided. The device includes a body, an articulator movably connected to the body, and at least a first and a second wire having distal ends. The first and second wire is in communication with the articulator. The device further includes a tool disposed at the distal end of the first and second wire, wherein the articulator is capable of moving the tool outside the longitudinal plane, and wherein the tool is capable of being extended and retracted in a longitudinal plane simultaneously with movement outside the longitudinal plane.

**[0006]** Further, a medical device is provided. The device includes a body, a slide assembly slideably attached to the body, and an articulator rotateably attached to the body. The articulator is in communication with the slide assembly. The device further includes a first wire and a second wire having distal ends, wherein the first wire and the second wire are attached to the articulator. The device further includes a tool disposed at the distal ends of the first and second wires, wherein the articulator is configured to move the tool outside a longitudinal plane, and wherein the slide assembly is configured to extend and retract the first and second wires.

**[0007]** Further, a medical device is provided. The device includes a tool formed by at least one wire. The device further includes means for extending or retracting the tool and simultaneously articulating the tool in a plane outside a longitudinal plane.

**[0008]** Further, a method for retrieving an object is provided. The method includes inserting a device for removing an object into a patient, extending a tool of the device out to the object, and articulating the tool to encapsulate the object. The method further includes retracting the tool to retrieve the object, wherein the extending and the articulating are capable of being performed simultaneously or the articulating and the retracting are capable of being performed simultaneously.



## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0009] The embodiments will be further described in connection with the attached drawing figures. It is intended that the drawings included as a part of this specification be illustrative of the embodiments and should in no way be considered as a limitation on the scope of the invention.

[0010] Figs. 1A, 1B-1C show partial cross-sectional views of an embodiment of the device;

[0011] Fig. 1D shows a partial plan view of an embodiment of the device;

[0012] Fig. 1E shows a partial cross-sectional view of an embodiment of the device;

[0013] Fig. 2 is an isometric view of the an embodiment of the device;

[0014] Fig. 3 is an isometric view of an embodiment of the device;

[0015] Figs. 4, and 4A show partial cross-sectional views of the proximal portion of embodiments of the device;

[0016] Figs. 5 and 5A-5C show partial cross-sectional views of the proximal portion of embodiments of the device;

[0017] Figs. 6, and 6A show partial cross-sectional views of the proximal portion of embodiments of the device;

[0018] Figs. 7A-7E are isometric views of pivot pins of embodiments of the device;

[0019] Figs. 8A-8B are isometric views of the proximal portion of embodiments of the device;

[0020] Figs. 9A-9C are isometric views of grasping wire restraint disks of embodiments of the device;

[0021] Fig. 10 is an isometric view of a sheath of an embodiment of the device;

[0022] Fig. 10A is a cross-sectional view of Fig. 10 at line 10A;

[0023] Fig. 10B-10C are isometric views of a sheath of embodiments of the device;

[0024] **Fig. 11** is a close-up view of the distal portion of an embodiment of the device;

[0025] **Fig. 12** is a close-up view of the distal portion of an embodiment of the device;

[0026] **Fig. 13** is a close-up view of the distal portion of an embodiment of the device;

[0027] **Fig. 14A** is a perspective view of the distal portion of an embodiment of the device;

[0028] **Figs. 14B-14D** are frontal views of the distal portion of embodiments of the device; and

[0029] **Figs. 15-18** depict another embodiment of the device.

#### DETAILED DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENTS

[0030] The device provides a way to simultaneously articulate and extend a retrieval basket and also to simultaneously articulate and retract the basket for retrieving stones, calculi, and other objects from a patient. The use of the device is not limited to use in human patients; the device has veterinary and non-medical uses including but not limited to retrieving objects from any hard-to-reach area. A more detailed description of the embodiments will now be given with reference to **Figs. 1-18**. The present invention is not limited to those embodiments illustrated; it specifically contemplates other embodiments not illustrated but intended to be included in the claims.

[0031] **Figs. 1A, 1B, 1C, and 1D** depict partial cross-sectional views of an embodiment of the device. Retrieval device **10** has a proximal portion **10a** and a distal portion **10b**. **Figs. 1B and 1C** are cross-sectionals of proximal portion **10a** of retrieval device **10** shown in **Fig. 1A**. **Fig. 1C** is a perspective view of proximal portion **10a** of retrieval device **10** shown in **Fig. 1A**. Located at distal portion are two grasping wires **11a** and **11b** that travel through a lumen **15a** extending through the sheath **15**. Although two grasping wires are depicted, it is contemplated that a greater or lesser amount of grasping wires can be used. Furthermore, it is contemplated that one continuous wire could also be used.



**[0032]** The use of the word "wire" is not intended to be limiting. Throughout the disclosure, grasping wires may be made from stainless steel but are preferably made from a shape memory alloy, including but not limited to Nitinol. Nitinol is available from Memry Corp of Bethel, Connecticut and from other suppliers. Grasping wires can also be made from other semi-flexible materials, including but not limited to nylon, plastic, as well as a shape memory polymer. Shape memory polymers are disclosed in U.S. Patent No. 6,720,402. Grasping wires may also include, but are not limited to, filaments or threads. Grasping wires preferably have a diameter of .005 - .009 inches; however, the diameter of grasping wires is not limited to those dimensions. Grasping wires may be larger or smaller depending on the need. Grasping wires are preferably round or flat, however other shapes can be used, such as the near- triangular pre-shaped Delta Wire<sup>TM</sup> available from Cook Urological, Spencer, Indiana.

**[0033]** At distal portion 10b of retrieval device 10 is a grasping wire connection point 18, which is preferably atraumatic and is used to connect grasping wires 11a, 11b so that they come together in the shape of a basket to keep grasping wires 11a, 11b constrained together. Grasping wires 11a, 11b may be looped together as shown here to form grasping wire connection point 18, but the connection of grasping wires 11a, 11b is not limited to just a loop. Looping of wires is disclosed in U.S. Patent No. 5,989,266.

**[0034]** Grasping wire restraint disk 16 is located within sheath 15 and can be held in place by ways including but not limited to, gluing, soldering, or sewing into place. Grasping wire restraint disk 16 is used to keep grasping wires 11a, 11b separated once they enter sheath 15. Grasping wire restraint disk 16 can be made from any medically-acceptable material, including but not limited to, polycarbonate, stainless steel, nylon, other metals, and plastics.

**[0035]** Sheath 15 protects grasping wires 11a, 11b from becoming tangled and controls their interaction with the patient. Sheath 15 is preferably made from PVC, but can also be made from materials including, but not limited to,



polytetrafluoroethylene (PTFE), polyimide, nylon, polyurethane, polyethylene, or any polymer or semi-flexible metal. Sheath **15** preferably has an outer diameter of 1.5 – 4.5 Fr., although other sizes can be used and the size should be suitable for insertion through an orifice. The outer diameter of sheath **15** is generally based on the size of the orifice through which it will be introduced.

[0036] The articulator **13** houses pivot pins **14a**, **14b**, and **14c** which can be made from many materials, including but not limited to, stainless steel, medically-acceptable polymers, and metals. Articulator **13** can be made from many materials, including but not limited to, rigid nylon, stainless steel, acrylonitrile-butadiene-styrene (ABS) and other medically acceptable polymers and metals. Sheath connection point **17d** of body **17** is threaded so that sheath **15** can connect to body **17**. Wires **11a**, **11b** travel through sheath connection point **17d**, into body **17**, through lumen **17b** of body **17**, and out through windows **17c** into articulator **13**. Pivot pin **14c** travels through articulator **13** and through body **17**. Pivot pin **14c** allows articulator **13** to have tilting see-saw movement on either side of transverse axis **X-X** articulating basket **B**. Although a basket is depicted, the use of other tools is contemplated including other grasping and sampling devices. Additionally, the wires need not be continuous with the tool, nor do the wires and the tool need to be made from the same material. Pivot pins **14a**, **14b**, and **14c** are configured in a triangle-shape.

[0037] First grasping wire **11a** is shown pulled through lumen **15a** of sheath **15**, into sheath connection point **17d**, into lumen **17b** of body **17**, out through windows **17c** and around pivot pin **14c** where it is attached to pivot pins **14a** and **14b**. Second grasping wire **11b** is attached directly to third pivot pin **14c**.

[0038] The configuration of pivot pins **14a**, **14b**, **14c** allows the user to articulate basket **B** from side-to-side, making basket **B** tilt on its side along transverse axis **X-X** enabling basket **B** to grasp an object that may not be directly in-line with basket **B**. Therefore, articulating basket **B** allows for basket **B** to move in a plane in addition outside the longitudinal access.

[0039] Furthermore, articulator **13** can move longitudinally along axis **Y-Y** of body **17** which in turn retracts or extends basket **B**. Thus, articulator **13** translates

relative to body 17; body 17 is stationary with respect to articulator 13 when a thumb (not shown) or other stationary object (not shown) is placed within thumb hole 17a. Two springs 17f sit within body 17 and are in communication with articulator 13 and body 17. Springs are made from stainless steel, although they can be made from any other material so long as they generate an acceptable force to push articulator 13 distally in order to extend basket B. Springs 17f provided resistance against pivot pin 14c which is attached to articulator 13. Thus, when fingers (not shown) apply pressure into either finger groove 12a, 12b and articulator 13 is pulled in the proximal direction, springs 17f are compressed and basket B is retracted. When compression is released from finger groove 12a, 12b, springs 17f are also released and will push articulator 13 in the distal direction, thus extending basket B.

[0040] To articulate basket B, the user tilts articulator 13 on either side of transverse axis X-X by pressing a finger (not shown) down into one of the finger grooves 12a, 12b. Tilting articulator 13 in the direction of finger groove 12a will articulate basket B in the direction of finger groove 12a. Similarly, tilting articulator 13 in the direction of finger groove 12b will articulate basket B in the direction of finger groove 12b.

[0041] While basket B is being articulated, the user can retract basket B by placing a thumb or finger (not shown) in the thumb-hole 17a and using fingers (not shown) placed in finger grooves 12a, 12b to pull articulator 13 proximally along longitudinal axis Y-Y compressing springs 17f. This moves the entire articulator 13 proximally, and thus, moves pivots pins 14a, 14b, and 14c proximally as well. The proximal movement pulls the respective grasping wires 11a, 11b proximally and retracts basket B. While retracting basket B, the user can articulate basket B by tilting articulator 13 on either side of transverse axis X-X by placing pressure into either finger groove 12a, 12b.

[0042] Furthermore, while basket B is being articulated, the user can also extend basket B by releasing the compression on finger grooves 12a, 12b, which releases springs 17f so that they push articulator 13 in the distal direction along longitudinal axis Y-Y. This moves the entire articulator 13 distally, and thus,



moves pivots pins **14a**, **14b**, and **14c** distally as well. The distal movement pushes the respective grasping wires **11a**, **11b** distally and extends basket **B**. While extending basket **B**, the user can articulate basket **B** by tilting articulator **13** on either side of transverse axis **X-X** by placing pressure into either finger groove **12a**, **12b**.

[0043] **Fig. 1E** shows a different embodiment from that shown in **Fig. 1A**. The embodiment shown in **Fig. 1E** needs no springs since finger holes **12c**, **12d** are provided. Thus, when a user places fingers (not shown) within finger holes **12c**, **12d**, the user is able to move articulator **13** in the distal direction along longitudinal axis **Y-Y** without the aid of a spring. Further embodiments are shown in **Figs. 2-14D**.

[0044] **Fig. 2** is an isometric view of an embodiment of the device. Sheath **25** is connected to body **27** at threaded sheath connection point **27d** of retrieval device **20**. Basket **B** enters sheath **25** through grasping wire restraint disk **26**. Articulator **23** is shown pushed in the distal direction along longitudinal axis **Y-Y** and tilted to the right-side of transverse axis **X-X**. Articulator **23** is moveable along axis **Y-Y** in the direction of the proximal portion **20a** or distal portion **20b** of retrieval device **20** when a user pulls or releases articulator **23**, which results in springs **27f** being compressed or released resulting in basket **B** being retracted or extended.

[0045] Retrieval device **20** is introduced into a ureter **U** through a functional lumen of an endoscope (not shown), or an access sheath, or other device. After introduction into the patient, retrieval device **20** is advanced to stone **S**. Here stone **S** is shown abutted to ledge **L** of ureter **U**, and thus, is not directly in front of basket **B**. When articulator **23** is pulled proximally, springs **27f** are compressed and basket **B** retracts. As articulator **23** is released, springs **27f** are released causing articulator **23** to move distally along axis **Y-Y**, as shown, basket **B** extends. A first finger **F1** is located in a first finger groove **22a**, a second finger **F2** is located in a second finger groove **22b**, and a thumb **T** is located in thumb hole **27a**. While extending basket **B**, second finger **F2** is pressing and tilting articulator **23** so that articulator **23** tilts along axis **X-X**, via pivot pin **27c**. This



causes basket **B** to articulate while simultaneously moving articulator **23** distally along longitudinal axis **Y-Y** to extend basket **B** out to stone **S** to surround stone **S**. Here, basket **B** is shown extended and articulated after having just captured stone **S**.

[0046] **Fig. 3** is an isometric view of another embodiment of the device. Here, the basket **B** of the retrieval device **30** is shown extended and articulated, having captured a stone **S** abutting a ledge **L** within a ureter **U**. The sheath **35** is connected to body **37** at sheath connection point **37d**. Basket **B** enters sheath **35** through grasping wire restraint disk **36**. Articulator **33** surrounds body **37**. Articulator **33** has longitudinal movement along longitudinal axis **Y-Y**. Furthermore, articulator **33** has tilting see-saw movement along either side of transverse axis **X-X** due to the pivot pin **34c** that extends from articulator **33** through body **37**. Articulator **33** moves in the direction of the proximal portion **30a** and distal portion **30b** of the retrieval device **30** when a user pulls and releases, respectively, articulator **33**. Thus, body **37** remains stationary with respect to articulator **33** when a thumb **T** is placed within the thumb-hole **37a**. When articulator **33** is released springs **37f** are released causing articulator **33** to move in the distal direction (not shown), which causes basket **B** to extend. As articulator **33** is pulled proximally along axis **Y-Y**, as shown, springs **37f** are compressed and basket **B** retracts. While retracting basket **B**, a first finger **F1** is located in a first finger groove **32a** and a second finger **F2** is located in a second finger groove **32b**. First finger **F1** is pressing and tilting articulator **33** so that articulator **33** tilts along transverse axis **X-X** causing basket **B** to articulate. Since basket **B** is articulated and retracted simultaneously, it can be manipulated in a sweeping motion to capture stone **S**.

[0047] **Figs. 4, 4A, 5, 5A, 5B, 5C, 6, and 6A** each show partial cross-sectional views of the proximal portion of embodiments of the device. The figures each show different configurations of the pivot pins housed within the articulator, **43**, **53**, **63**. In **Fig. 4** the retrieval device **40** has articulator **43** that houses pivot pins **44a**, **44b**, **44c**. Each grasping wire **41a**, **41b** enter lumen **47b** of body **47** at the sheath connection point **47d**. From there, grasping wires **41a**, **41b** travel through

lumen 47b of body 47 and out through windows 47c of body 47 into articulator 43. Each grasping wire 41a, 41b loops around pins 44a, 44b. Pivot pin 44c travels through articulator 43 and into body 47 to allow for tilting see-saw movement of articulator 43 which in turn articulates the basket (not shown). Furthermore, articulator 43 is movably connected to body 47 to allow for longitudinal movement which extends and retracts grasping wires 41a and 41b attached to pivot pins 44a, 44b. Springs 47f are compressed when articulator 43 is pulled in the proximal direction via finger grooves 42a, 42b and thumb hole 47a which retracts the basket (not shown). When springs 47f are released they push articulator 43 in the distal direction which extends the basket (not shown).

[0048] Fig. 4A is the same as Fig. 4, except that no springs are needed since articulator 43 has finger loops 42c, 42d that allow a user to push and pull articulator along longitudinal axis of body 47 in order to extend and retract the basket (not shown).

[0049] Fig. 5 shows another pivot pin – 54a, 54b, 54c – configuration housed within articulator 53 of retrieval device 50. Here, grasping wires 51a, 51b each travel through lumen 57b of body 57 at sheath connection point 57d, out through windows 57c, and into articulator 53. Each end of grasping wires 51a, 51b are each attached to a pivot pin 54a, 54b, located on either side of articulator 53. Pivot pin 54c travels through articulator 53 and into body 57 to allow for tilting see-saw movement which in turn articulates basket (not shown). Furthermore, articulator 53 is movably connected to body 57 to allow for longitudinal movement which extends and retracts grasping wires 51a and 51b attached to pivot pins 54a, 54b. The greater the distance, the less tilting see-saw movement of articulator 53 is required to articulate the basket (not shown). Springs 57f are compressed when articulator 53 is pulled in the proximal direction using finger grooves 52a, 52b, and thumb hole 57a which retracts the basket (not shown). When springs 57f are released they push articulator 53 in the distal direction which extends the basket (not shown).

[0050] Fig. 5A is the same as Fig. 5, except that no springs are needed since articulator 53 has finger loops 52c, 52d that allow a user to push and pull



articulator along the longitudinal axis of body 57 in order to extend and retract the basket (not shown).

[0051] Fig 5B is the same as Fig. 5 except grasping wires 51a and 51b are in a different configuration. Here, each grasping wire 51a, 51b first goes around pin 54c before connecting to pivot pins 54a, 54b.

[0052] Fig. 5C is the same as Fig. 5B, except that no springs are needed since articulator 53 has finger loops 52c, 52d that allow a user to push and pull articulator directly along a longitudinal axis of body 57 in order to extend and retract the basket (not shown).

[0053] Fig. 6 shows yet another pivot pin configuration – 64a, 64b, 64c, 64d, 64e – housed within articulator 63 of retrieval device 60. Grasping wires 61a, and 61b enter body 67 at sheath connection point 67d and travel through lumen 67b of body 67. Grasping wires 61a and 61b then both loop around fourth pivot pin 64d, exit through window 67c, and are attached to first pivot pin 64a. Grasping wires 61a and 61b also both loop around third pivot pin 64c, exit through window 67c, and then are attached to second pivot pin 64d. Pivot point 64e allows for the articulator 63 to have tilting see-saw movement to allow the basket (not shown) to be articulated. Articulator 63 to move longitudinally proximally and distally along longitudinal axis of body 67. This configuration allows for both pushing and pulling of the basket (not shown). Springs 67f are compressed when articulator 63 is pulled in the proximal direction using finger grooves 62a, 62b, and thumb hold 67a which retracts the basket (not shown). When springs 67f are released they push articulator 63 in the distal direction which extends the basket (not shown).

[0054] Fig. 6A is the same as Fig. 6, except that no springs are needed since articulator 63 has finger loops 62c, 62d that allow a user to push and pull articulator along longitudinal axis of body 67 in order to extend and retract the basket (not shown).

[0055] Figs. 7A-7E are isometric views of pivot pins of embodiments of the device. In Fig. 7A, pivot pin 74a is a nail-shaped pin having a head H that has a greater diameter than the body. This prevents grasping wire 71 from slipping off



of pivot pin 74a when the basket (not shown) is articulated, extended, and/or retracted.

[0056] **Fig. 7B** shows an alternate embodiment of pivot pin 74b having an eye E in which grasping wire 71 is threaded through to prevent it from becoming detached from pivot pin 74b when the basket (not shown) is articulated, extended, and/or retracted.

[0057] **Fig. 7C** shows a pivot pin 74c with an arch shape through which grasping wire 71 is threaded to prevent grasping wire 71 from becoming detached from pivot pin 74c when the basket (not shown) is articulated, extended, and/or retracted.

[0058] **Fig. 7D** shows a pivot pin 74d having a "j" shape, an angular bend AB, and a head H that has a larger diameter than the body. Pivot pin 74d keeps grasping wire 71 in place when the basket (not shown) is articulated, extended, and/or retracted.

[0059] **Fig. 7E** shows a pivot pin 74e with grasping wire 71 attached to pivot pin 74e by way of soldering.

[0060] **Figs. 8A and 8B** are isometric views of the proximal portion of embodiments of the device. In **Fig. 8A** the articulator 83 of retrieval device 80 has ergonomically-shaped finger grooves 82a, 82b and thumb-hole 87a. The shape provides a comfortable fit for fingers F1, F2 and thumb T. Grasping wires 81a, 81b enter body 87 at sheath connection point 87d, travel through lumen 87b, and connect to pivot pins (now shown). Pivot pin 87c allows articulator 83 to have tilting see-saw movement in order to allow for the basket (not shown) to articulate. Basket (not shown) retraction occurs by moving articulator 83 proximally along longitudinal axis of body 87 which compresses springs 87f. Basket (not shown) extension occurs by releasing articulator 83 which decompresses springs 87f causing articulator 83 to move along body 87.

[0061] **Fig. 8B** shows an alternate configuration of articulator 83 of retrieval device 80. Here, articulator 83 has ergonomically-shaped finger holes 82c, 82d for fingers F1, F2. No springs are needed in this embodiment since finger holes

**82c, 83d** allow the user to pull and push articulator **83** directly thus enabling basket (now shown) retraction and extension.

[0062] **Figs. 9A-9C** are isometric views of grasping wire restraint disks. In **Fig. 9A** the grasping wire restraint disk **96** is shown having four guide holes **96a** for wires in the shape of a cross. Each grasping wire (not shown) is threaded through a single lumen **96a** of grasping wire restraint disk **96**.

[0063] **Fig. 9B** shows a grasping wire restraint disk **96** wherein four lumens are created with circular-shaped openings **96b** cut into grasping wire restraint disk **96** creating four guide holes. Each of grasping wires (not shown) are threaded through a single lumen **96b** of grasping wire restraint disk **96**.

[0064] **Fig. 9c** shows a grasping wire restraint disk **96** wherein grasping wires (not shown) are treaded through a single lumen **96c**.

[0065] **Fig. 10** is an isometric view of an optional sheath for the retrieval device. Here, instead of maintaining grasping wire (not shown) separation by using a grasping wire restraint disk (not shown) the sheath **105** itself has four semi-circular lumens **105a**. A cross section of sheath **105** at line-**10A** is depicted in **Fig. 10A**. Each grasping wire (not shown) are threaded through a lumen **105a** of sheath **105** so that the grasping wires (not shown) do not become tangled and stay separated as they travel through sheath **105**. **Fig. 10B** depicts an alternate configuration of circular-grasping wire lumens **105b** built into sheath **105**. **Fig. 10C** depicts an alternate configuration of a single circular grasping wire lumen **105c** built into sheath **105**.

[0066] **Fig. 11** is a close-up view of the distal portion **110b** of an embodiment of retrieval device **110**. Here, grasping wires **111a, 111b** are connected at grasping wire connection point **118** via a soldered point in order to form the top of basket **B**.

[0067] **Fig. 12** is a view of the distal portion **120b** of retrieval device **120**. Here, grasping wires **121a, 121b**, are connected at grasping wire connection point **128** via a grasping wire connection disk **128a** in order to form the top of basket **B**. Grasping wire connection disk **128a** can be made from many materials including polycarbonates, stainless steel, nylon, and polymers. Grasping wire connection



disk **128a** contains four holes **128b** through which grasping wires **121a**, **121b** are threaded.

[0068] **Fig. 13** is a view of the distal portion **130b** of retrieval device **130**.

Here, grasping wires **131a**, **131b** are connected at grasping wire connection point **138** via a loop-in-loop configuration in order to form the top of basket **B**.

[0069] **Fig. 14A** is a perspective view of the distal portion of retrieval device **140**. Each grasping wire **141a**, **141b** is connected at a soldered grasping wire connection point **148** and then threaded into sheath **145**. The net configuration of grasping wires **141a**, **141b** may enable better retrieval of smaller stones or calculi that could slip between the wires if there were no net.

[0070] **Figs. 14B-14D** are frontal views of retrieval device embodiments **140**, **180**, **190**. Each show grasping wire **141a**, **141b** connected at a soldered grasping wire connection point **148**. Each figure depicts a different net-configuration of wire fibers **141c**, **141d**, **141e**. Wire fiber **141c**, **141d**, **141e** configurations are not limited to those depicted. Depending on the shape of the object to be retrieved, different wire fiber **141c**, **141d**, **141e** configurations may result in a better retrieval success rate of smaller stones (not shown), calculi (not shown), or other objects (not shown).

[0071] **Figs. 15-17** depict different views of another embodiment of the device. **Fig. 15** is a side-view of a retrieval device **150** having a proximal portion **150a** and a distal portion **150b**. **Fig. 16** is a partial cross-sectional view of retrieval device **150**. **Fig. 17** is an exploded view of articulator **162**.

[0072] Body **157**, and the components housed therein including an articulator **162** and a slide assembly **161** depicted in **Figs. 16-17**, can be made from many materials, including but not limited to, rigid nylon, stainless steel, acrylonitrile-butadiene-styrene (ABS) and other medically acceptable polymers and metals. Body **157** is preferably a snap-fit housing consisting of two pieces that house that components depicted in **Figs. 16-17**.

[0073] Distal portion of grasping wires come together to form a basket (not shown). Each of grasping wires **151a** and **151b** is disposed through optional sheath **105** and is connected to a wire pivot **153a**, **153b** respectively. Wire pivots



**153a, 153b** each have a male thread **155a, 155b**, respectively, that engages with female thread **156a, 156b**, respectively, located on articulator drum **160**. Articulator drum **160** has a post **159** disposed therethrough. Articulator drum **160** is rotateably attached to slide assembly **161** which is slideably attached to body **157** and is held in place by each of anchors **158a, 158b** that are fixedly attached to post **159** and rotateably attached to body **157**. Tilting lever **154** from side to side causes post **159** and articulator drum **160** to rotate in the direction that lever **154** is pushed. Rotation of the drum **160** is not limited to use of lever **154**; the device can also be driven by a gear set, a wheel, or any device capable of causing rotation. As articulator drum **160** is rotated, wire pivots **153a, 153b** move opposite each other in the proximal **150a** or distal **150b** direction causing each of wires **151a, 151b** to move in the direction that wire pivots **153a, 153b** move; accordingly, this movement causes the basket to articulate from side to side. Pulling slide **152** in the proximal direction **150a** causes the basket to retract because articulator drum **160** and its component wire pivots **153a, 153b** and grasping wires **151a, 151b** are moved in the proximal direction. Pushing slide **152** in the distal direction **150b** causes the basket to extend because articulator drum **160** and its component wire pivots **153a, 153b** and grasping wires **151a, 151b** are moved in the distal direction. In addition, the basket can be articulated by tilting lever **154** with finger **F1** and simultaneously retracted or extended by moving slide **152** in the proximal **150a** or distal **150b** direction with thumb **T**. The embodiments described are not limited to the specific component parts herein named. For example the articulating components could be made from a series of gears and/or wheels that are configured to articulate a basket. Additionally, not all component parts are necessary, nor is it required that the component parts be assembled in an identical fashion. For example, the locations of lever **154** and slide **152** are not limited to that which is shown; both may be placed in alternate locations including the side of the retrieval device as depicted in **Fig. 18**, retrieval device **170**. Additionally, wire pivots **153a, 153b** may be configured so as to move along the same female thread **156a**, as depicted in **Fig. 18**.

[0074] To use a retrieval device having an articulating basket for removing an object from a patient that is configured for simultaneous basket extension or basket retraction, the basket is inserted into the patient and is moved near an item to be removed from a patient, i.e. a calculus, stone, etc. The basket is extended out to the object to be removed. The object to be removed is captured by simultaneously articulating the basket while extending or retracting the basket until the object is captured. The basket is then retracted and the device and object are removed from the patient.

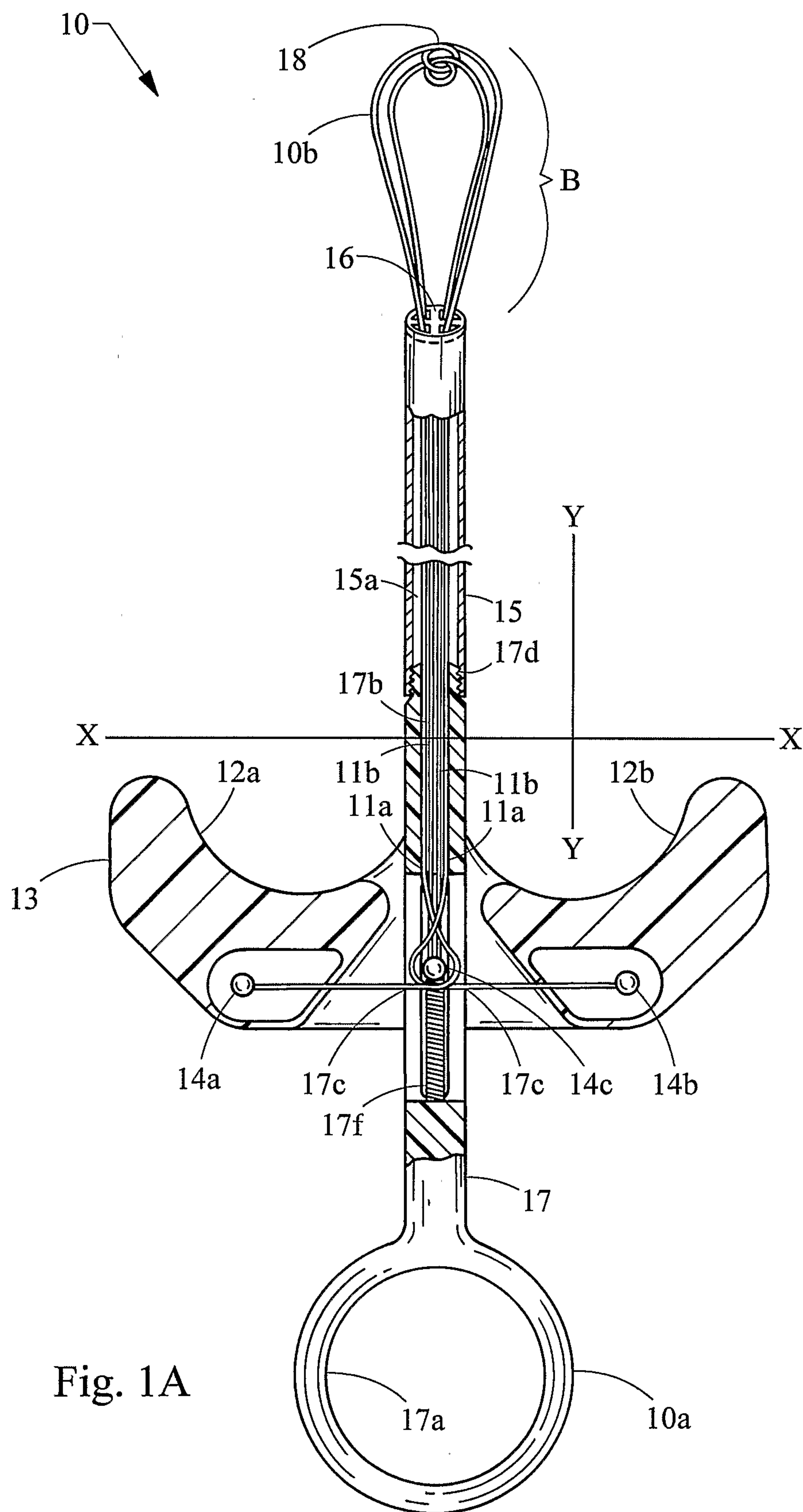
[0075] As is evident, the embodiments provide a very effective solution for removal of stones, calculi, or other objects from a patient by a device that allows for simultaneous basket articulation and extension, and also provides for simultaneous basket articulation and retraction.

[0076] The scope of the claims should not be limited by the preferred embodiments set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole.

What is claimed is:

1. A retrieval device, the device comprising:  
a tool formed by a first and a second wire; and  
means for extending or retracting the tool and simultaneously articulating the tool in a plane outside a longitudinal plane, wherein the means for articulating the tool comprises a first wire pivot and a second wire pivot, wherein the first wire pivot and the second wire pivot are attached to an articulator drum, wherein the articulator drum includes a means for facilitating guided movement of the first wire pivot and the second wire pivot across a surface of the articulator drum, wherein the first wire pivot is threadily attached to the first wire, and the second wire pivot is threadily attached to the second wire, wherein the first wire pivot is positioned proximal to the second wire pivot, and wherein the first wire pivot is fixedly attached to the first wire, and the second wire pivot is fixedly attached to the second wire.
2. The device according to Claim 1, wherein the means for extending the tool comprises a slide assembly.
3. The device according to Claim 1, wherein the tool is a basket, a grasping device, or a sampling device.
4. The device according to Claim 1, wherein the means for articulating the tool comprises an articulator.





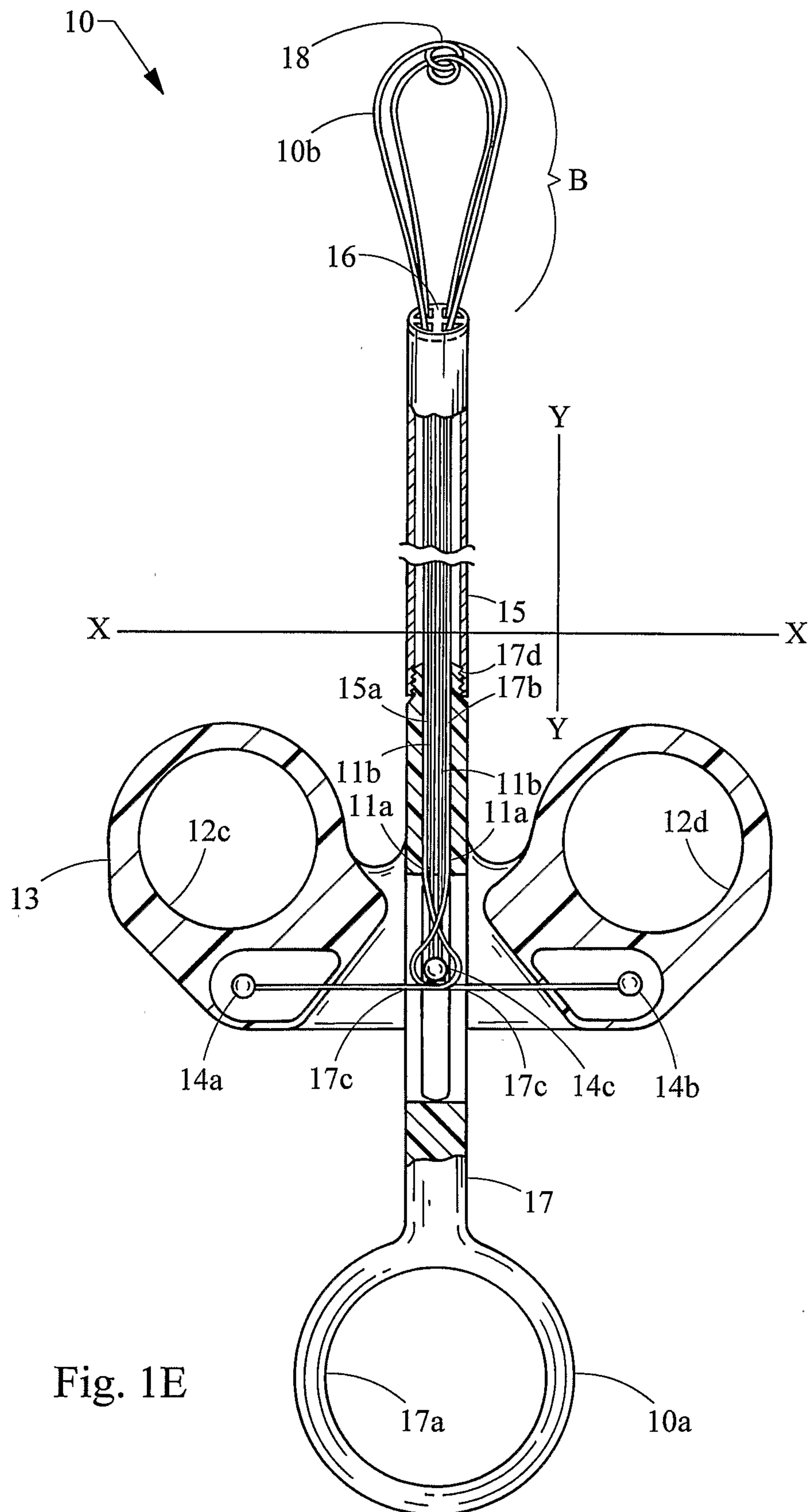


Fig. 1E



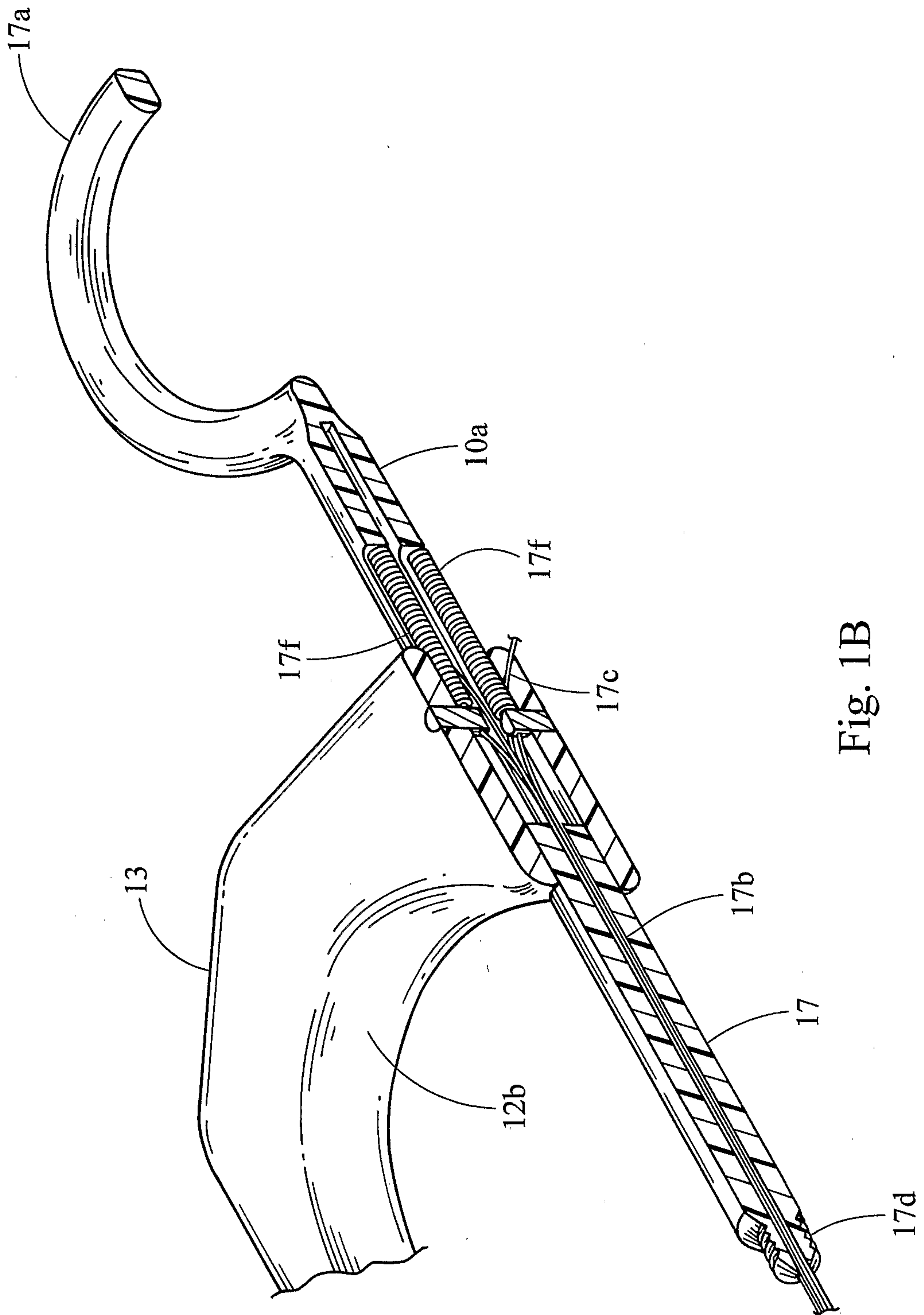


Fig. 1B

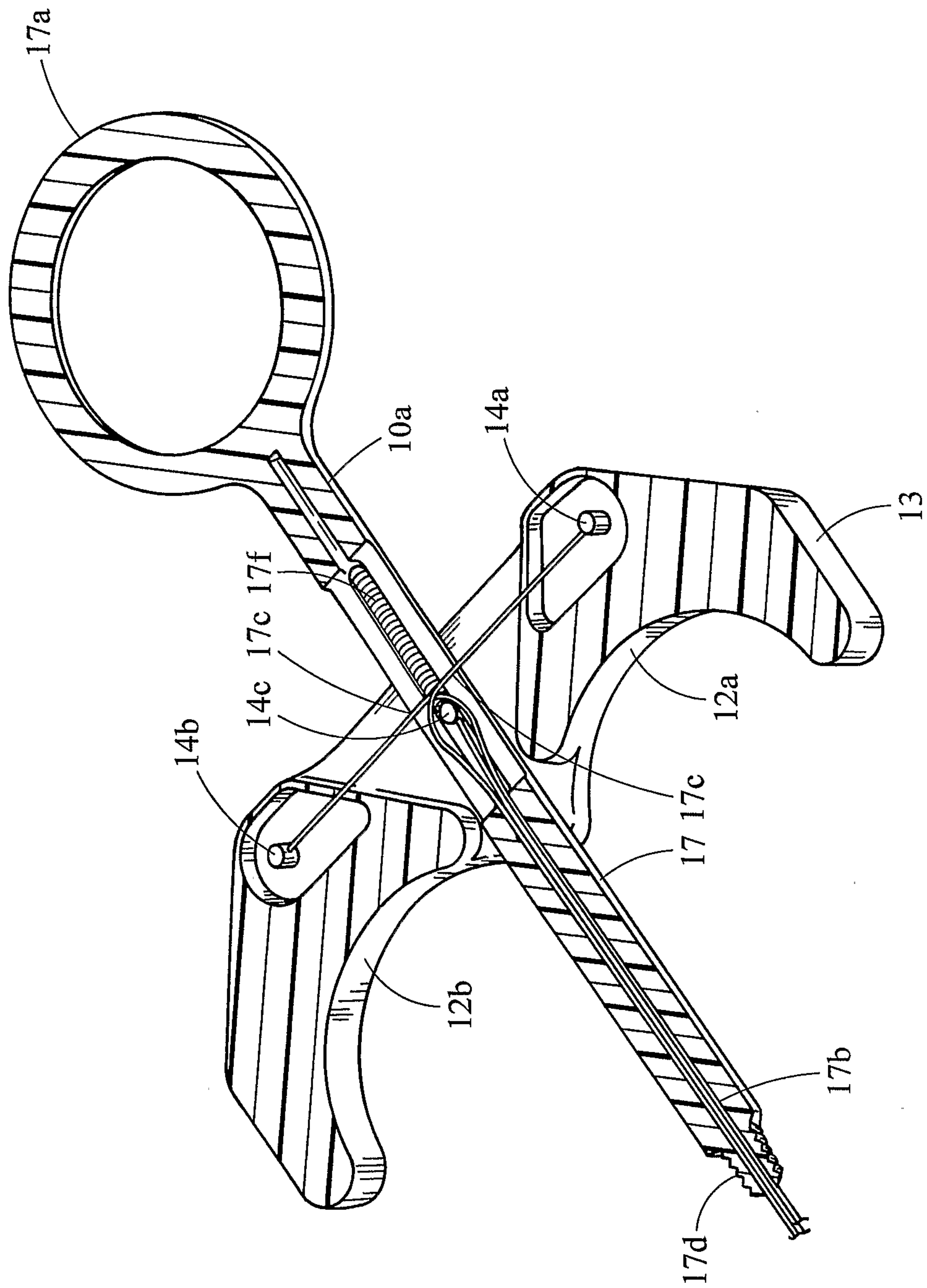


Fig. 1C



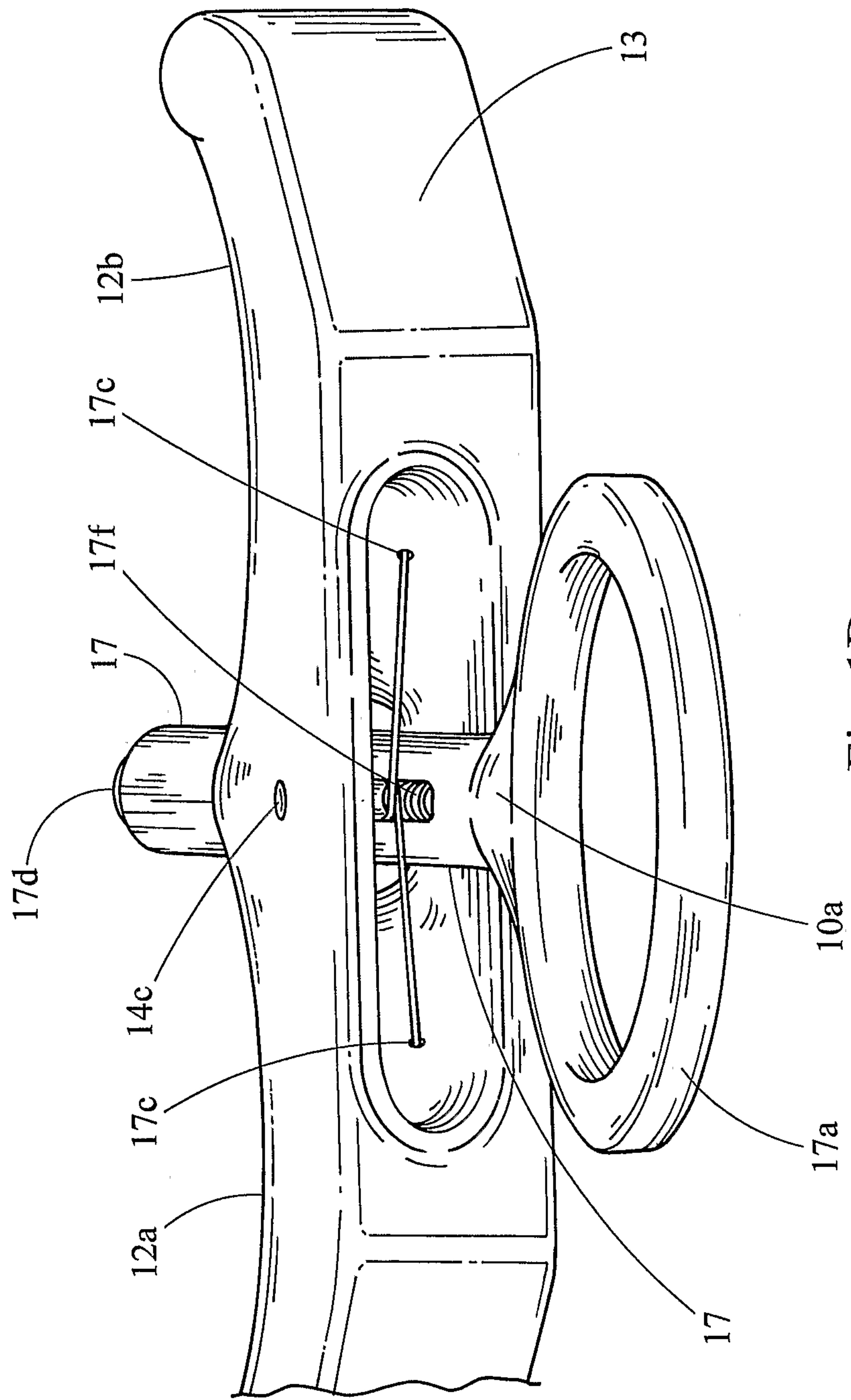


Fig. 1D

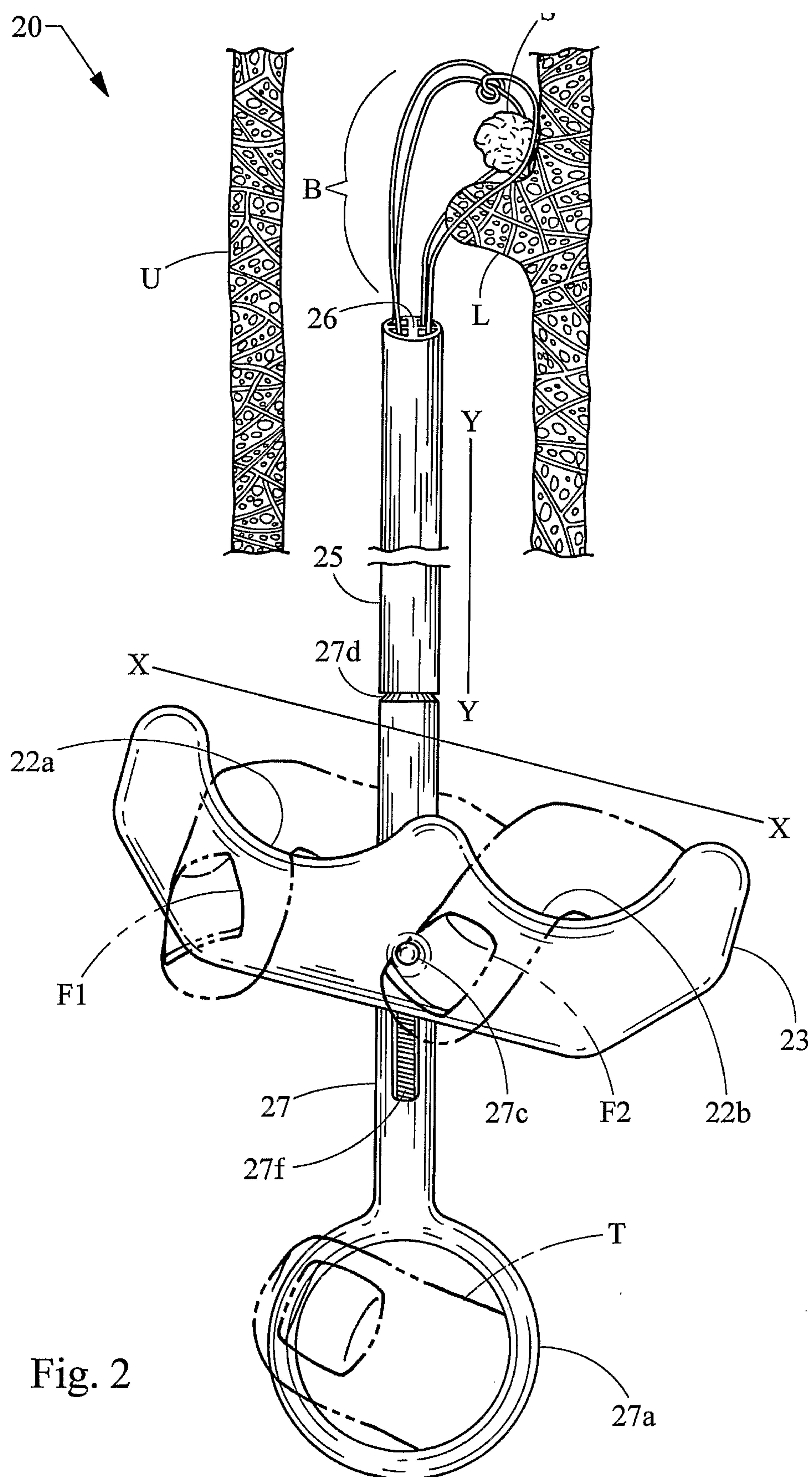


Fig. 2



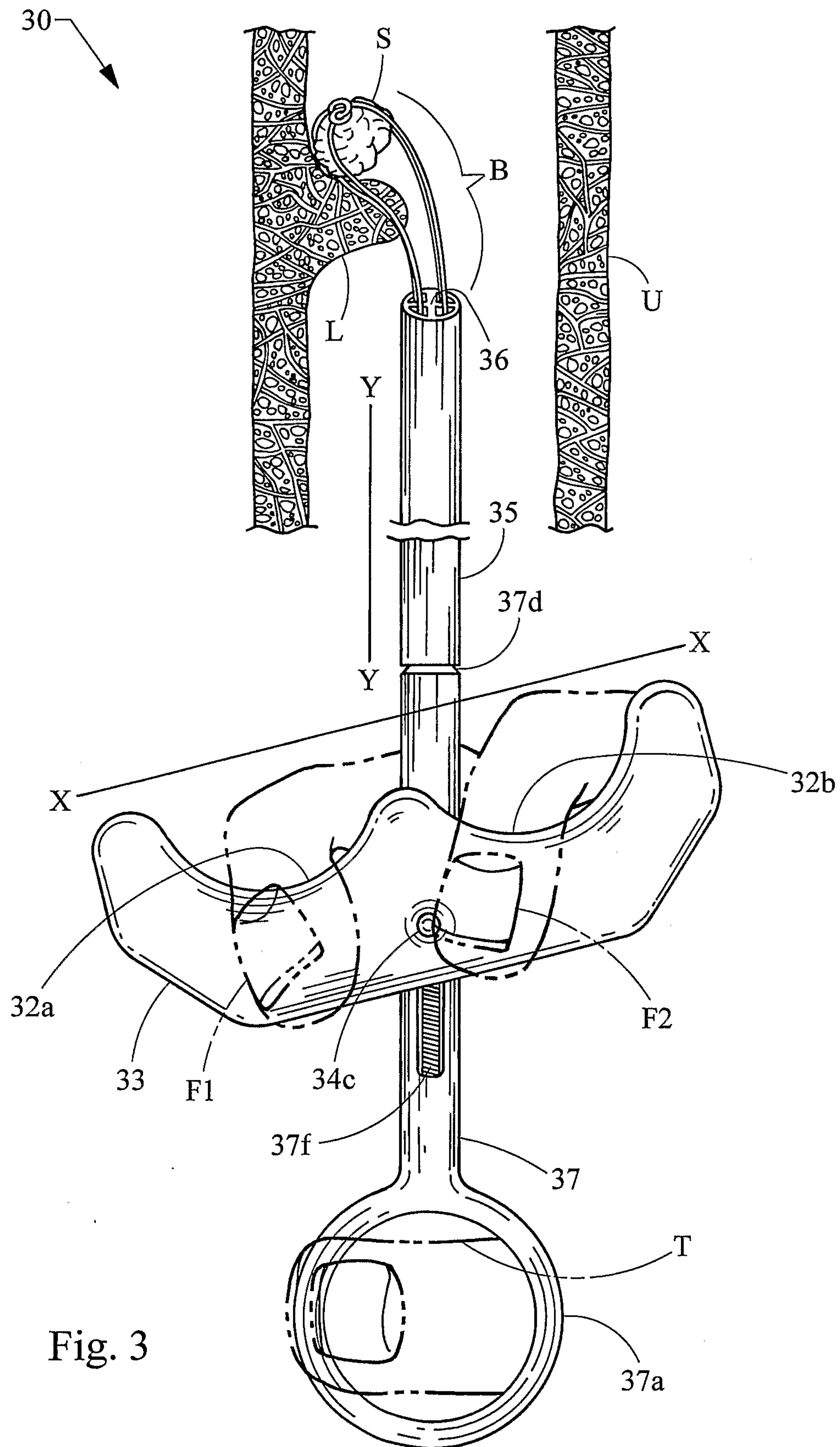
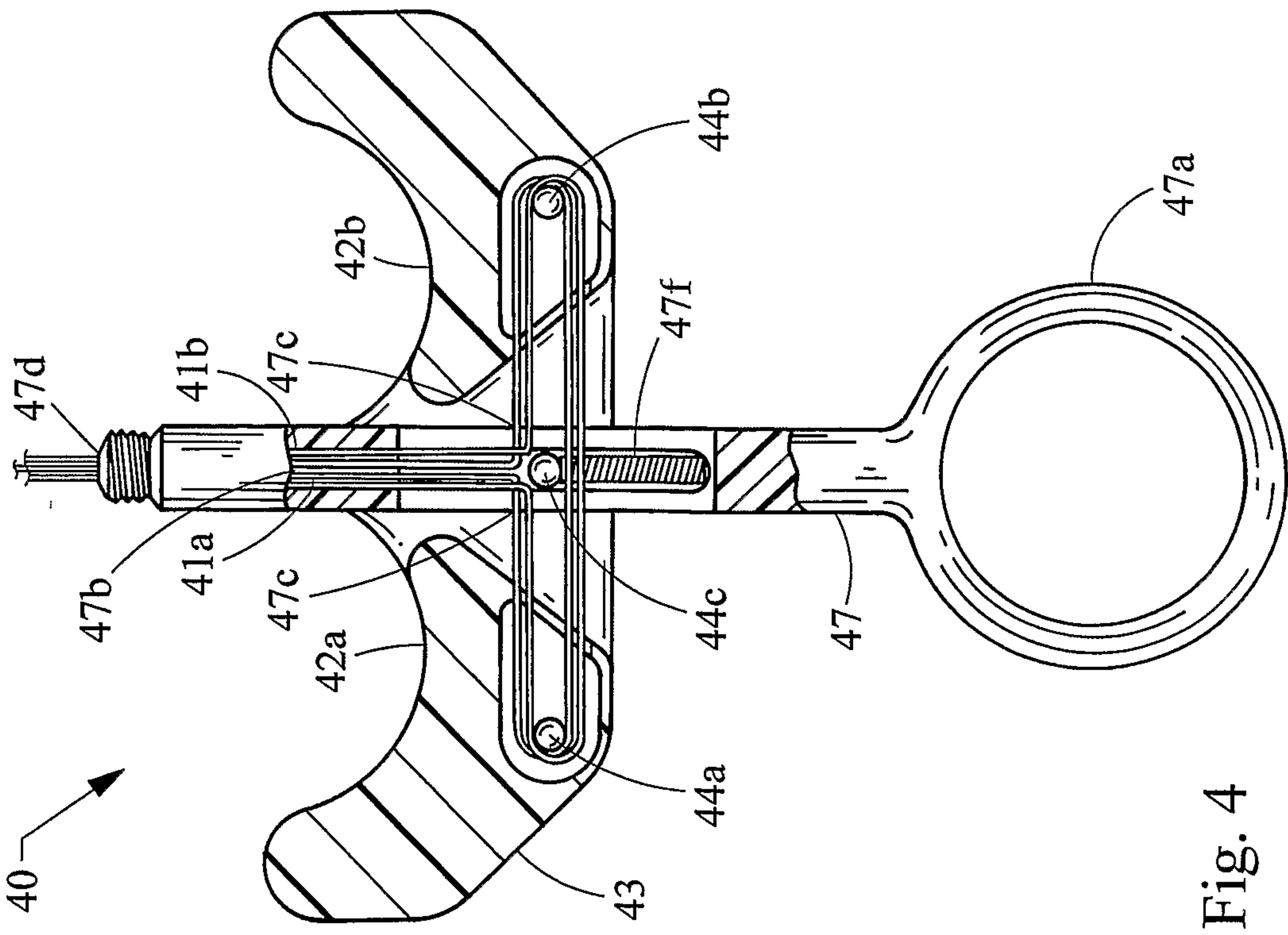
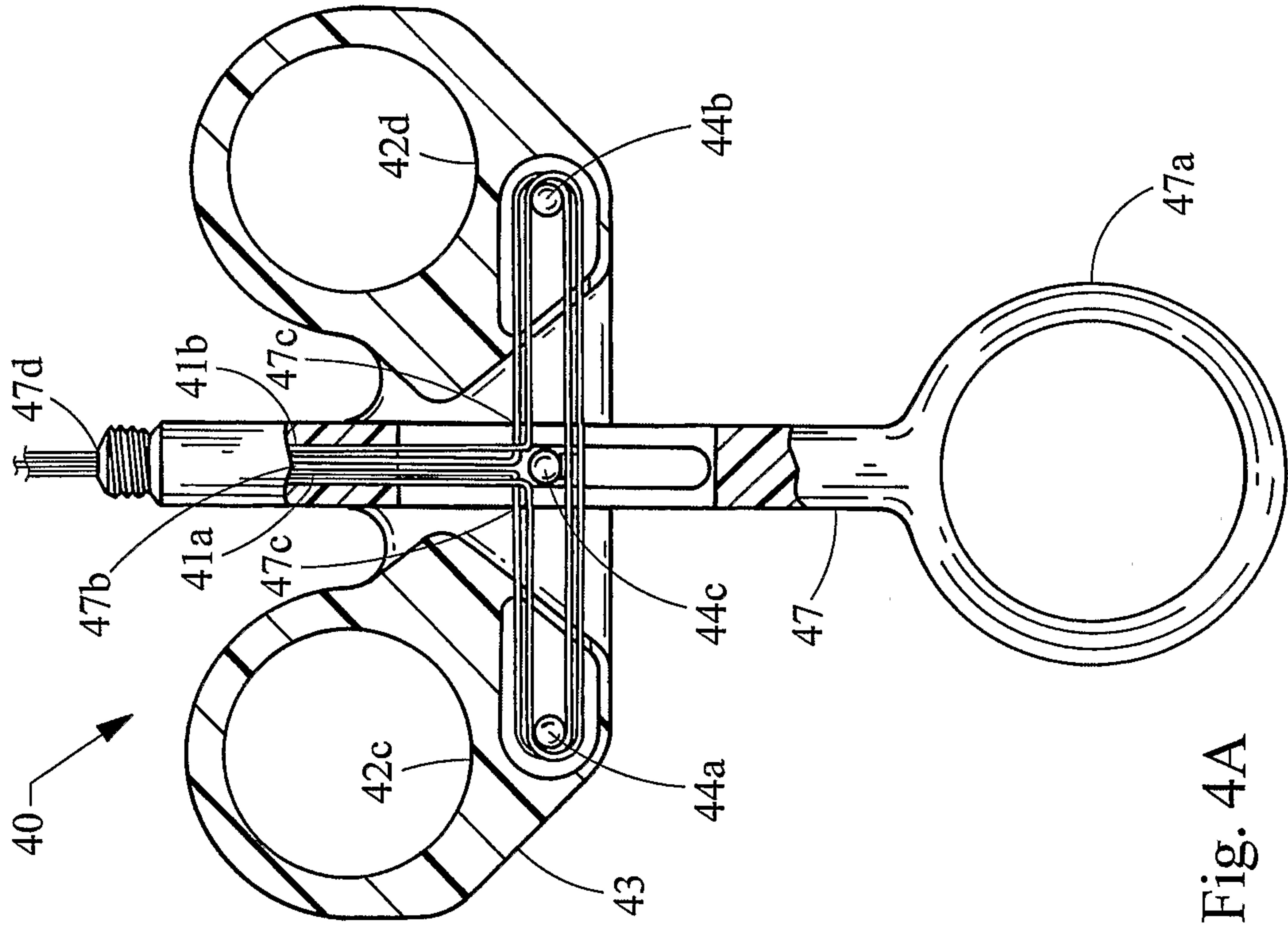
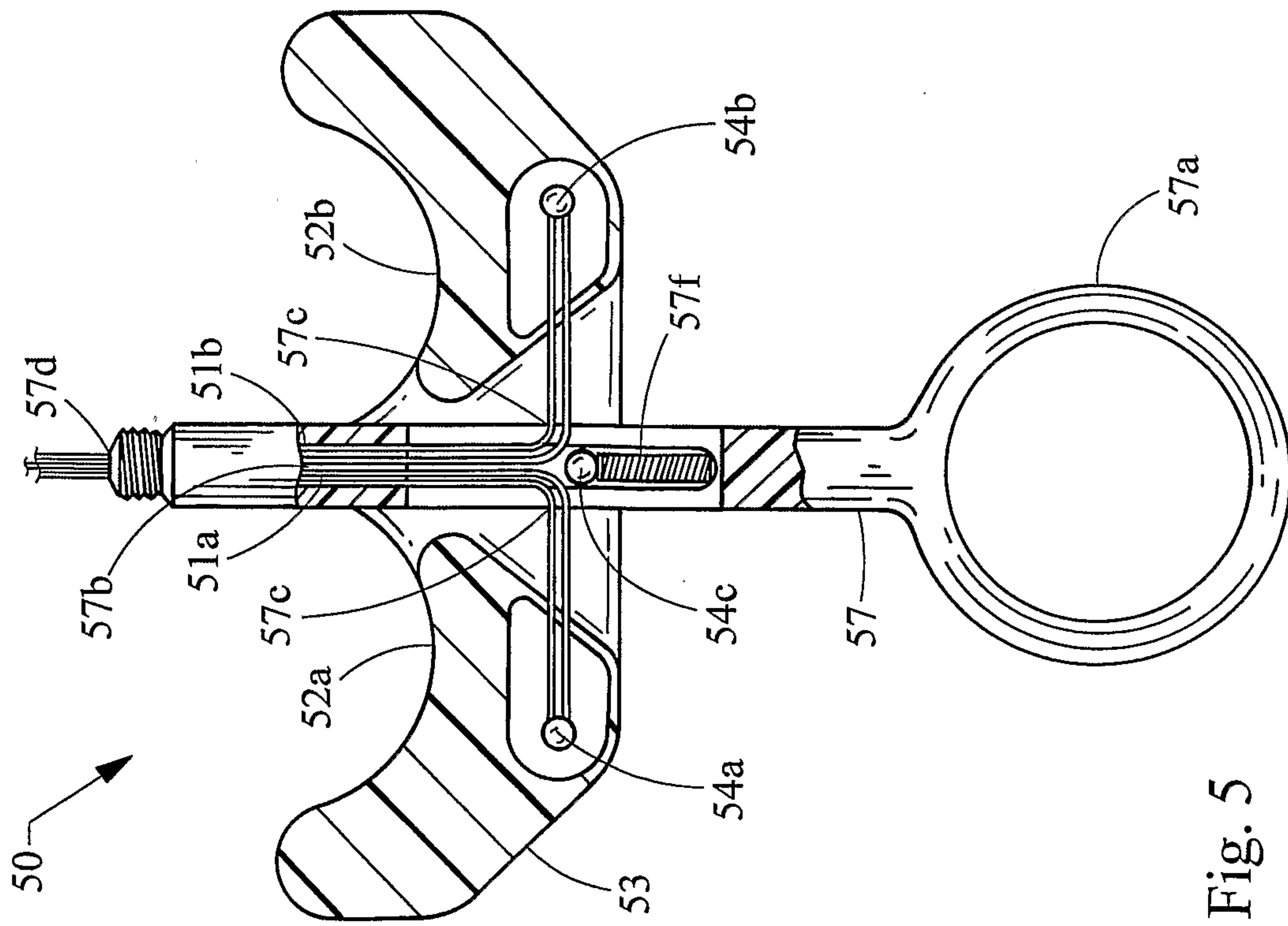
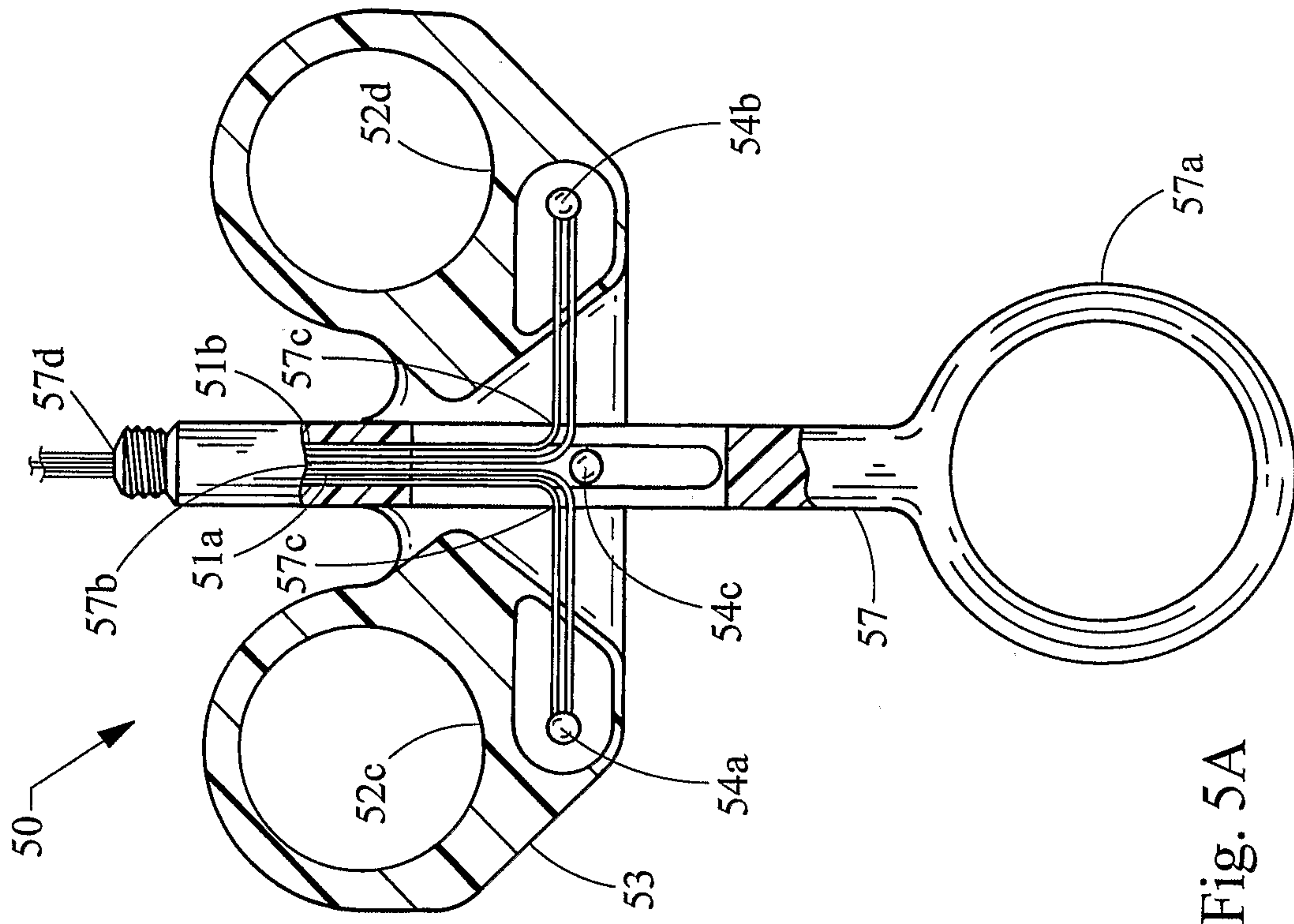
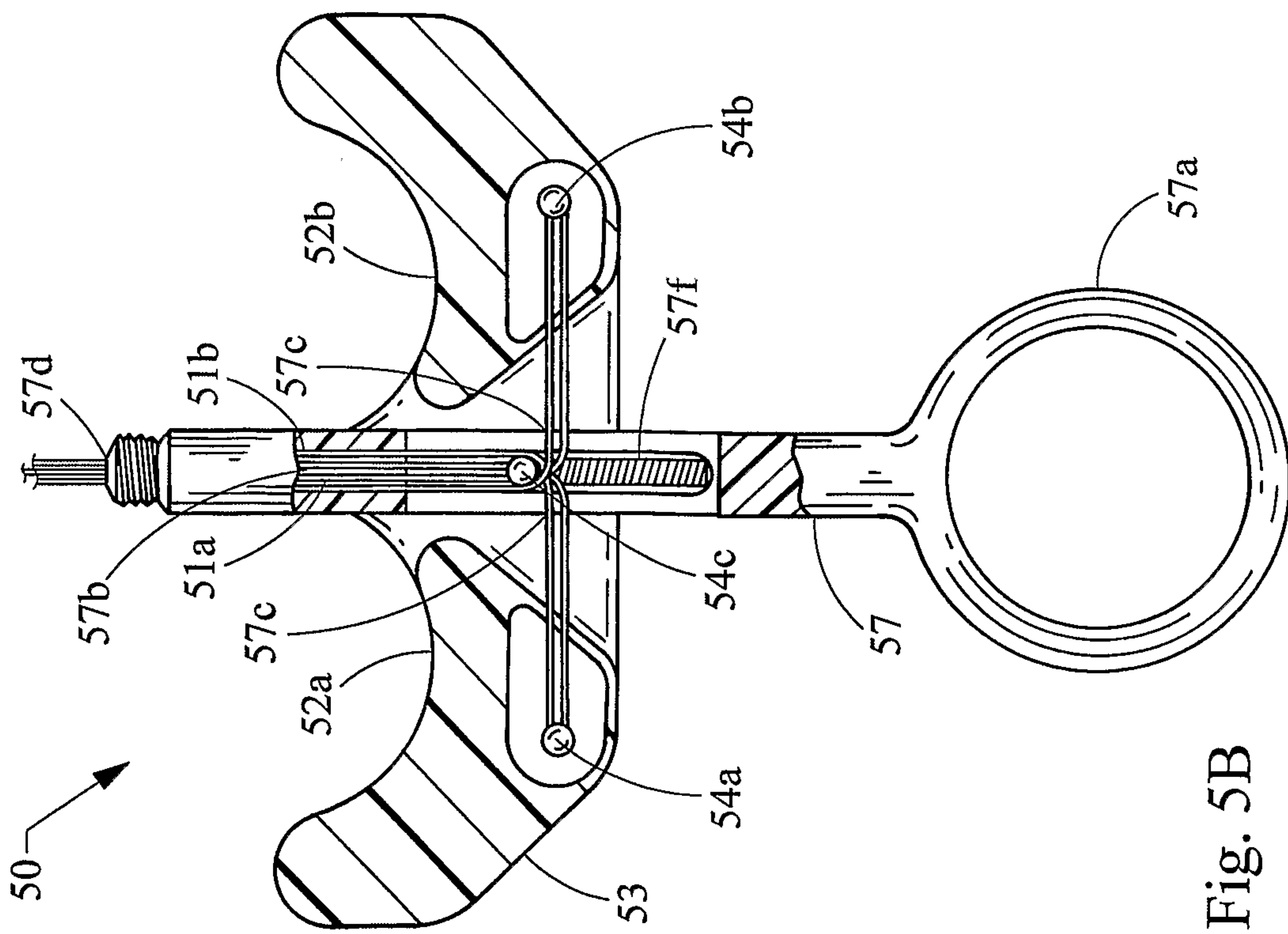
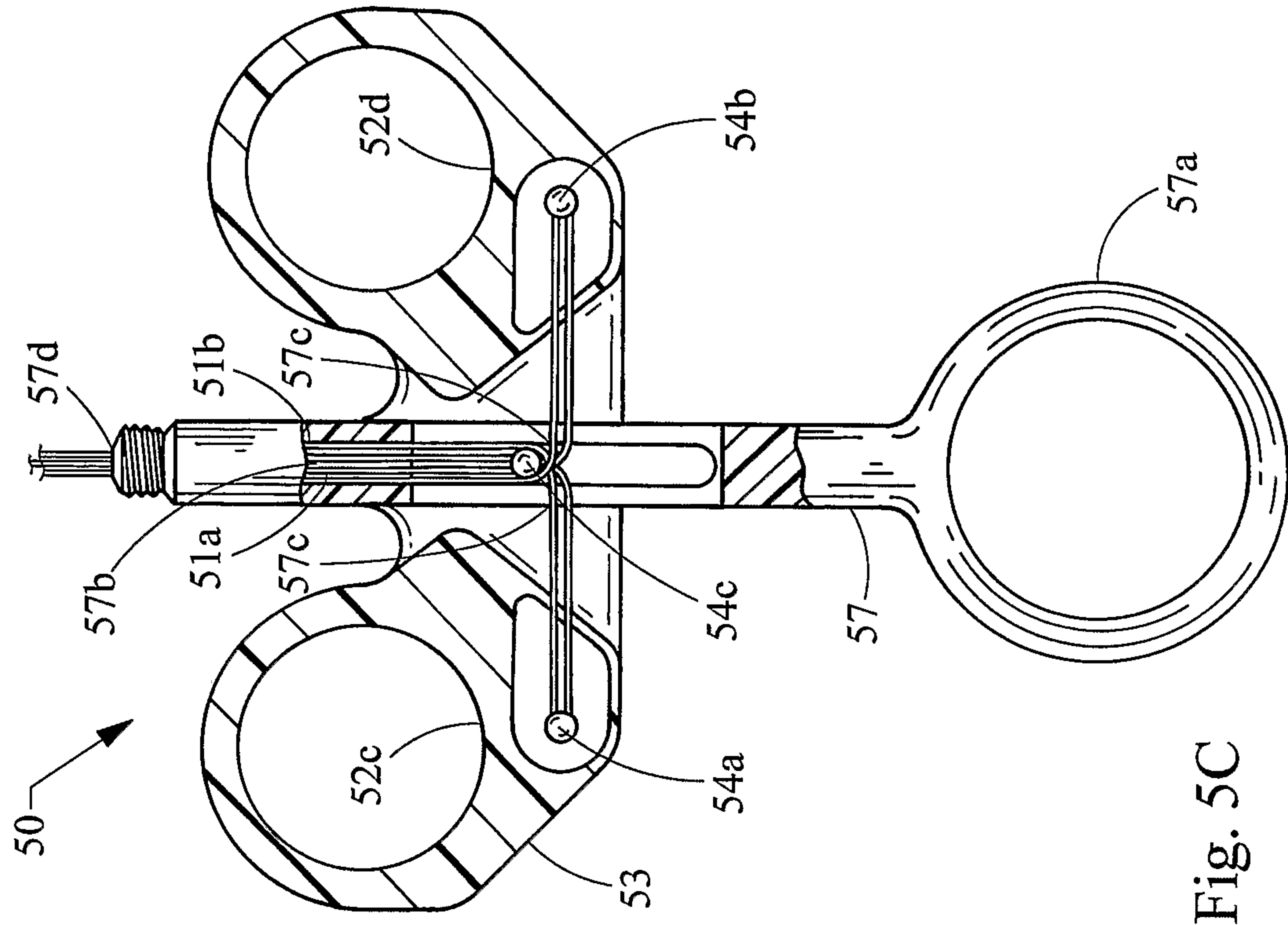


Fig. 3











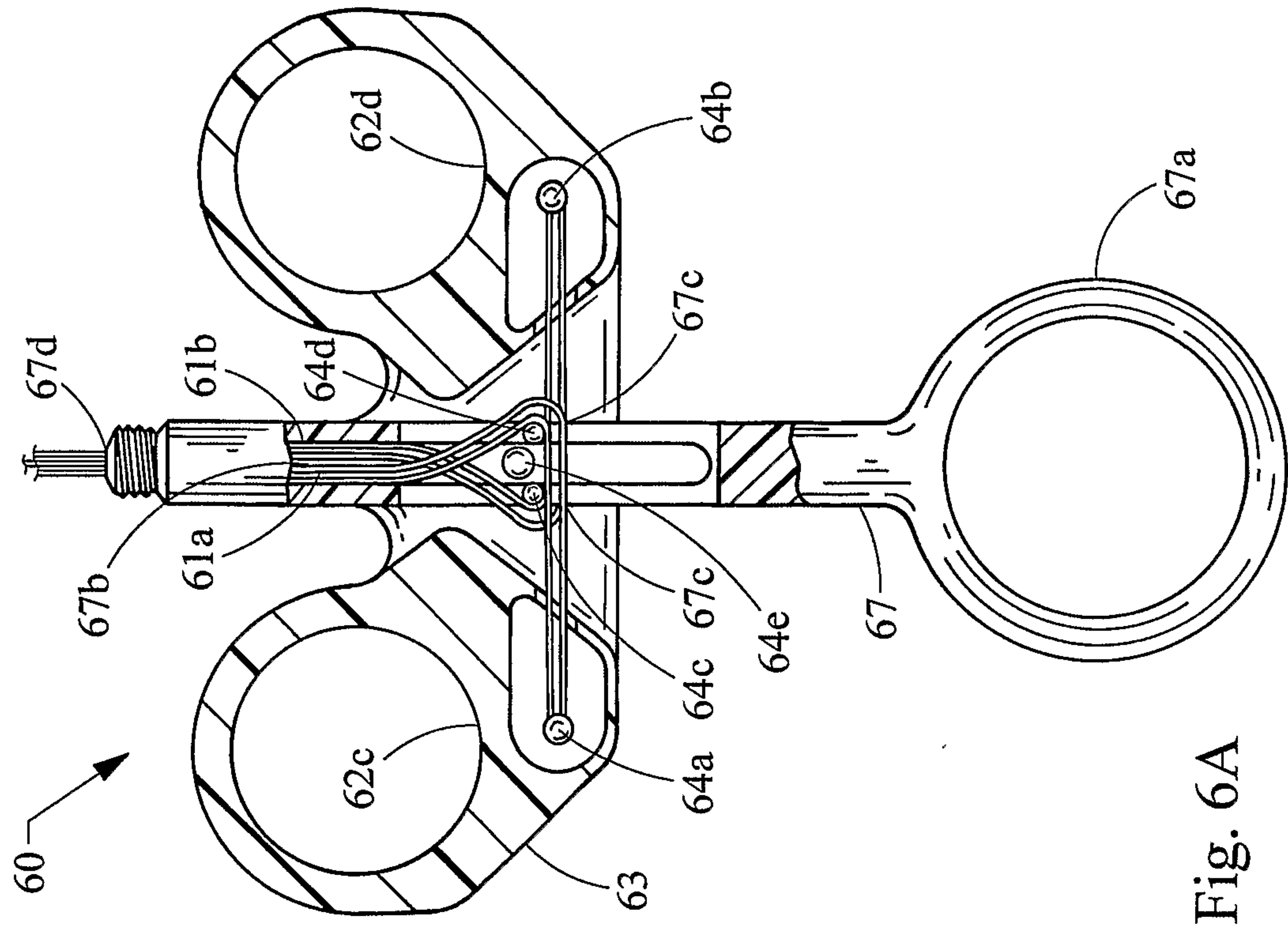


Fig. 6A

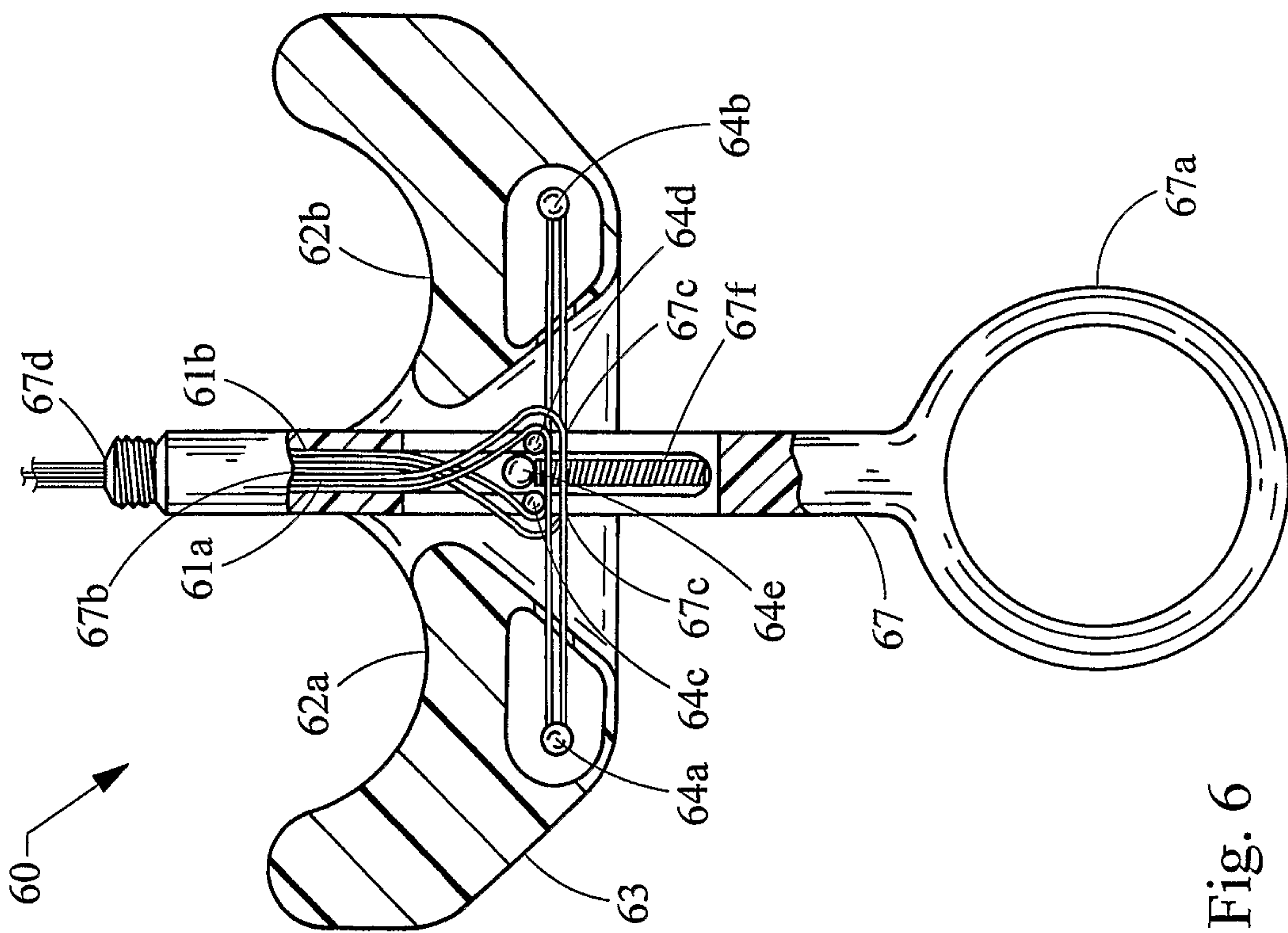


Fig. 6

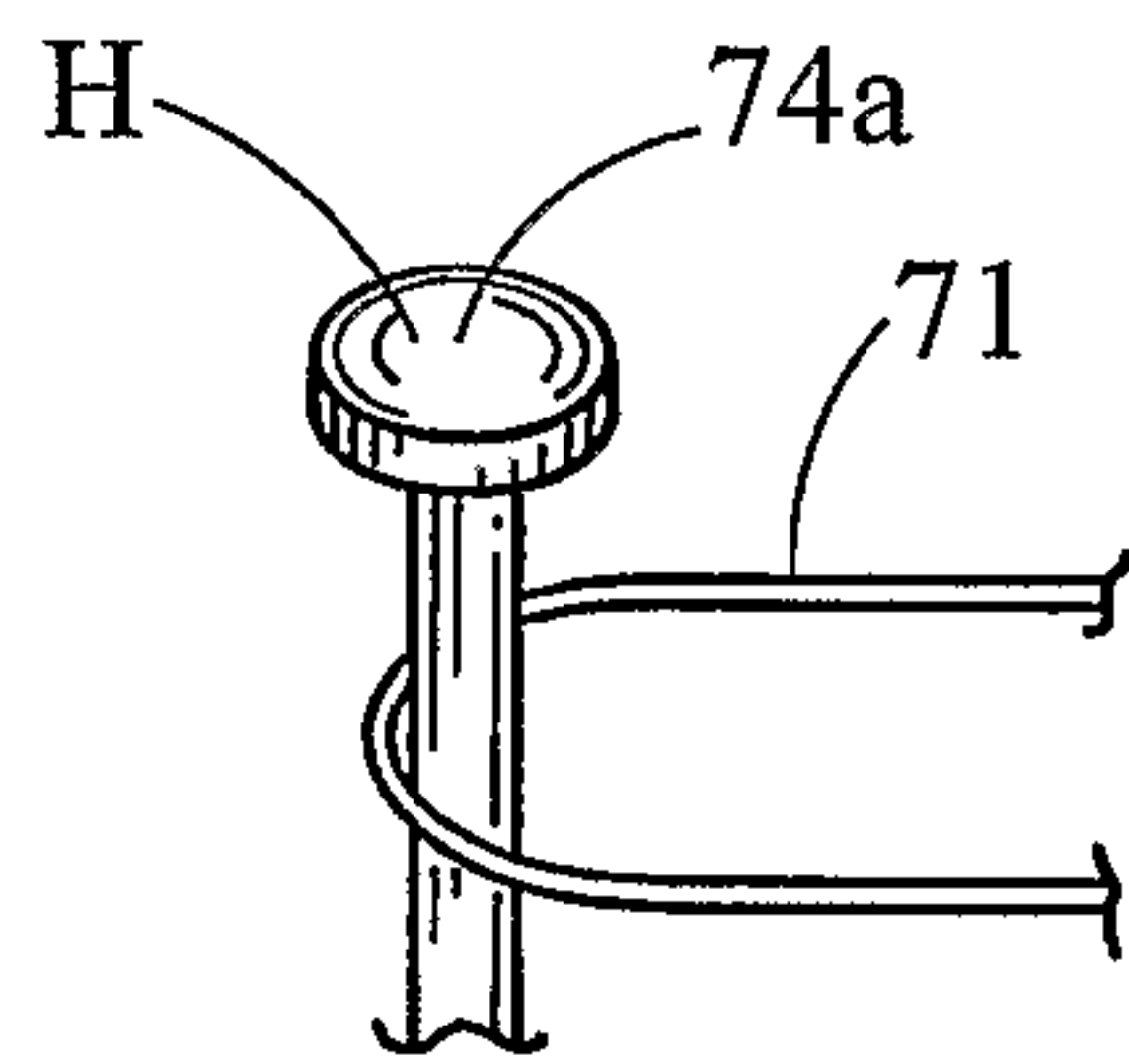


Fig. 7A

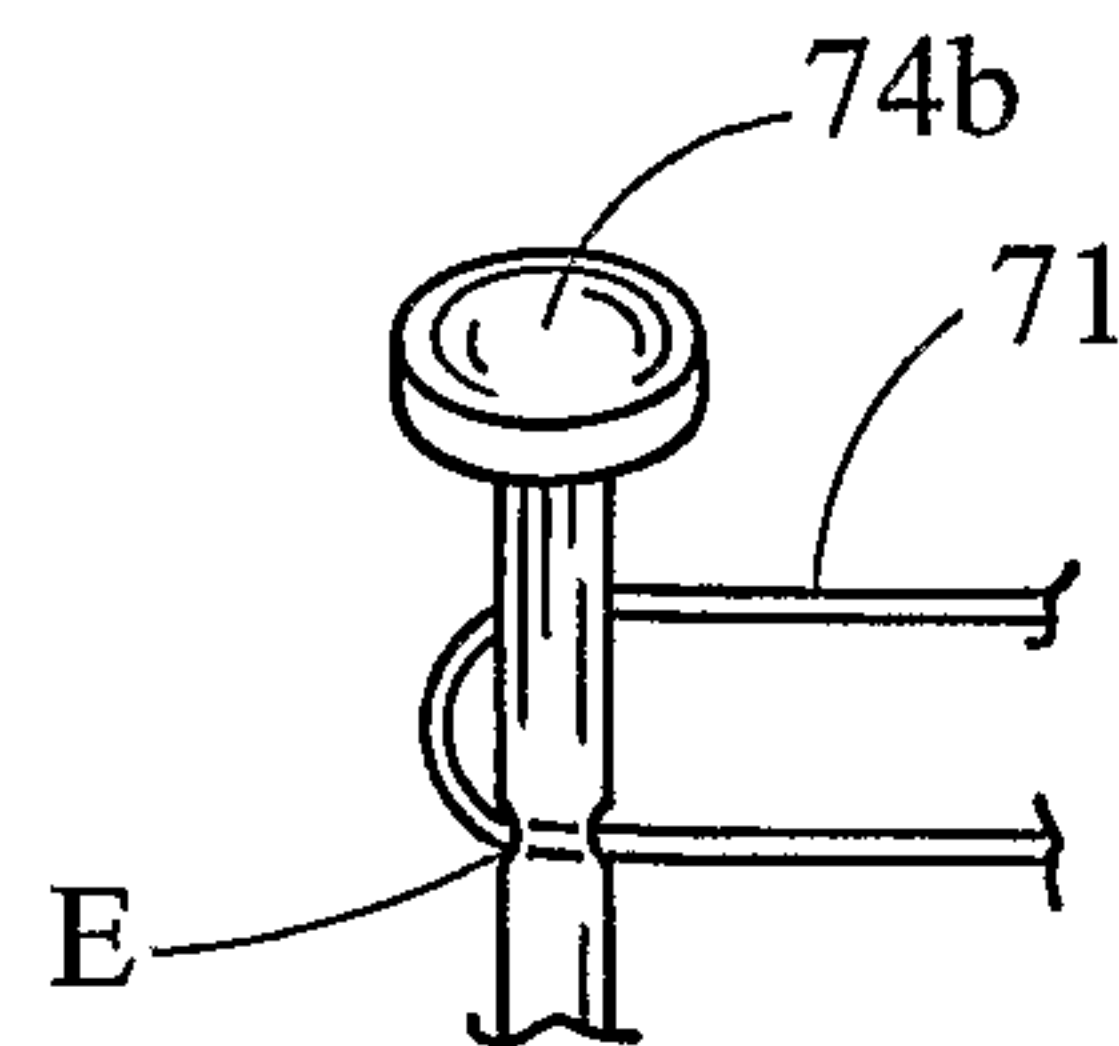


Fig. 7B

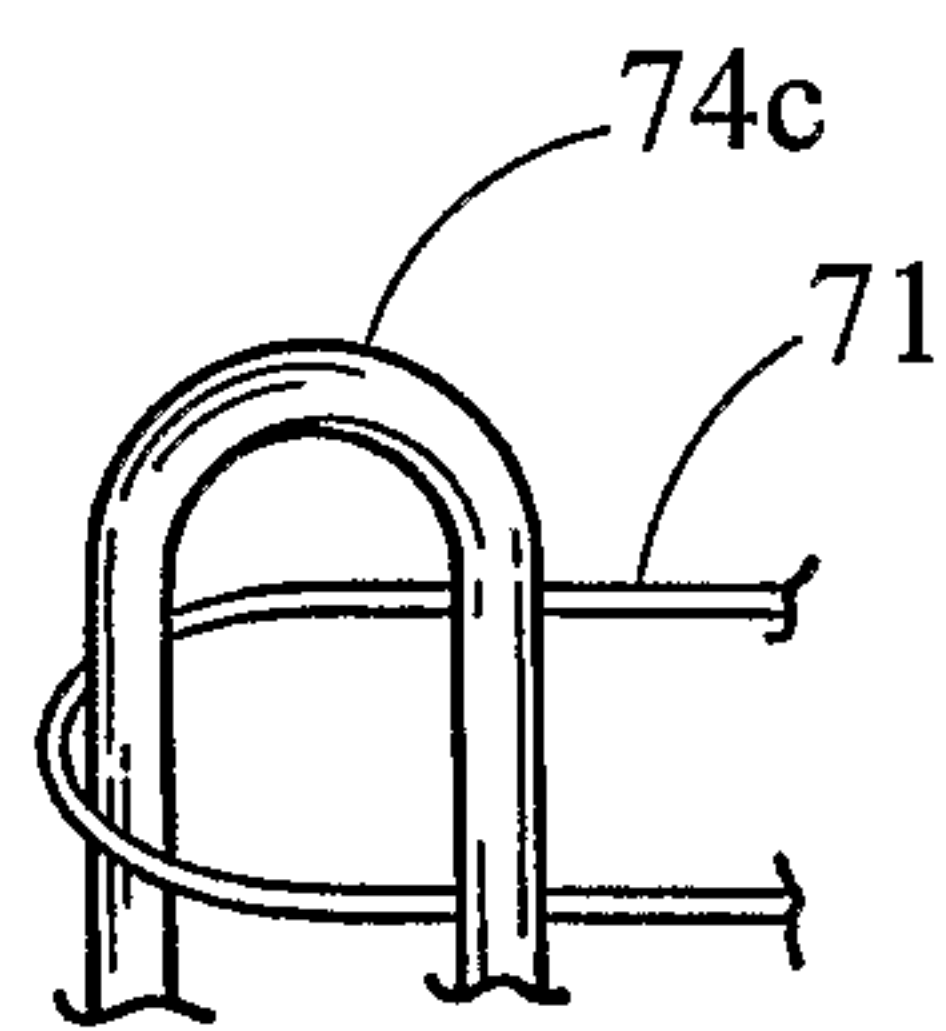


Fig. 7C

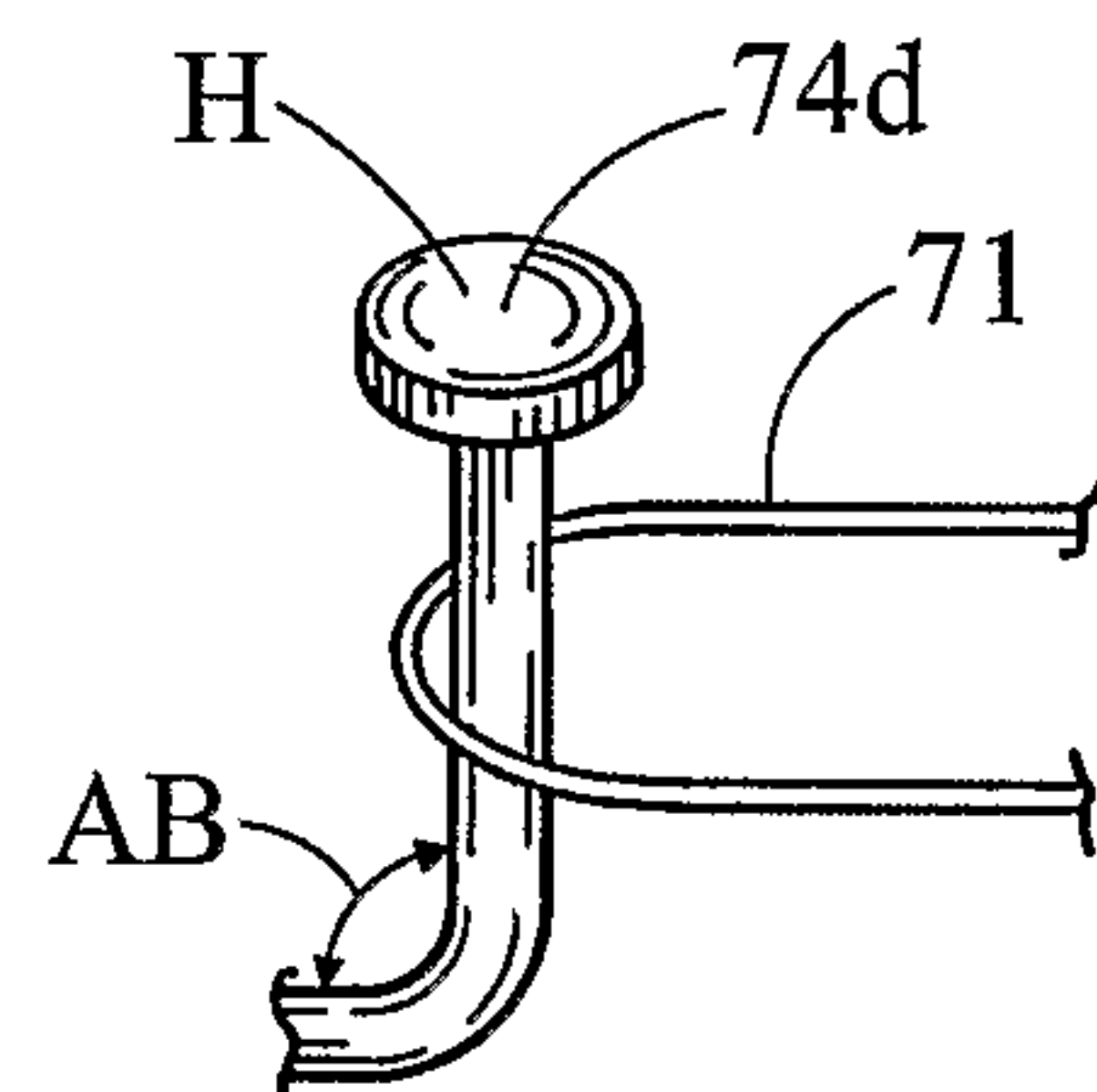


Fig. 7D

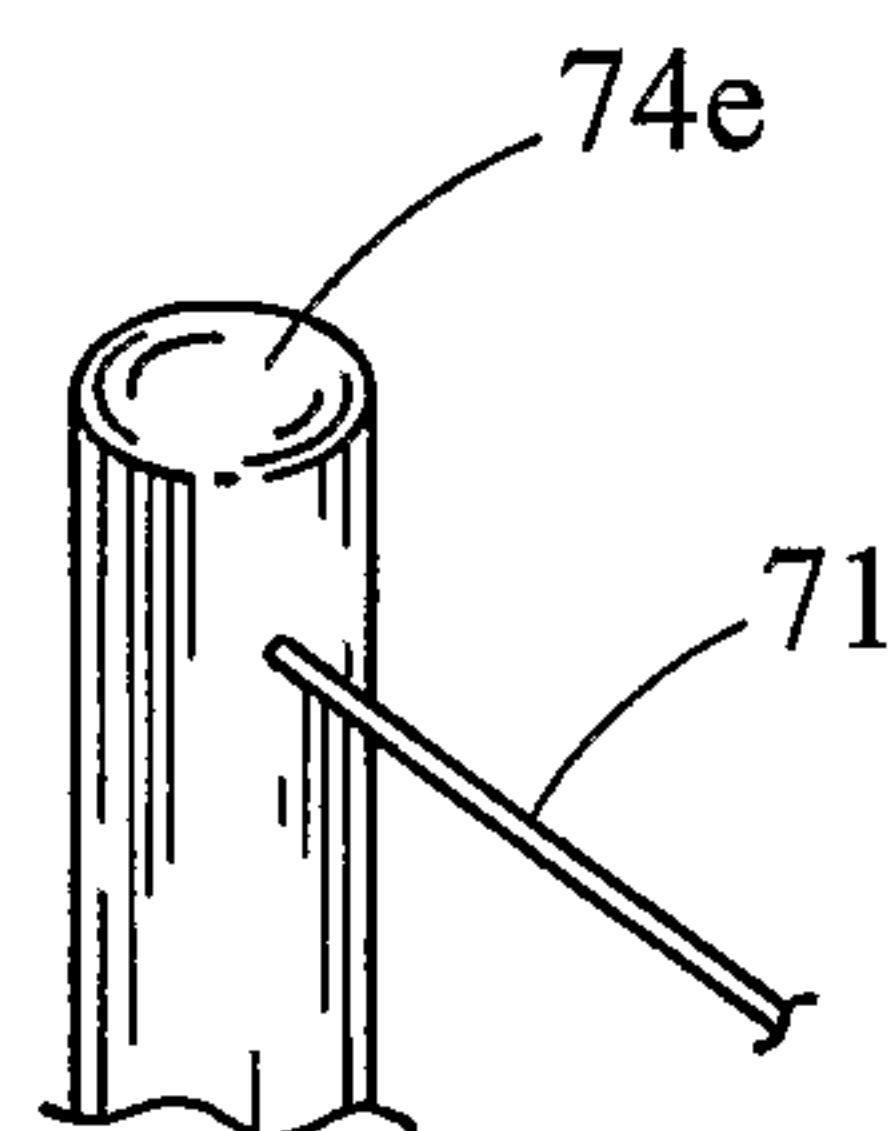


Fig. 7E





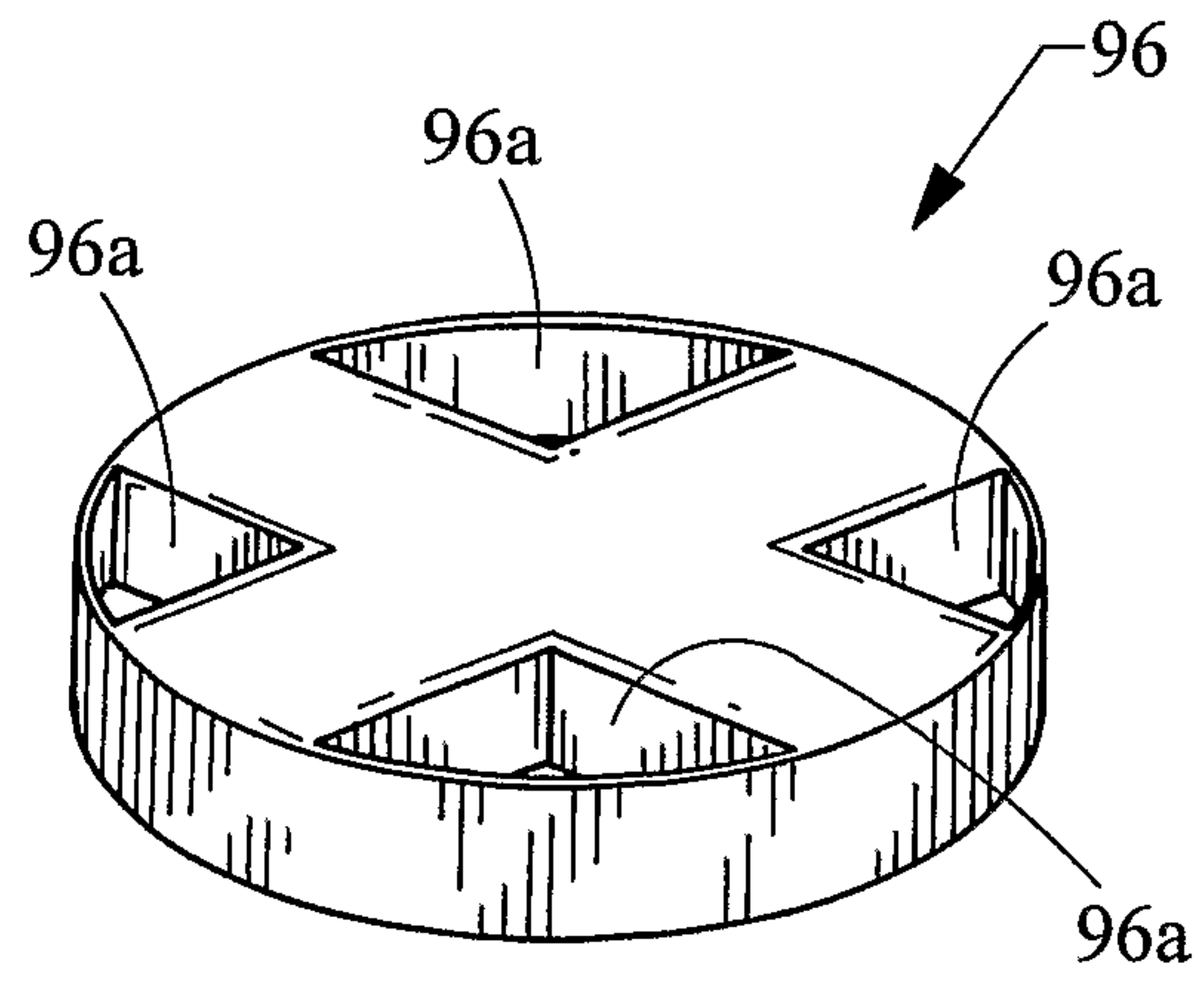


Fig. 9A

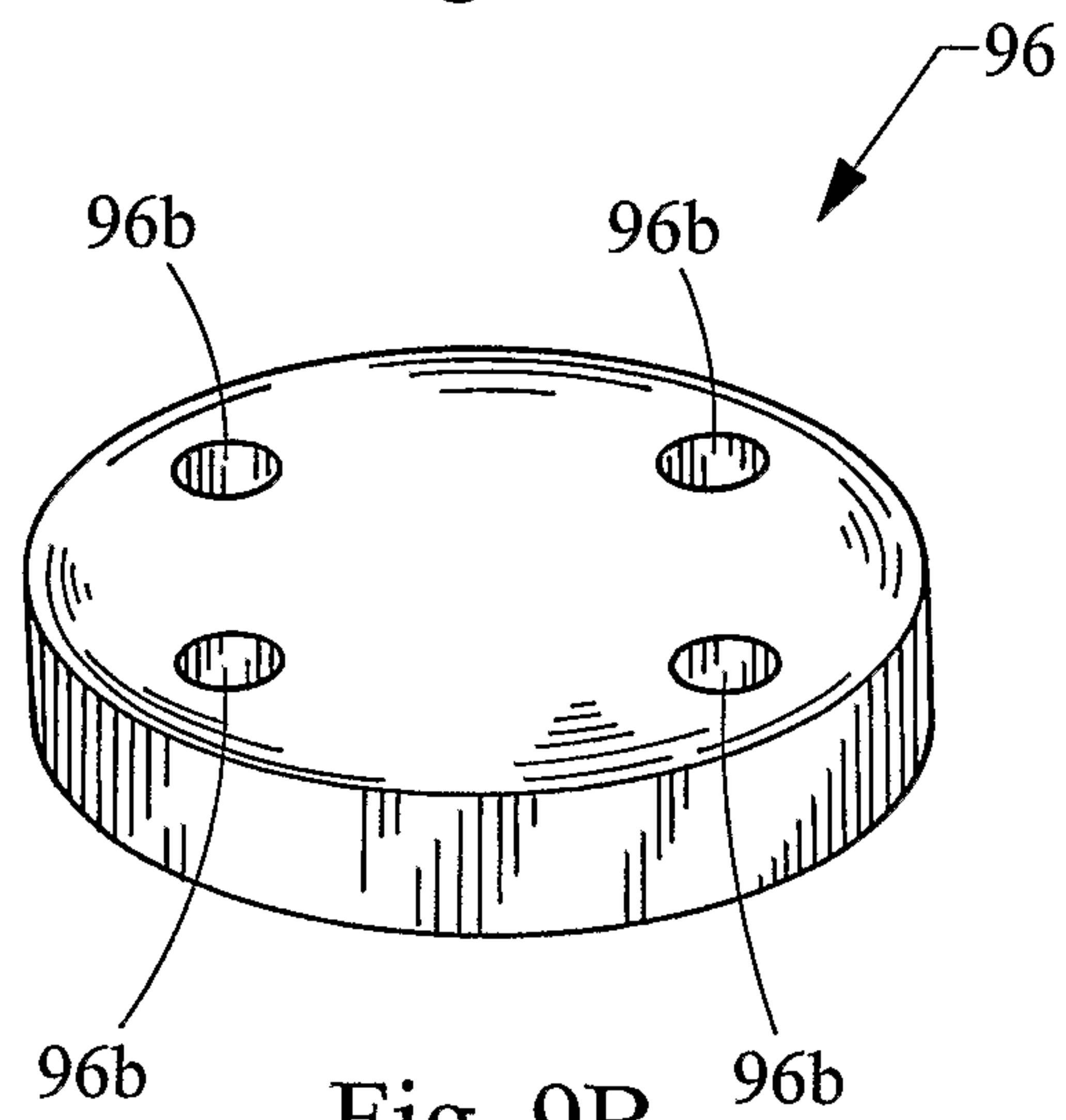


Fig. 9B

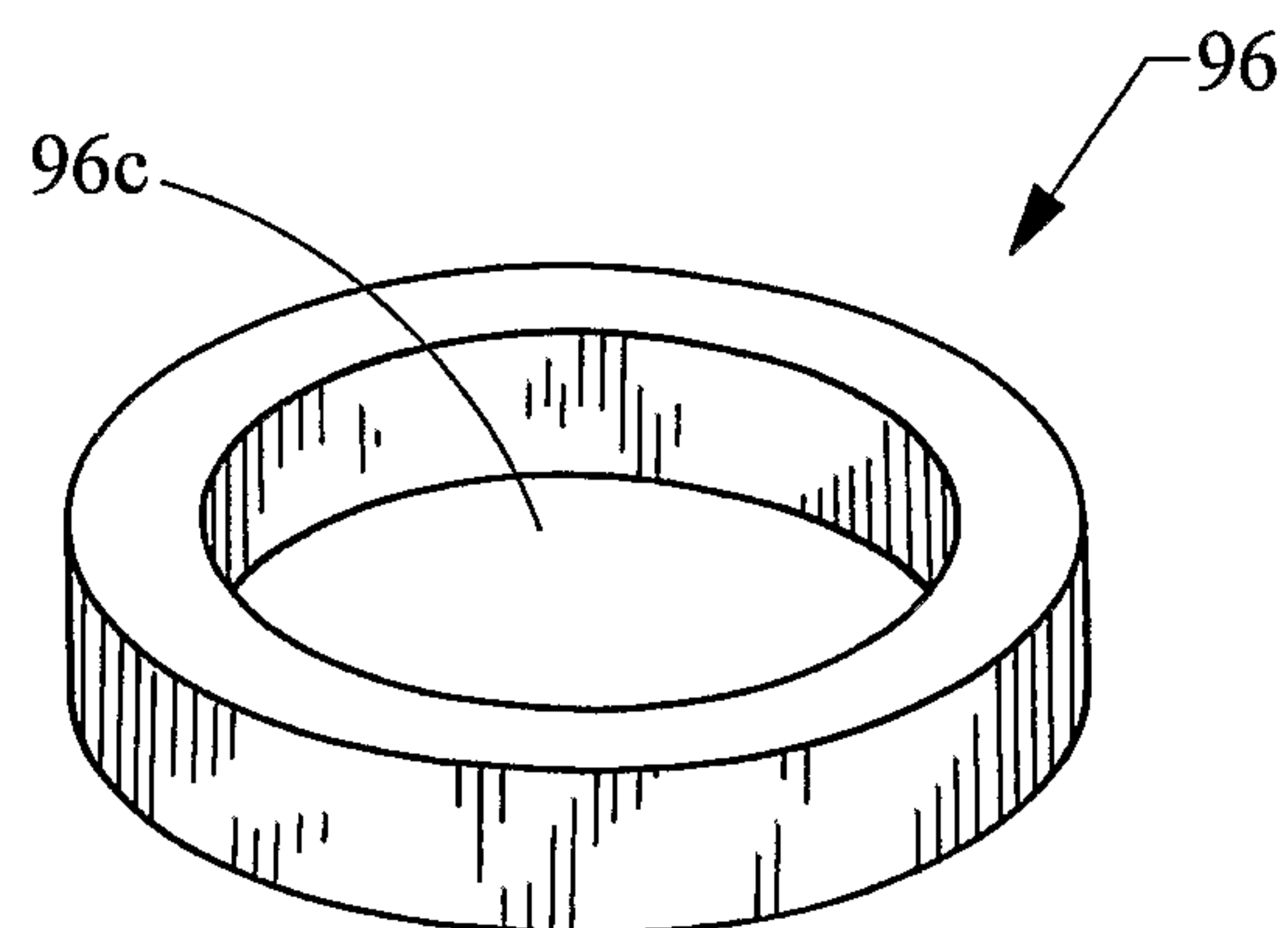


Fig. 9C



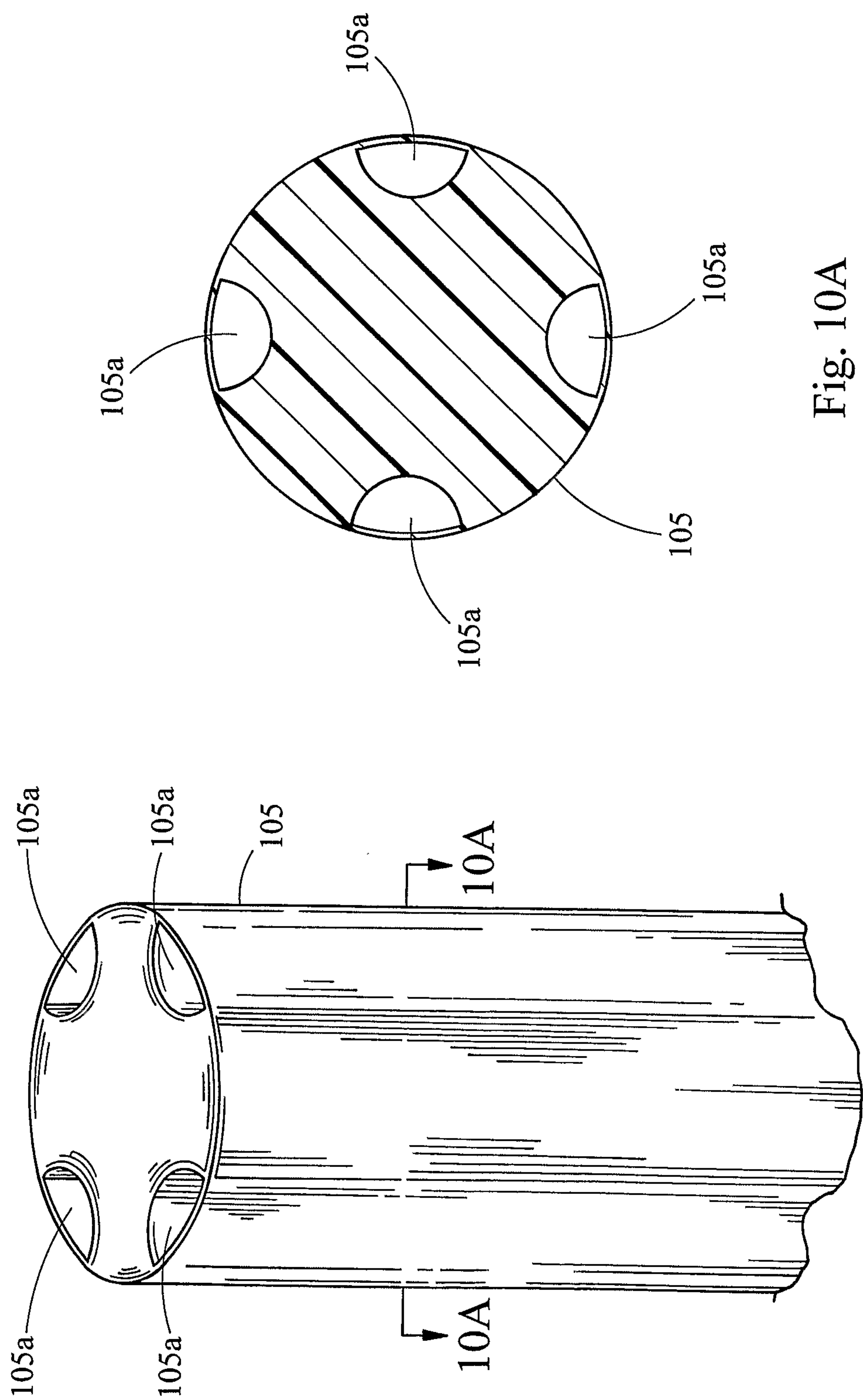


Fig. 10

Fig. 10A

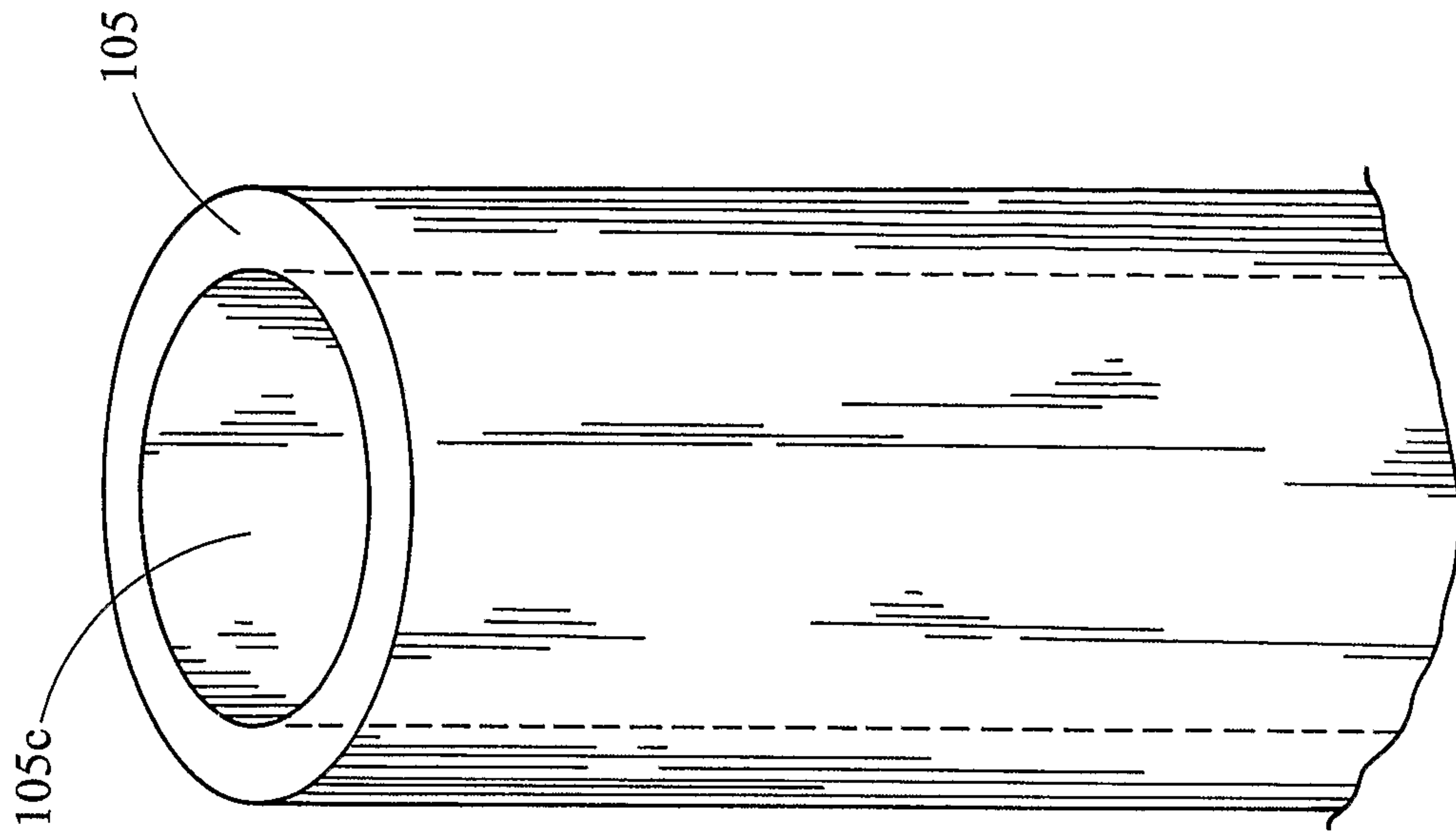


Fig. 10C

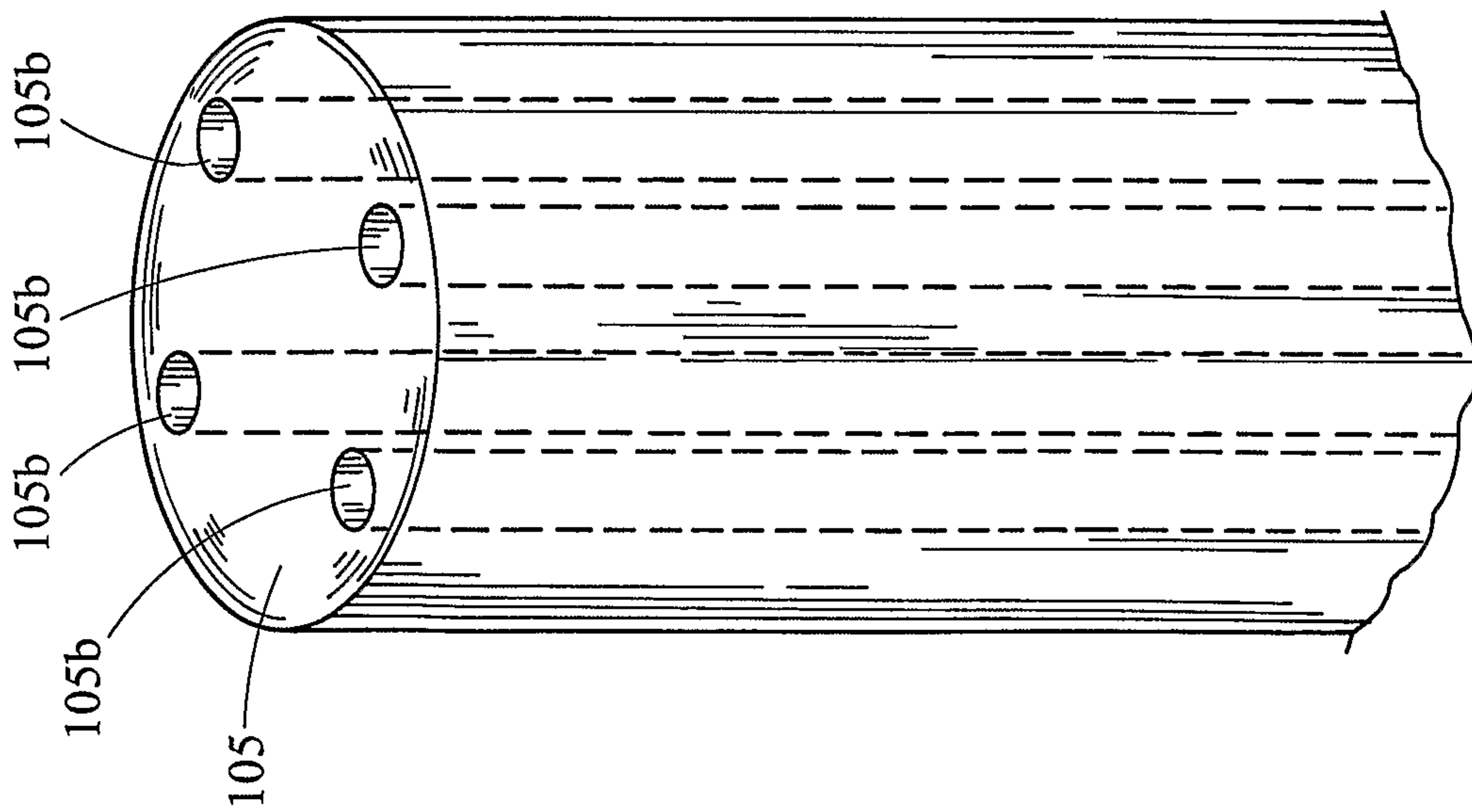


Fig. 10B



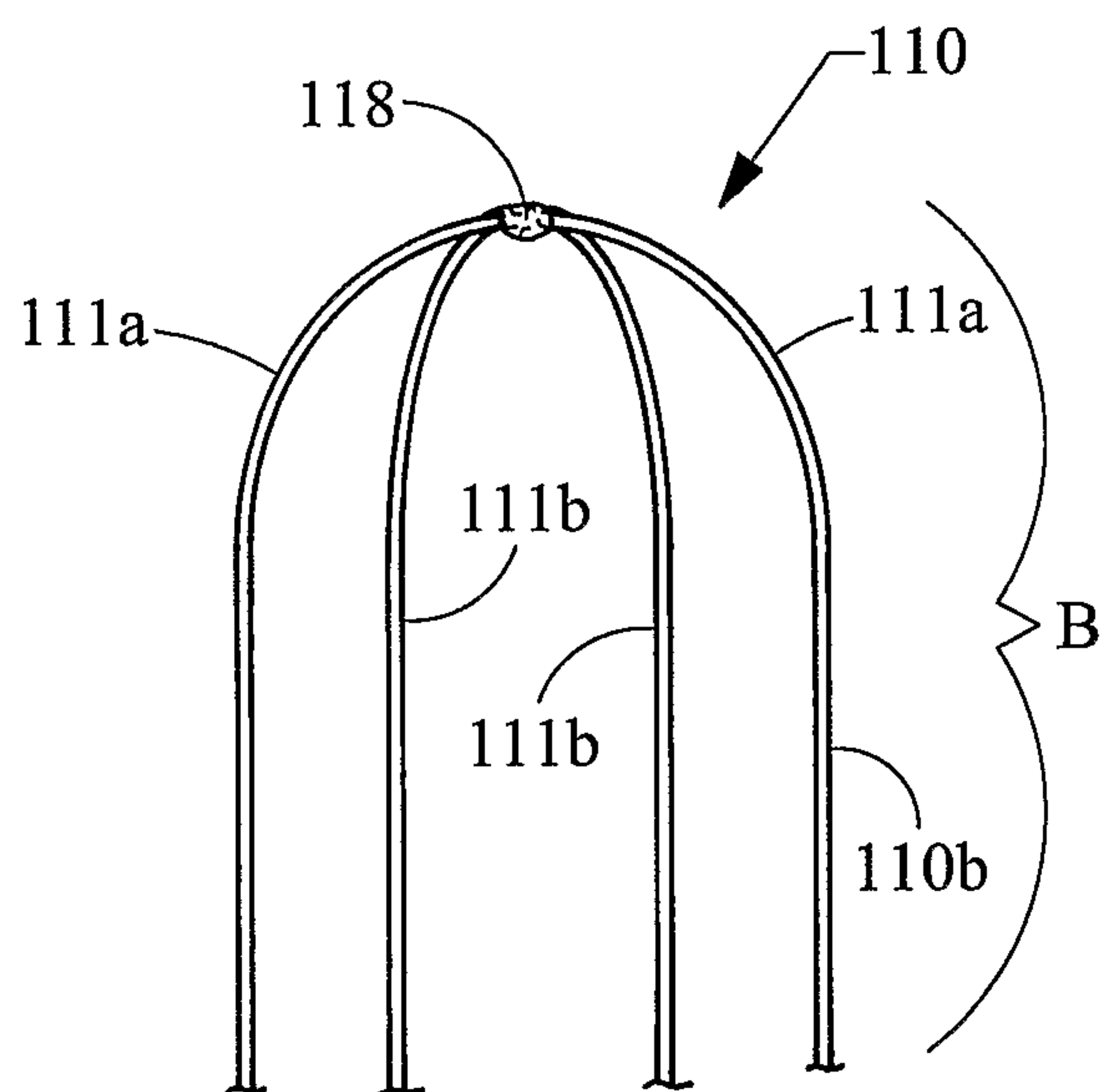


Fig. 11

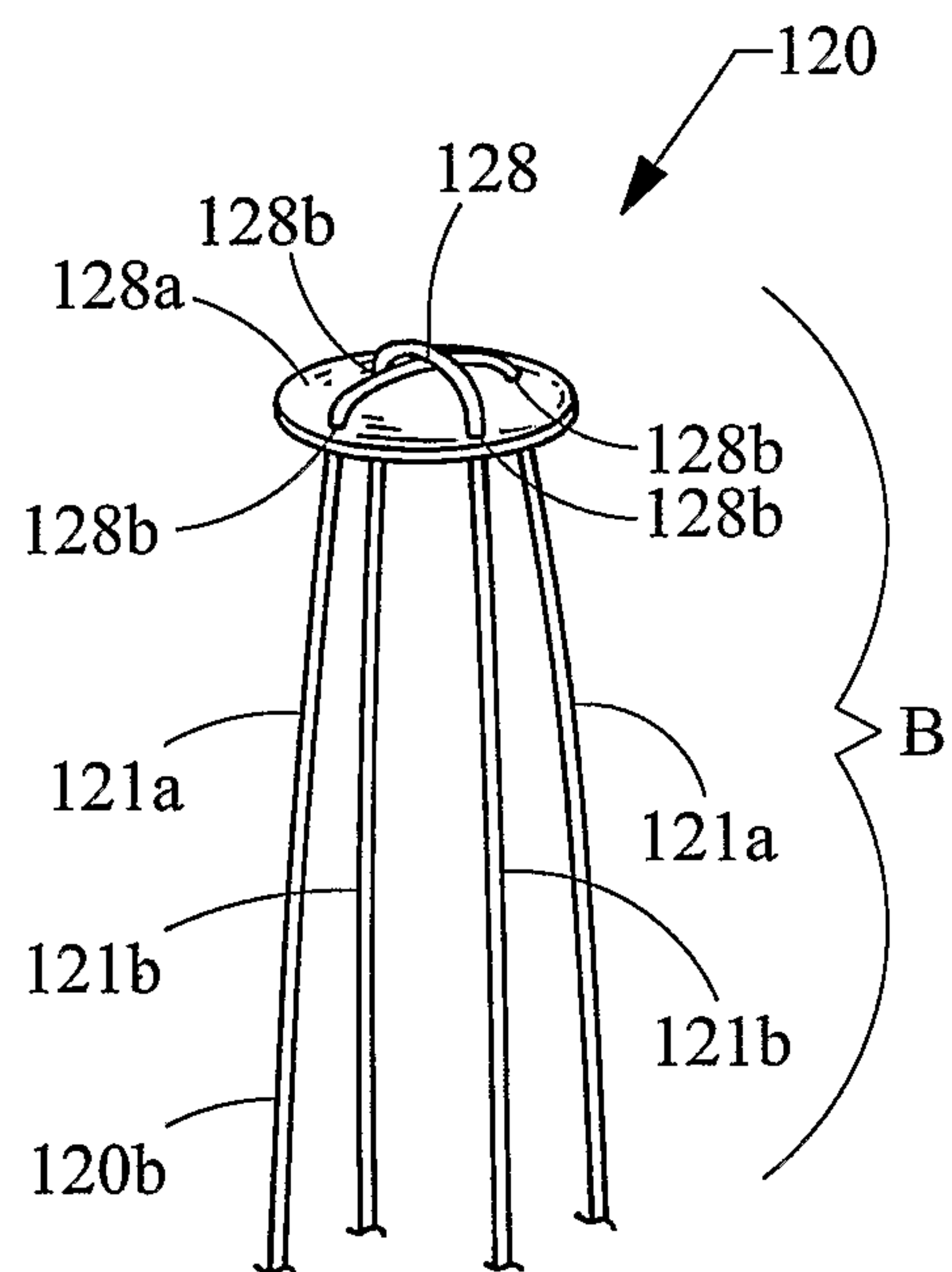


Fig. 12

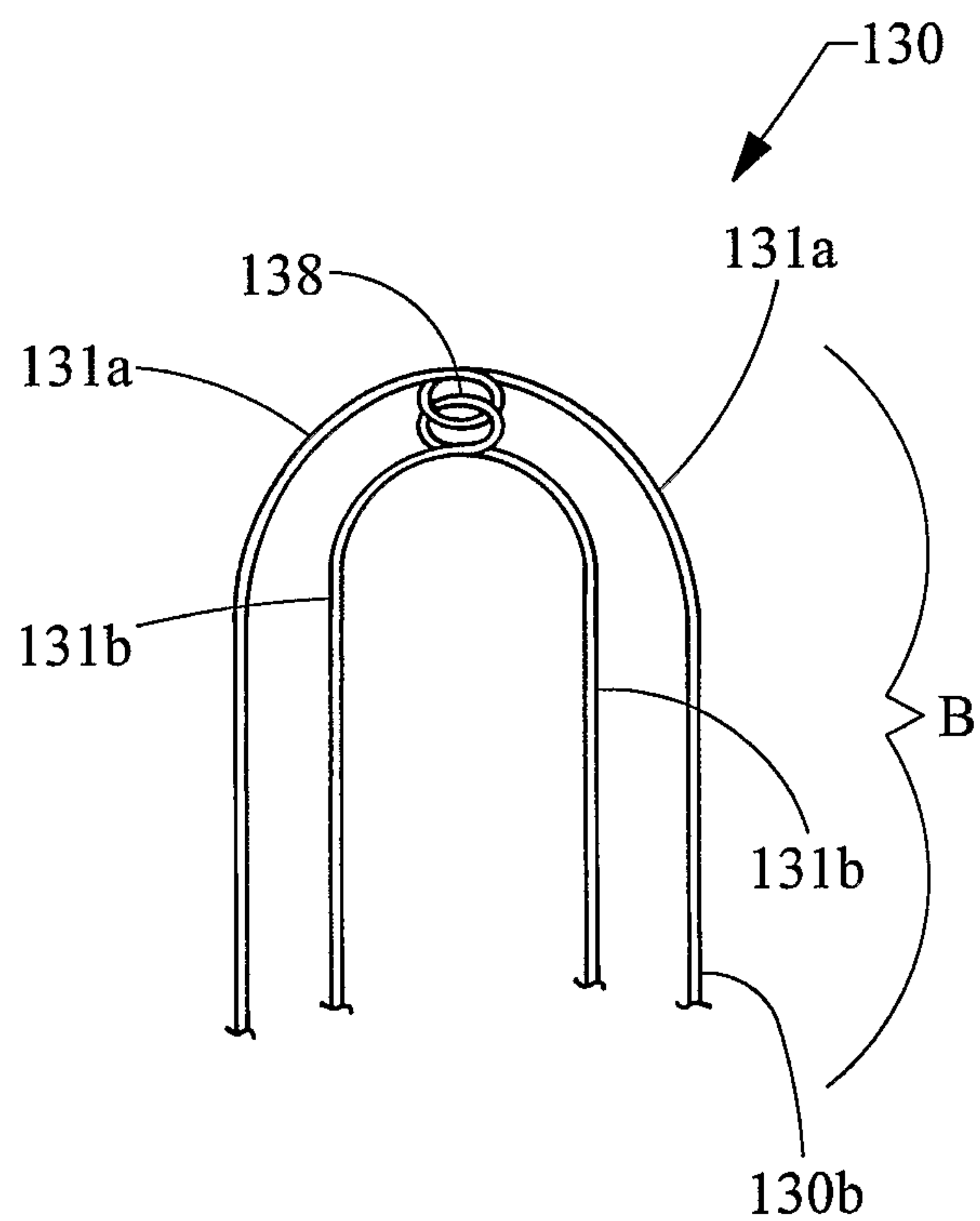


Fig. 13

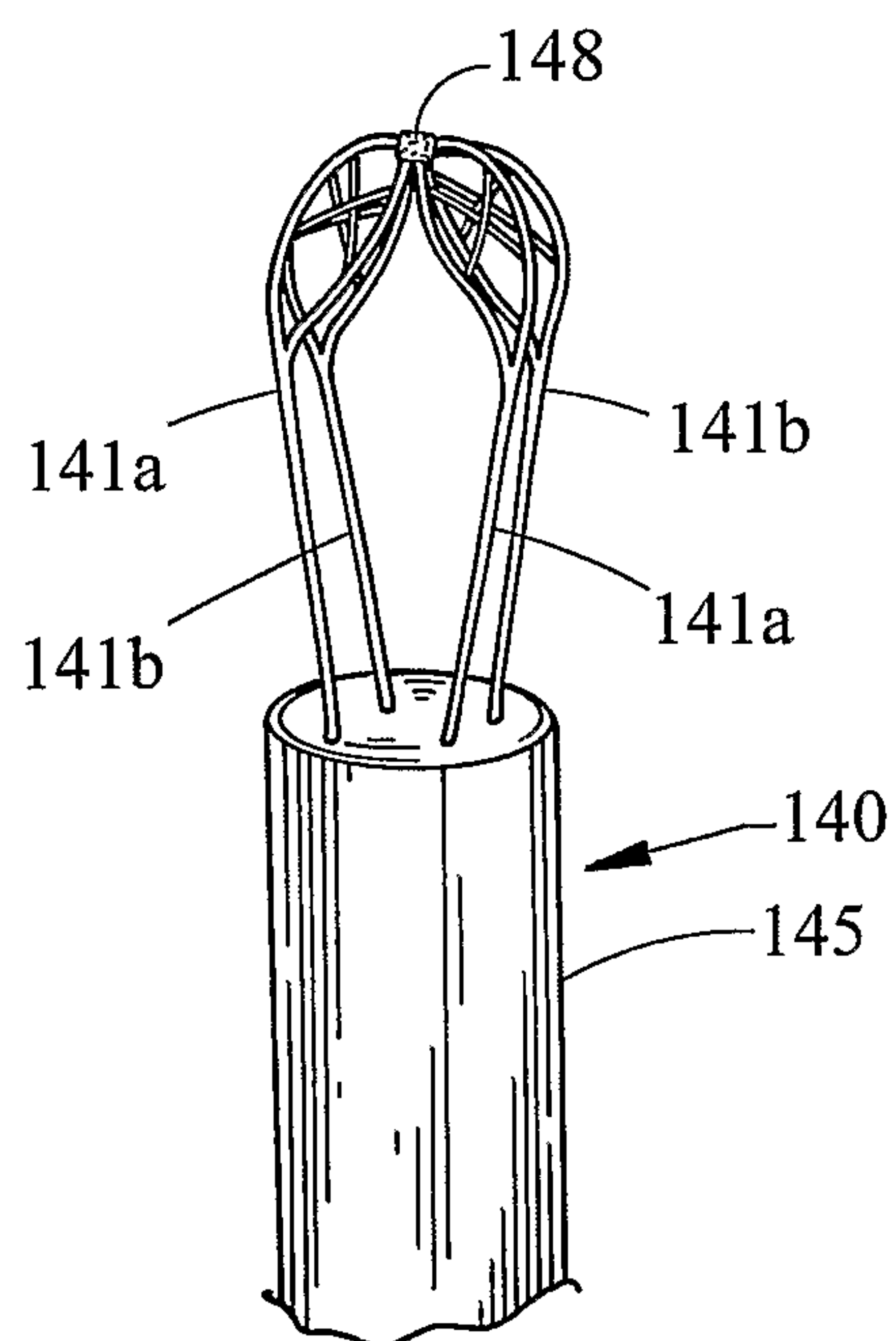


Fig. 14A

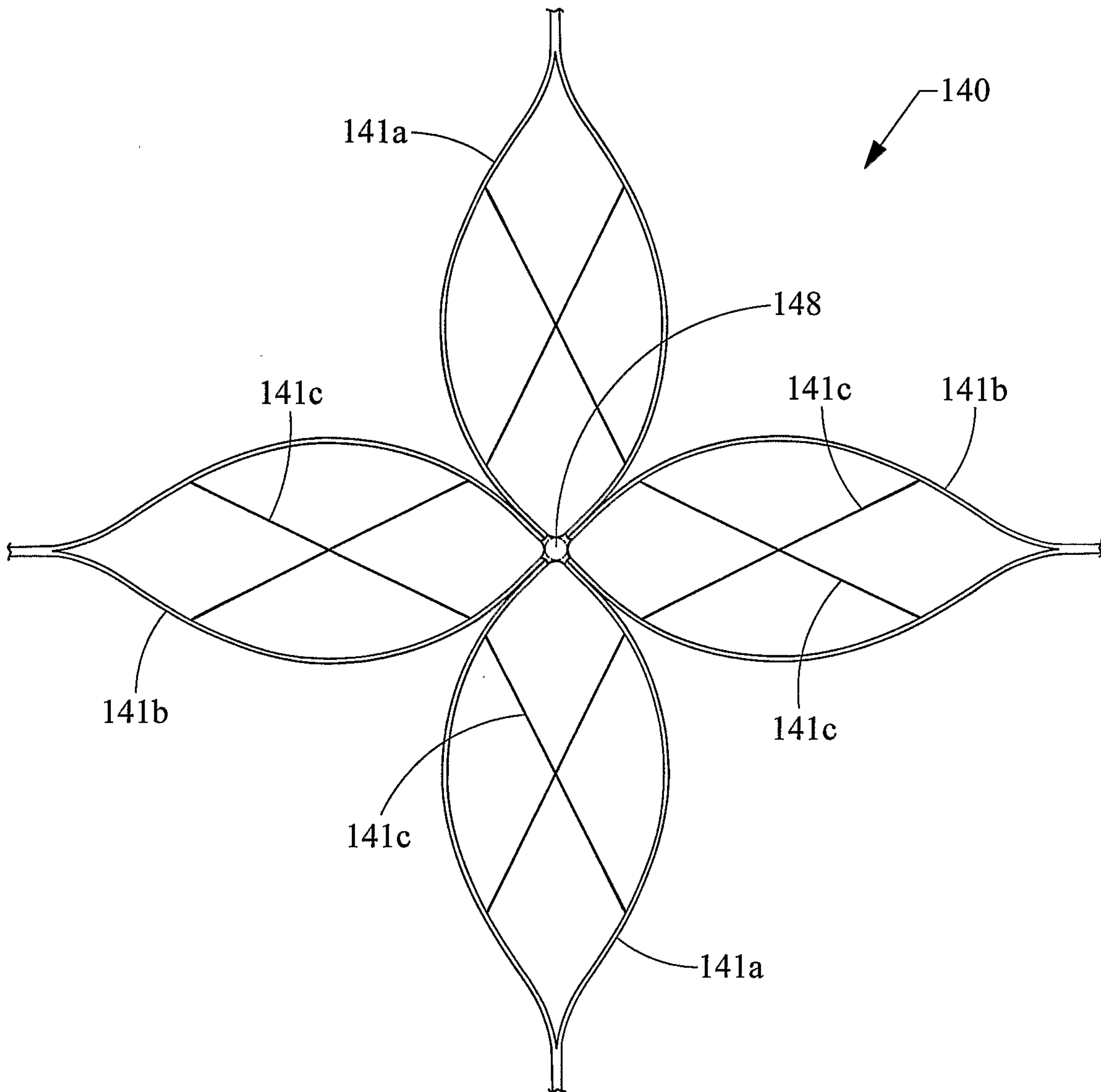


Fig. 14B

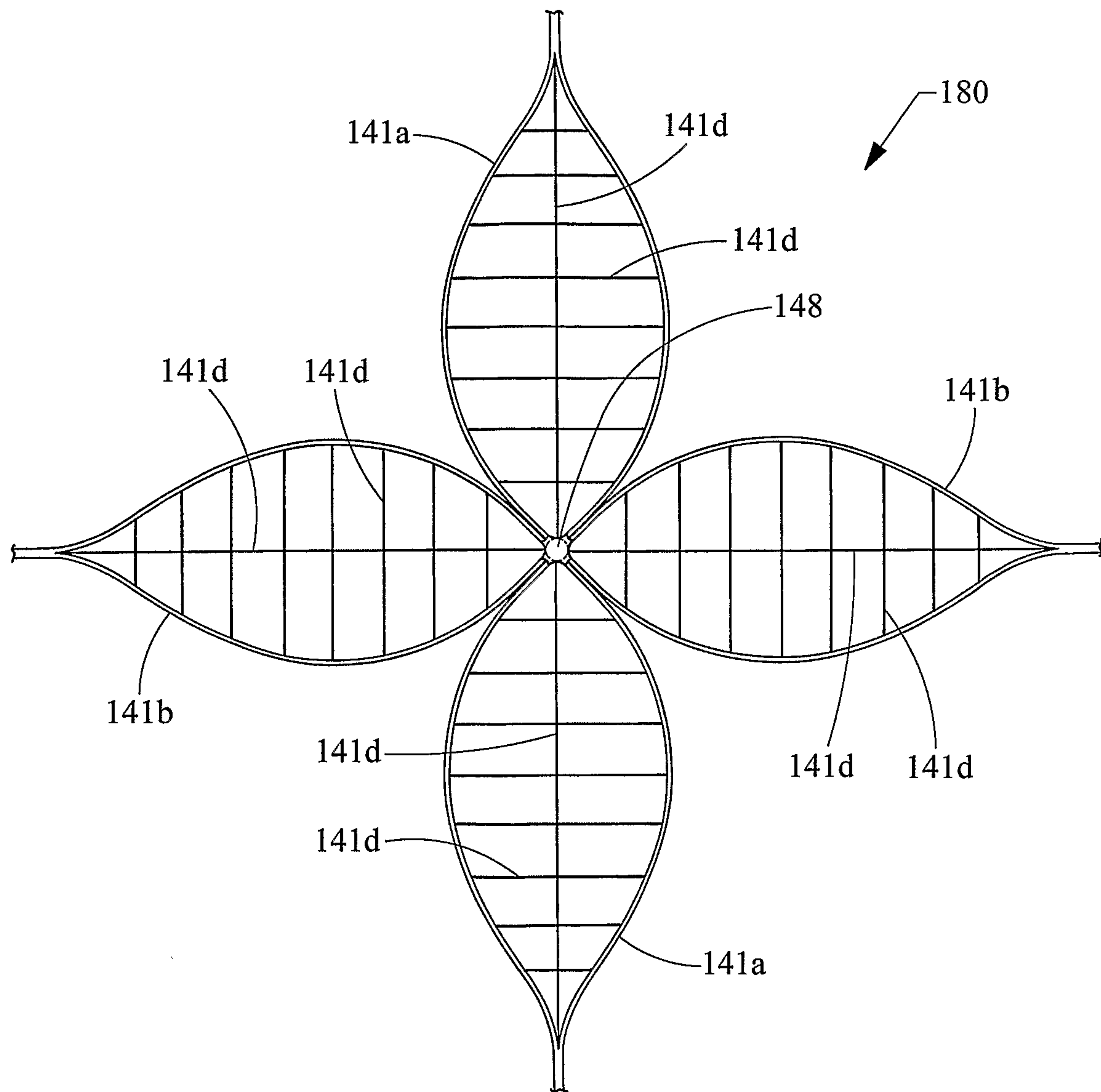


Fig. 14C



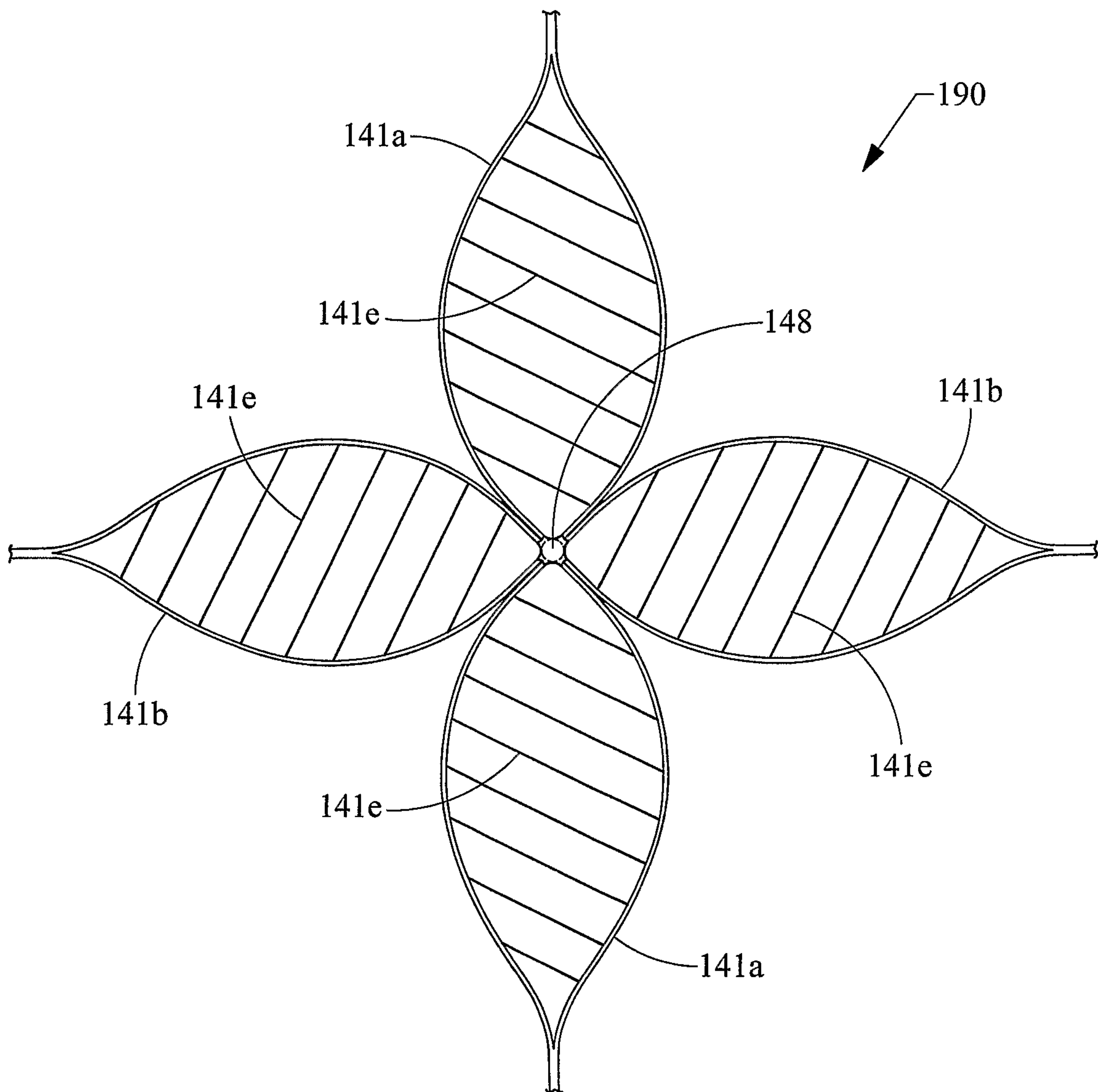


Fig. 14D

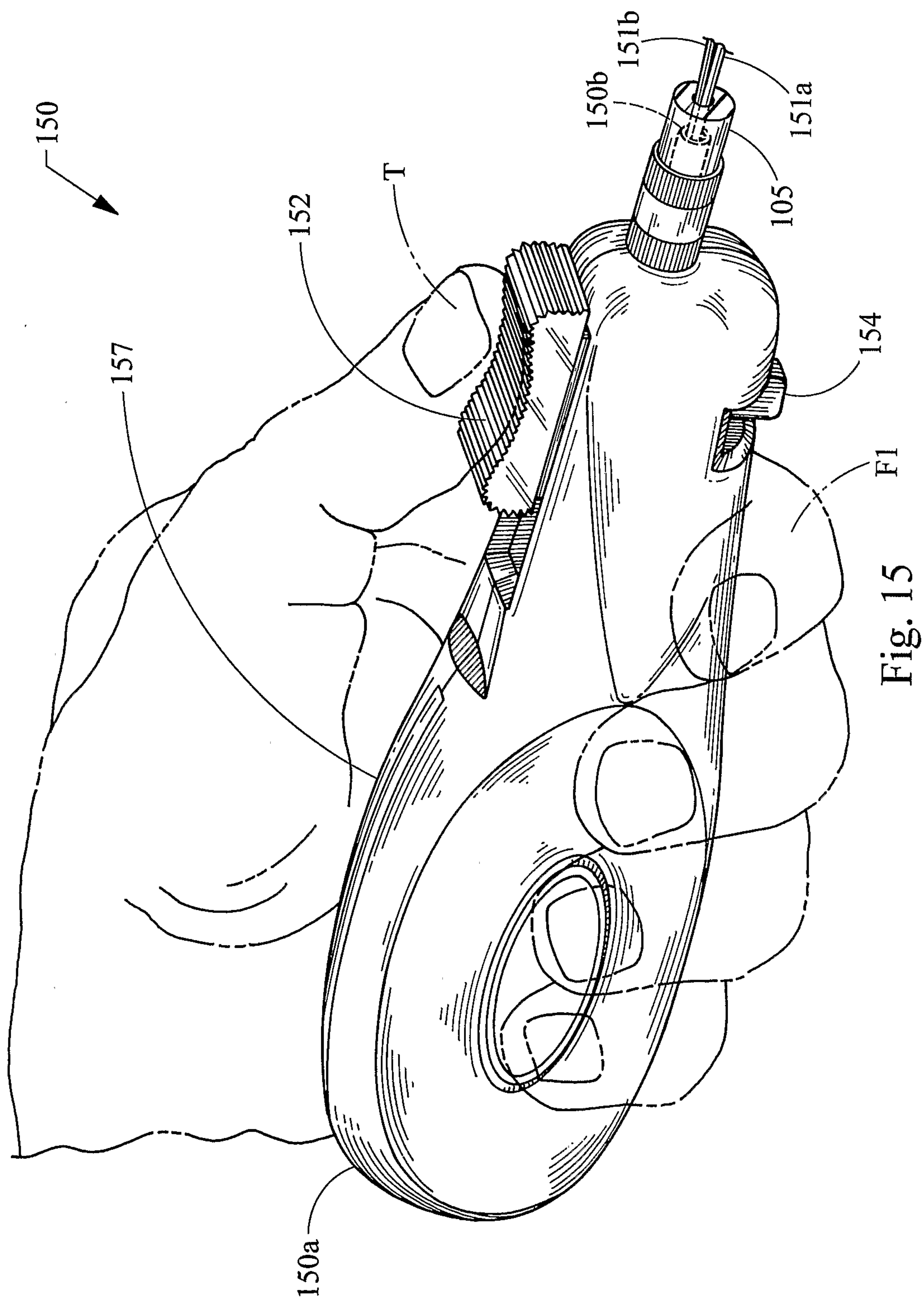


Fig. 15

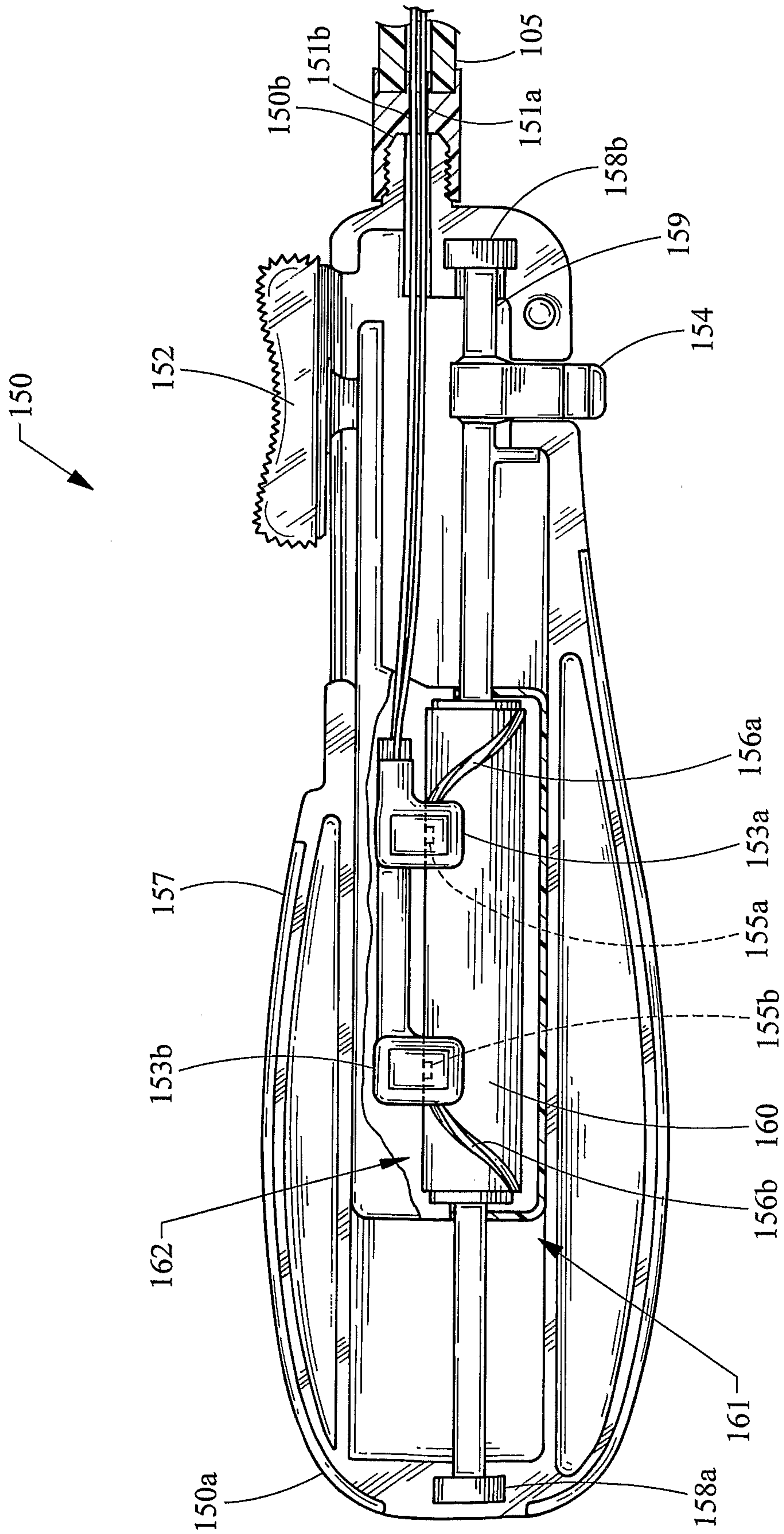


Fig. 16



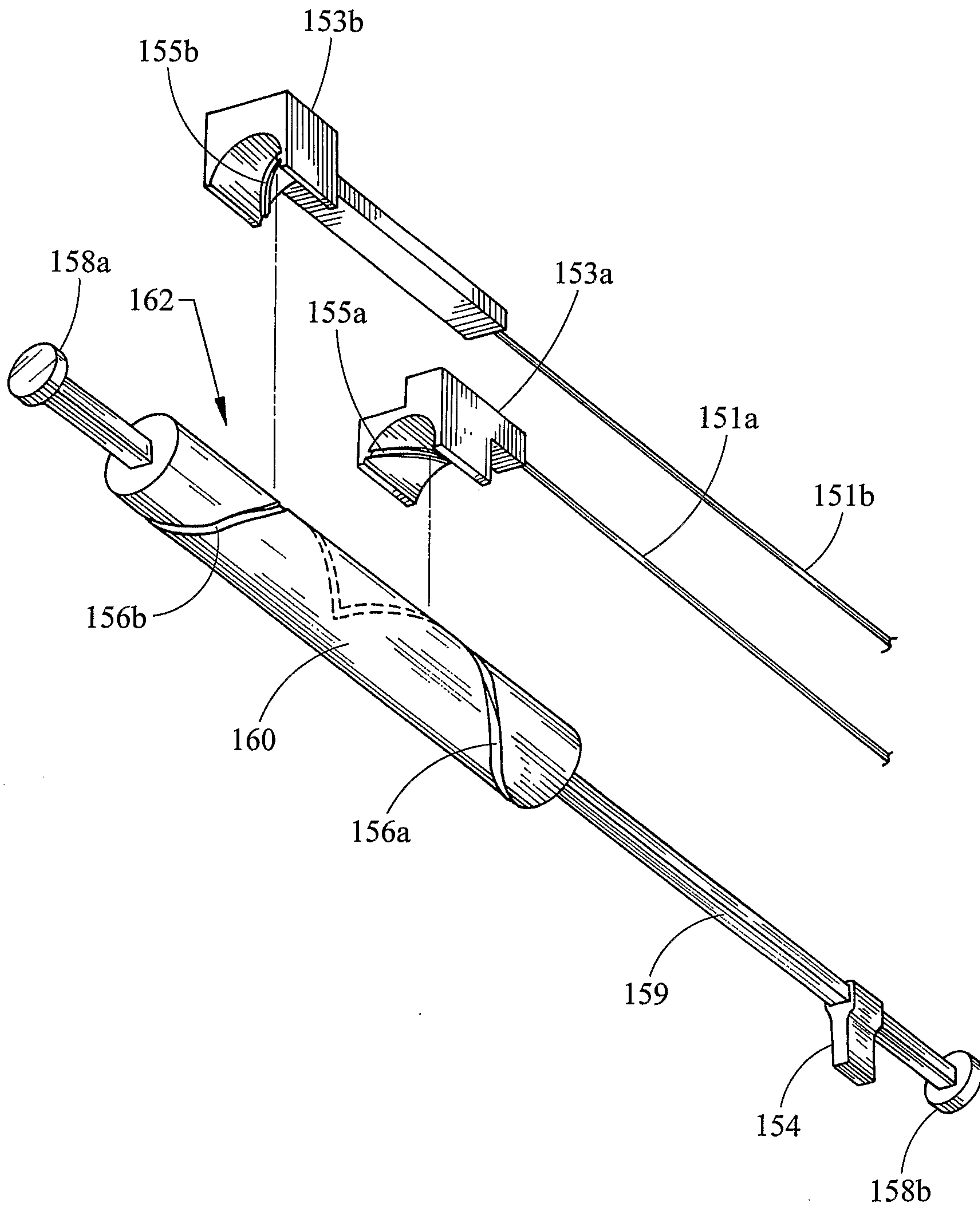


Fig. 17

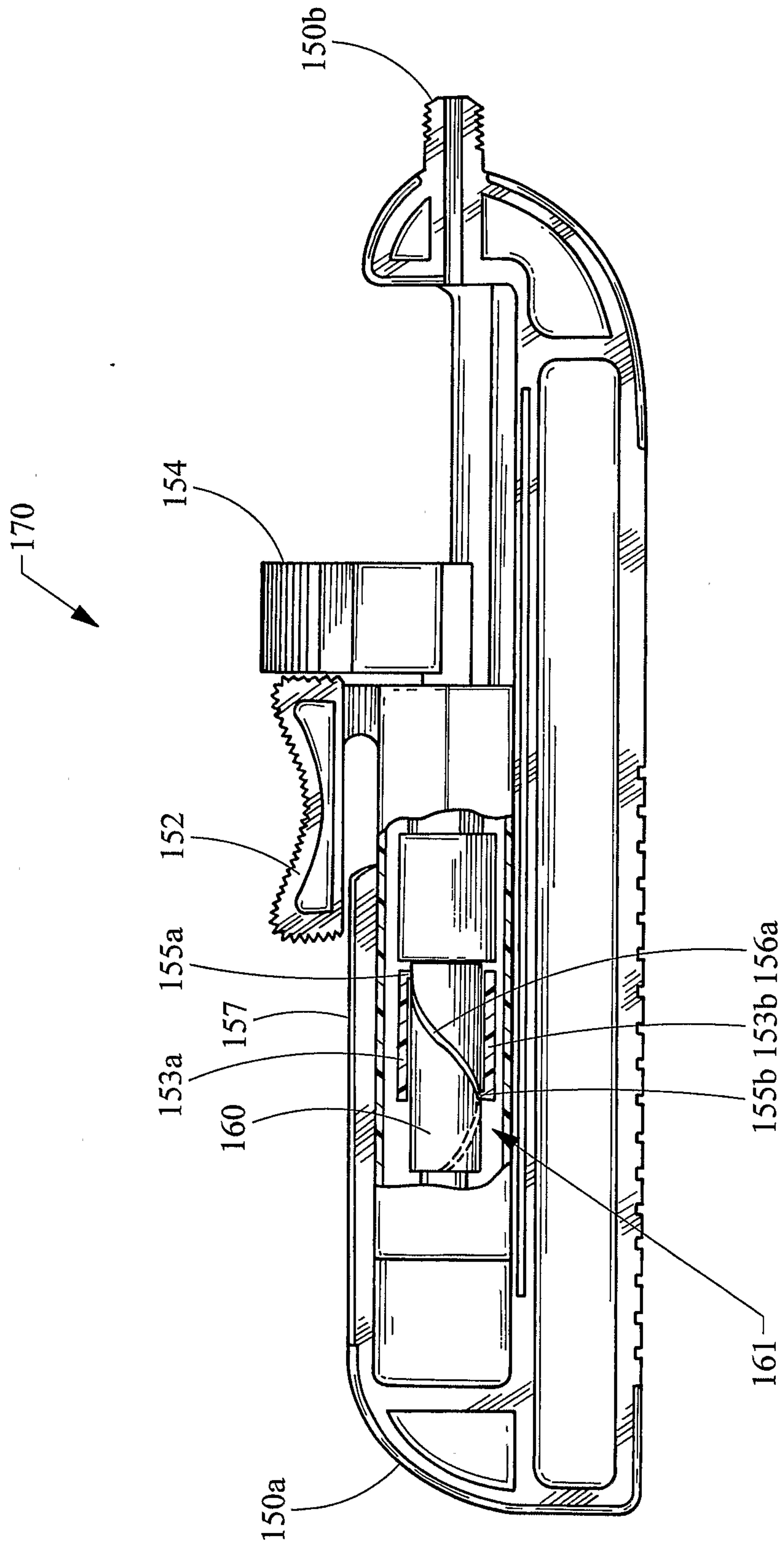


Fig. 18

