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Barnhart

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(54) **SURGICAL INSTRUMENT FOR EXTRACTING TISSUE INGROWTH FROM A PERMEABLE MEMBER OF AN IMPLANTED CATHETER**

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(52) **U.S. Cl.** **606/108**

(58) **Field of Search** 606/104, 108, 606/107, 110, 190; 433/159; 604/106

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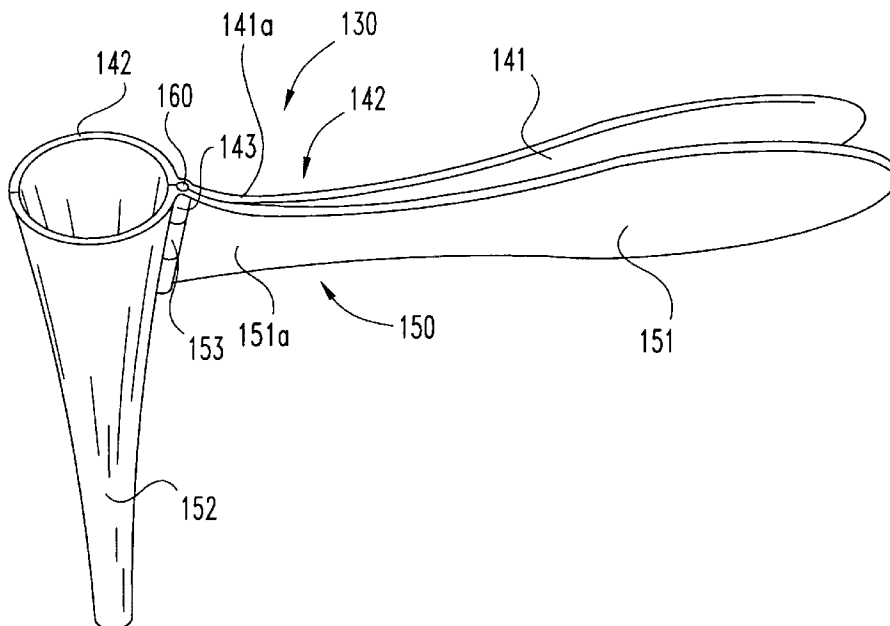
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(57) **ABSTRACT**

A surgical instrument for extracting tissue ingrowth from a permeable member of a catheter implanted in a patient is disclosed. The surgical instrument includes a first extracting component and a second extracting component pivotally coupled to the first extracting component. Both extracting components include a wedge having a blunted leading edge sized and shaped to be lodged adjacent an adhesion interface between the permeable member and tissue of a patient when the extracting components are pivoted to a closed position. The extracting components can then be pivoted to an open position to forcibly pull the tissue ingrowth out of the permeable member. Each wedge further has a concave surface sized and shaped such that, after the complete extraction of the tissue ingrowth from the permeable member, the wedges can clench the permeable member when the first extracting component and the second extracting component are pivoted to a closed position.

8 Claims, 14 Drawing Sheets



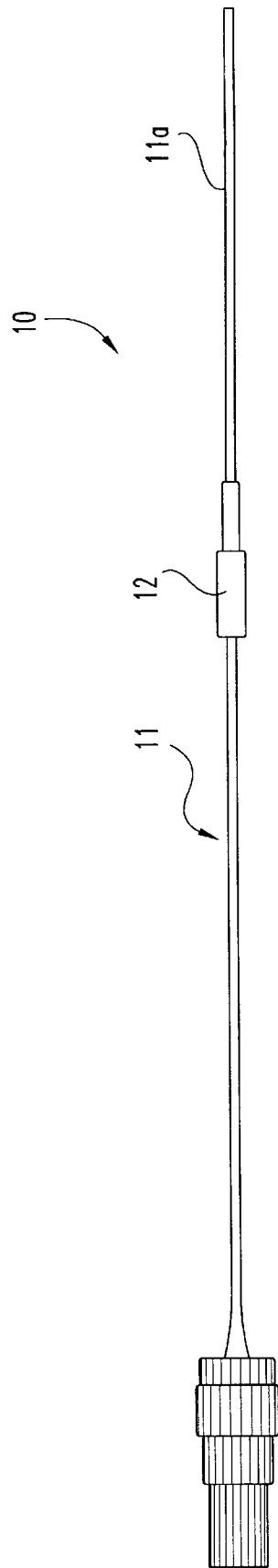


Fig. 1

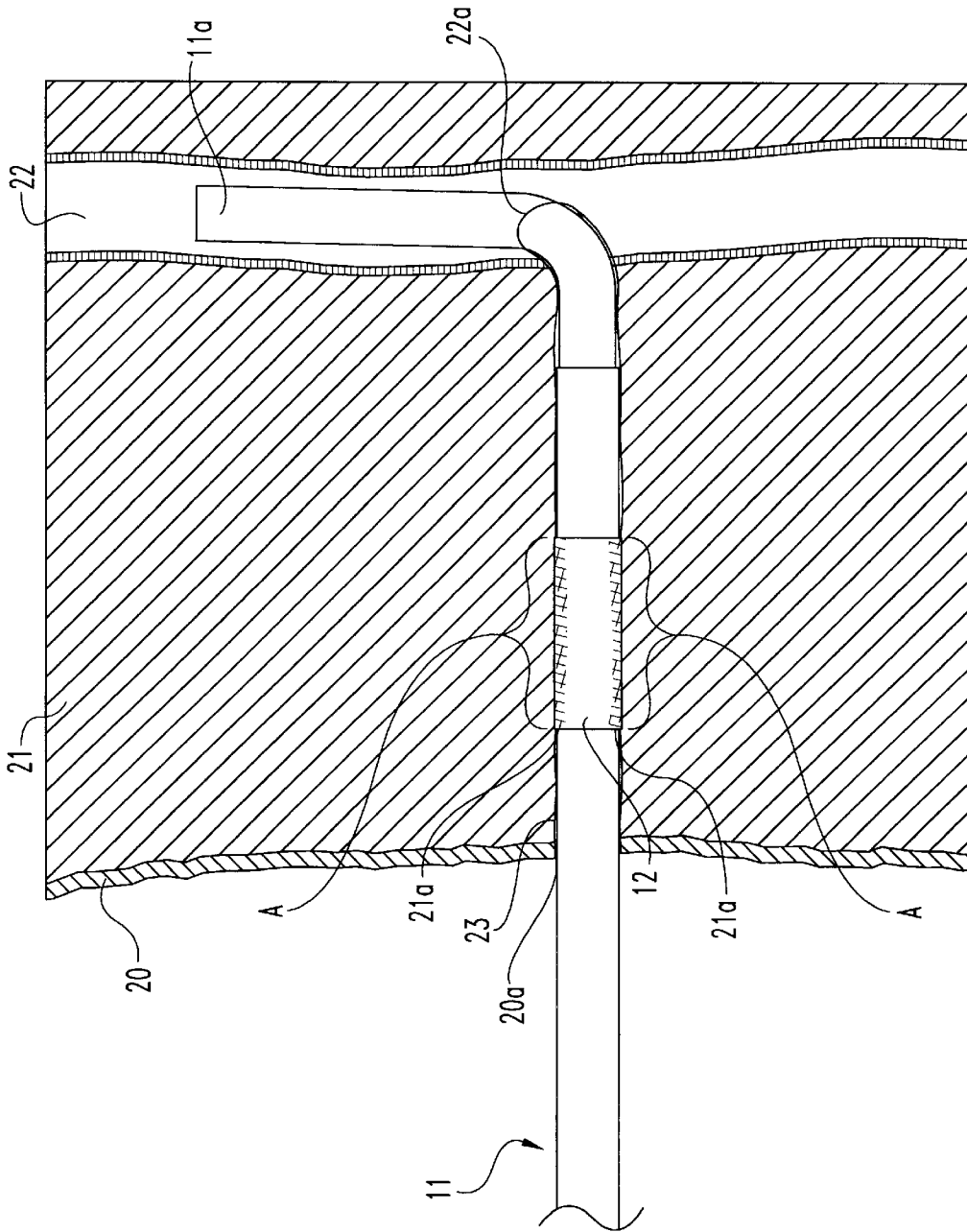


Fig. 2

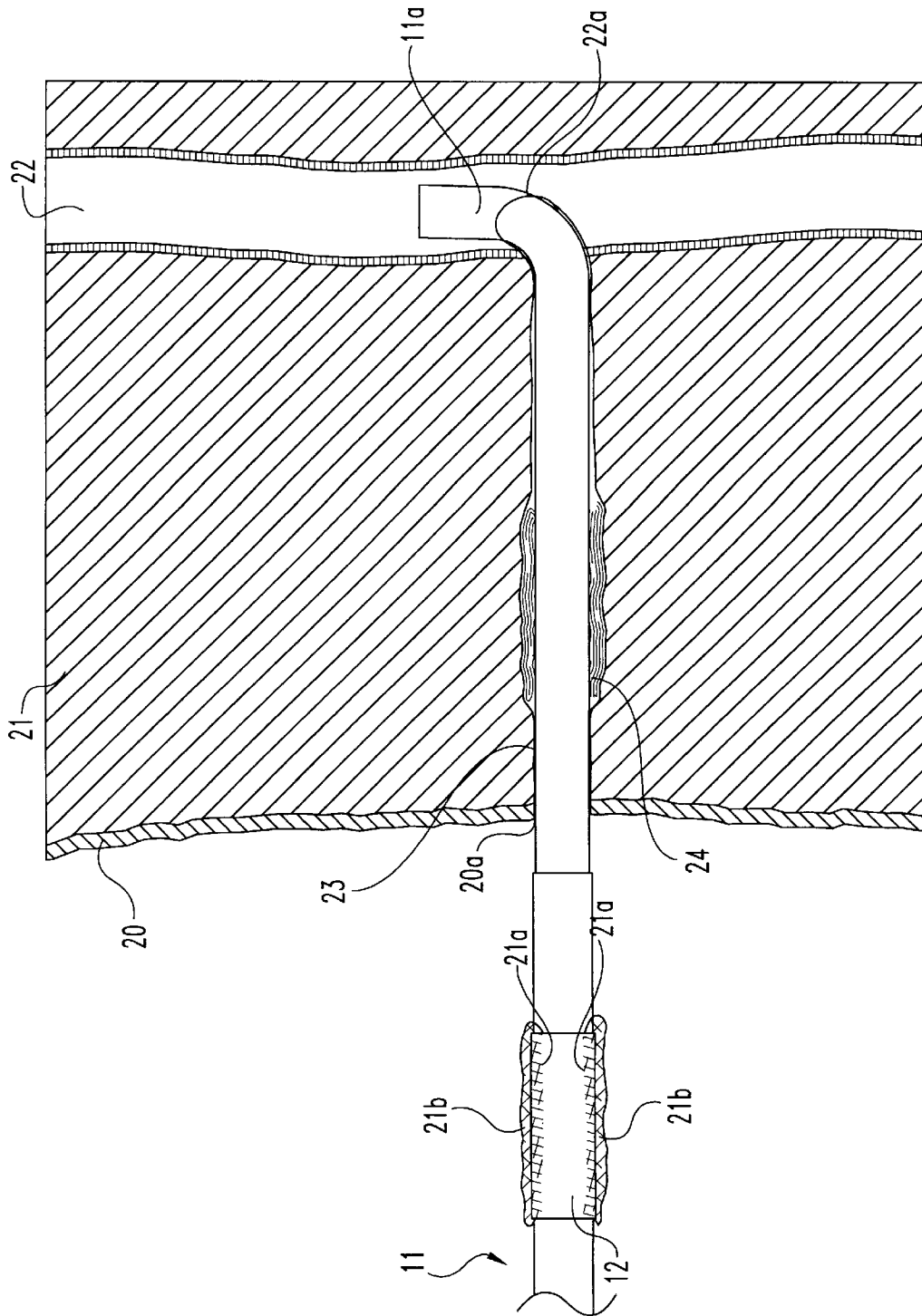


Fig. 3

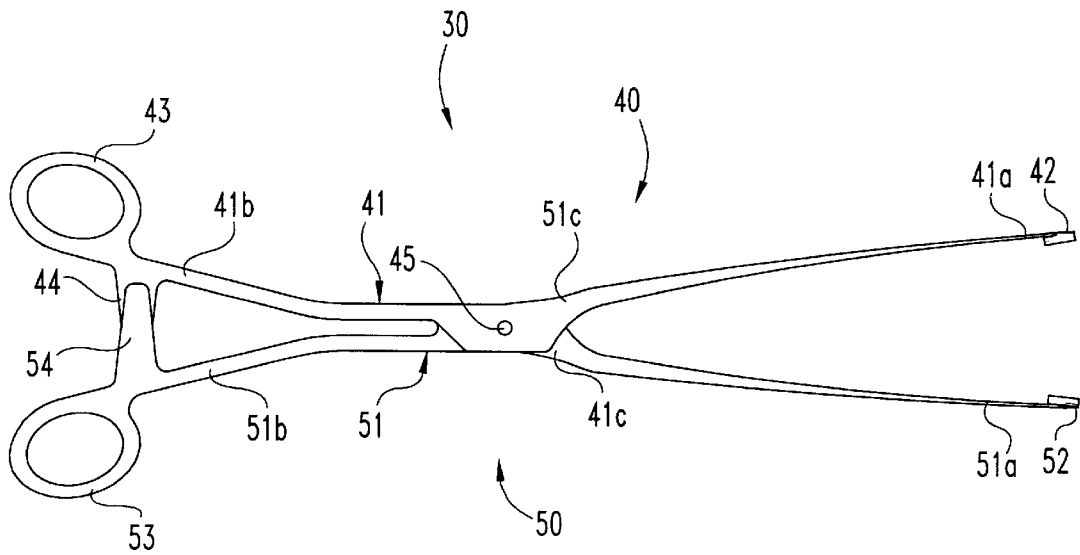


Fig. 4A

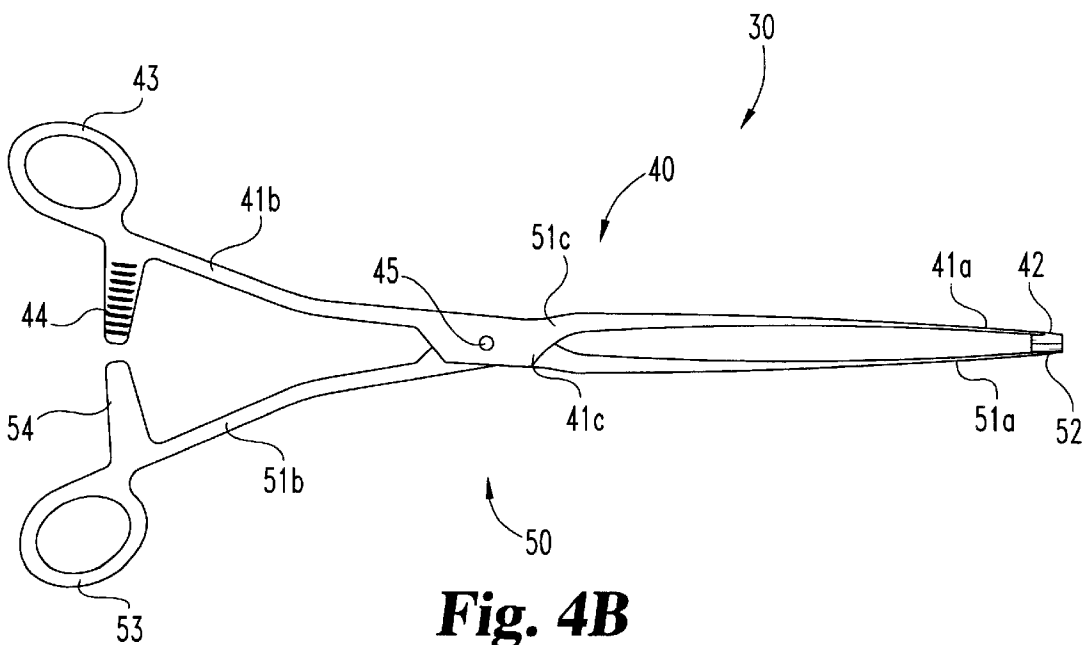


Fig. 4B

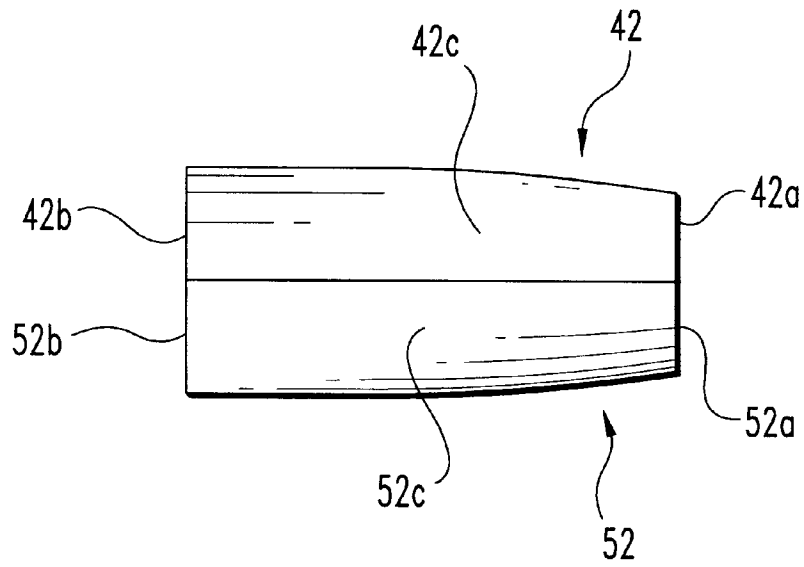


Fig. 5A

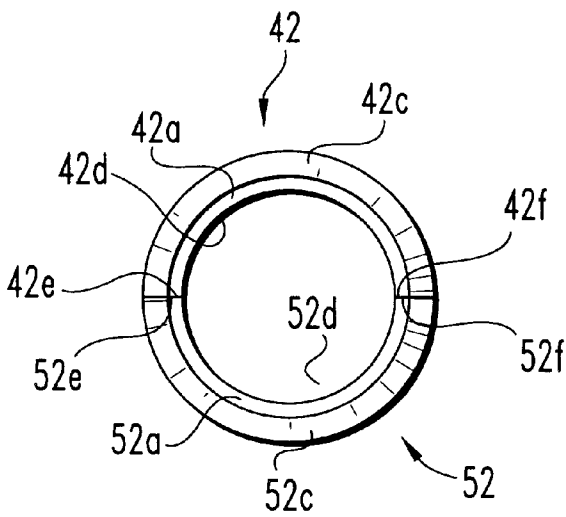


Fig. 5B

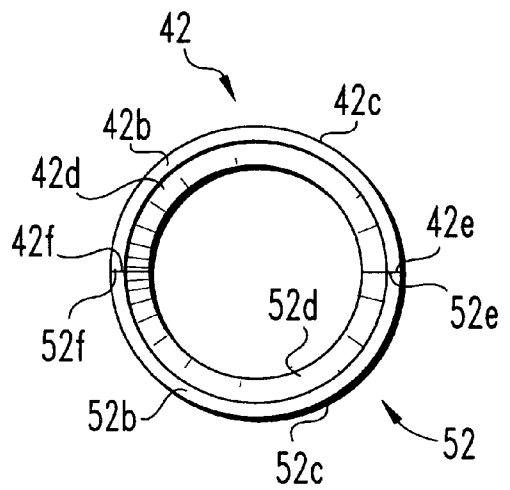


Fig. 5C

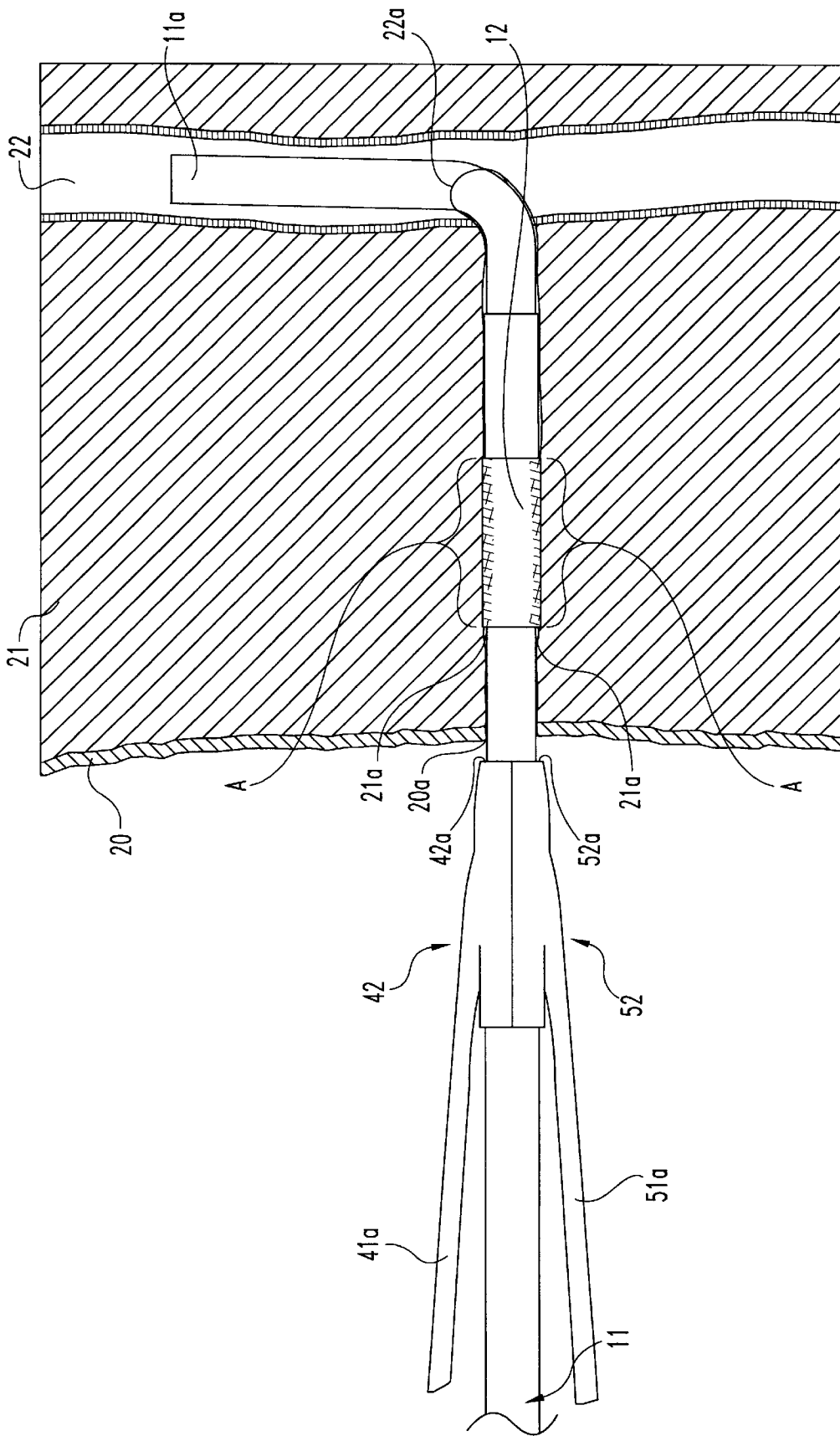


Fig. 6A

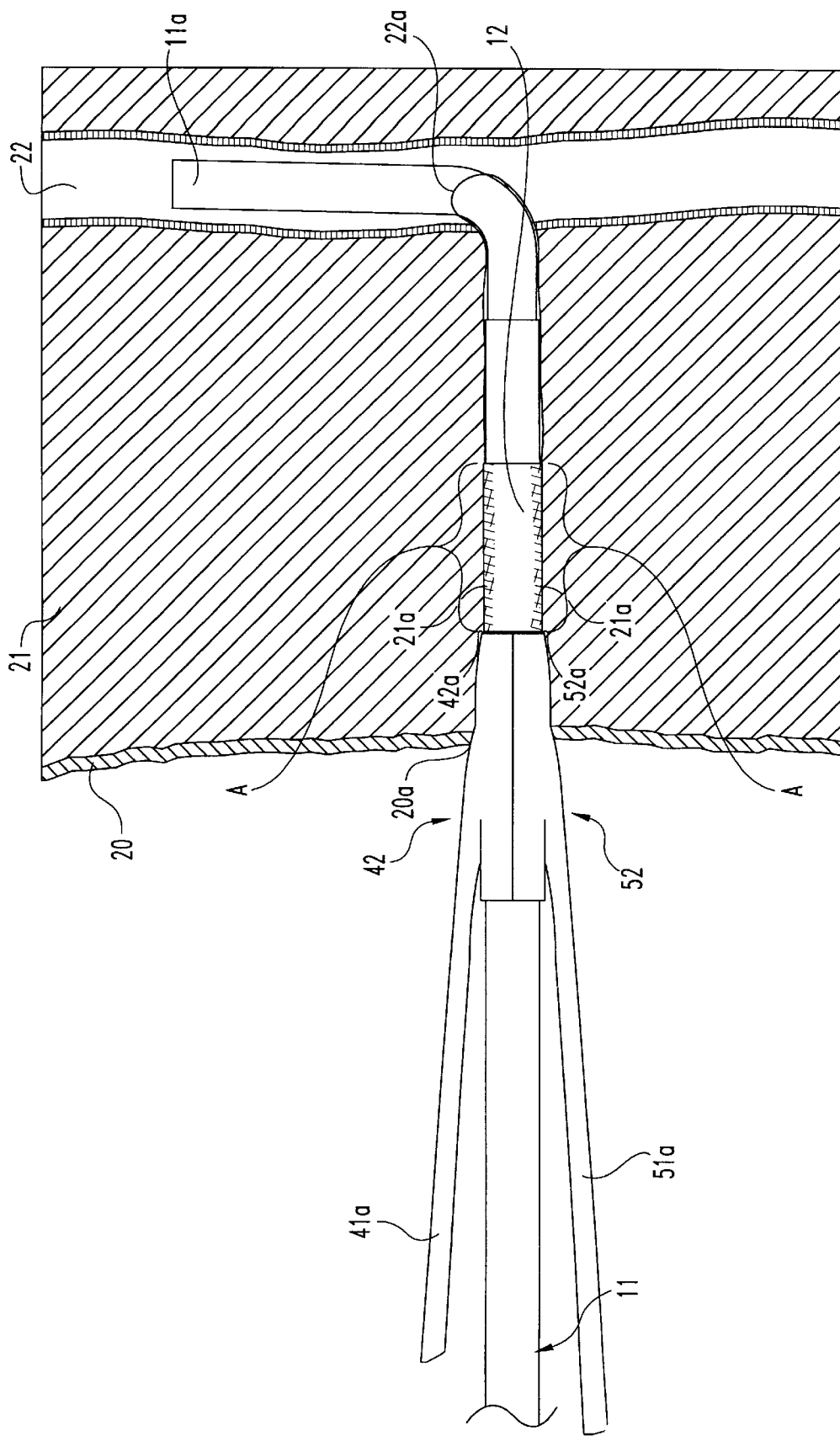


Fig. 6B

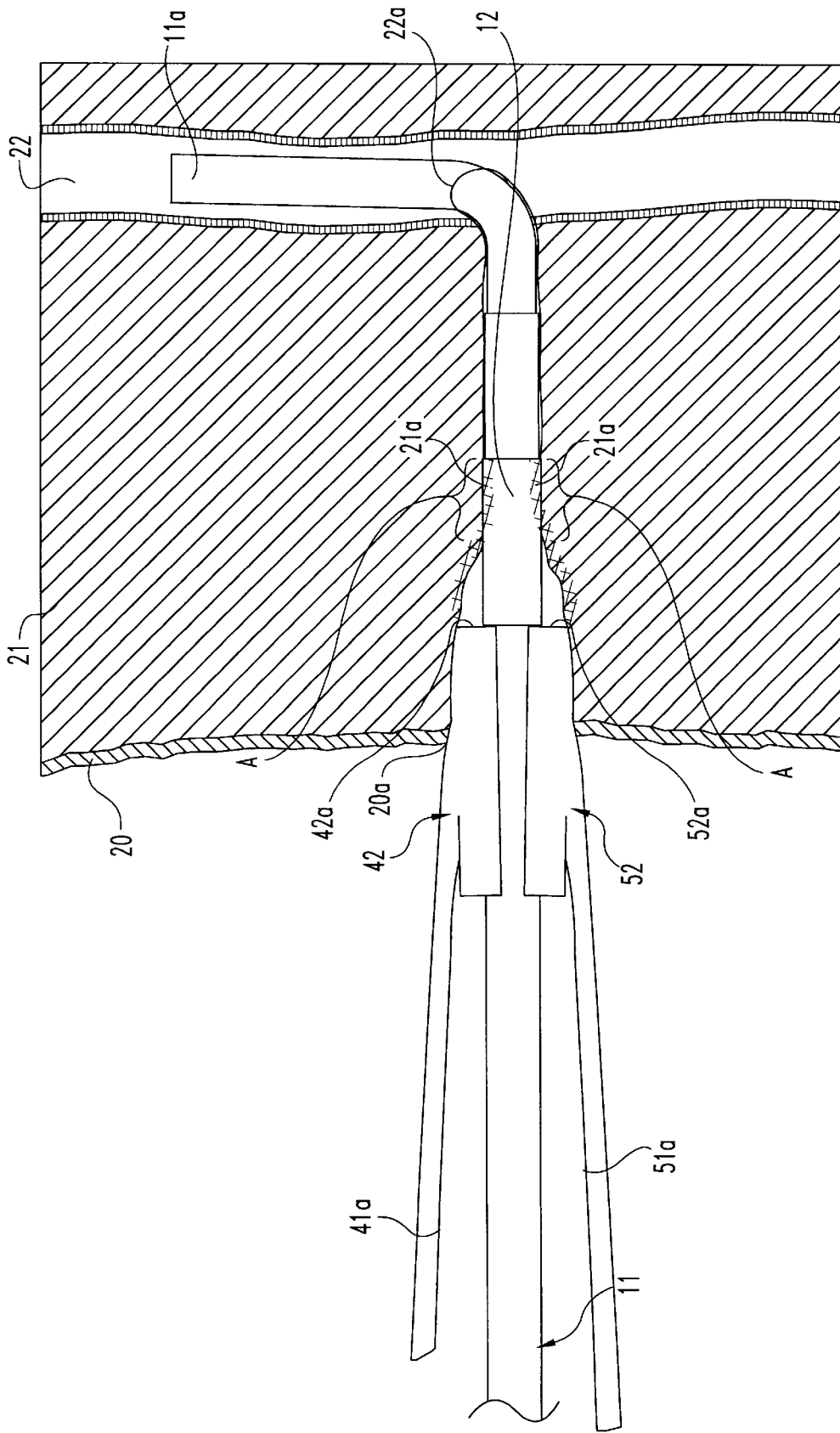


Fig. 6C

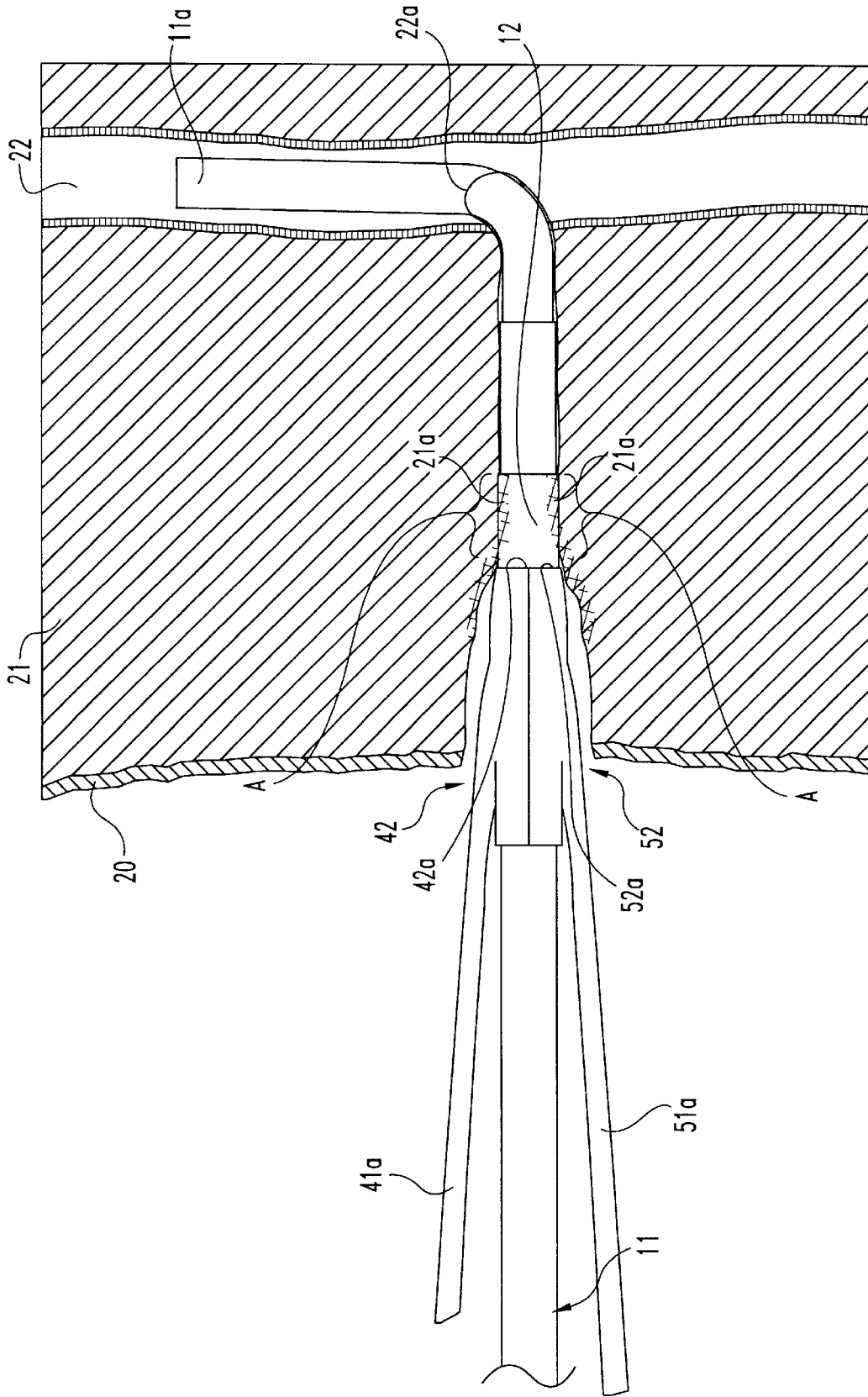


Fig. 6D

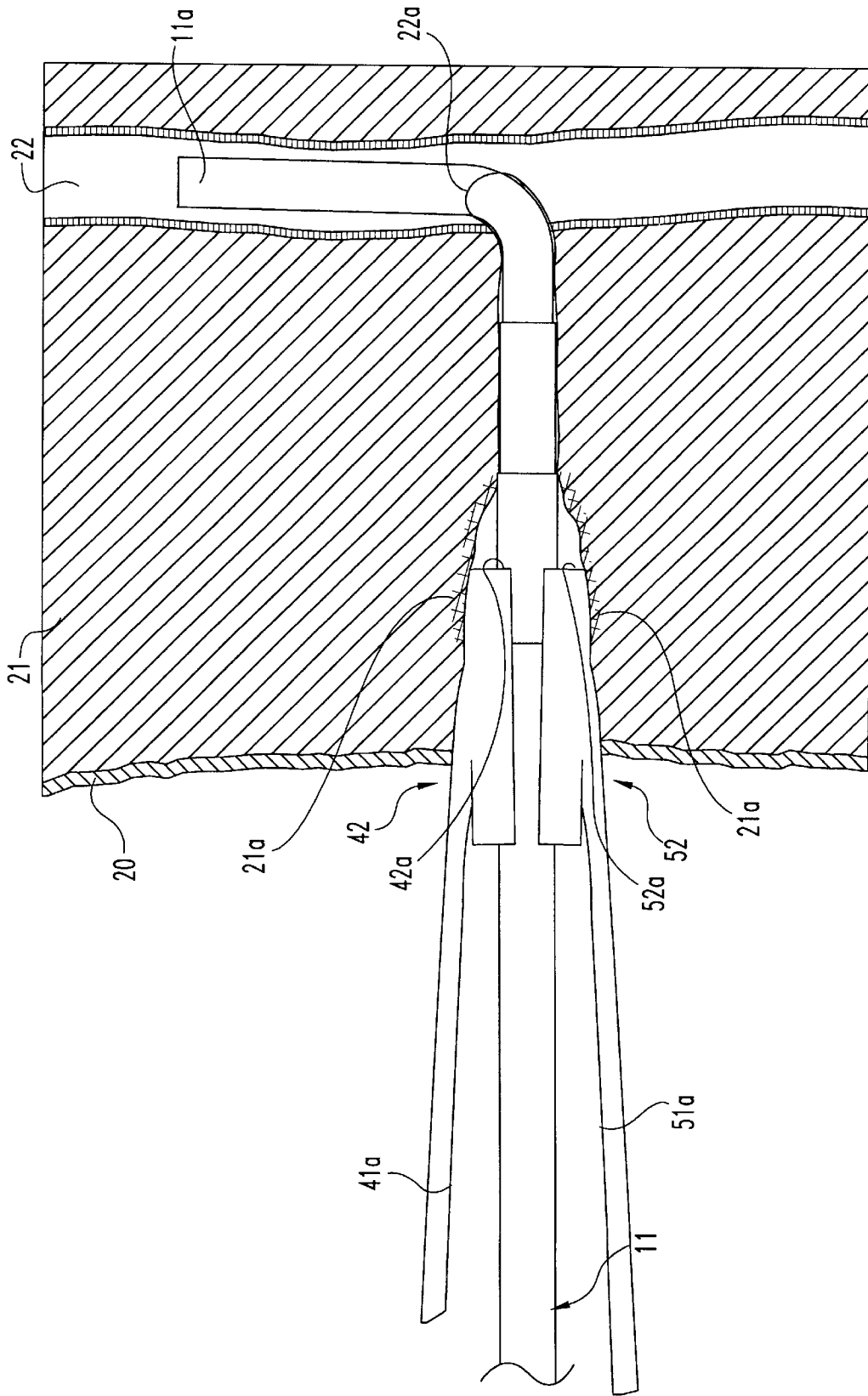


Fig. 6E

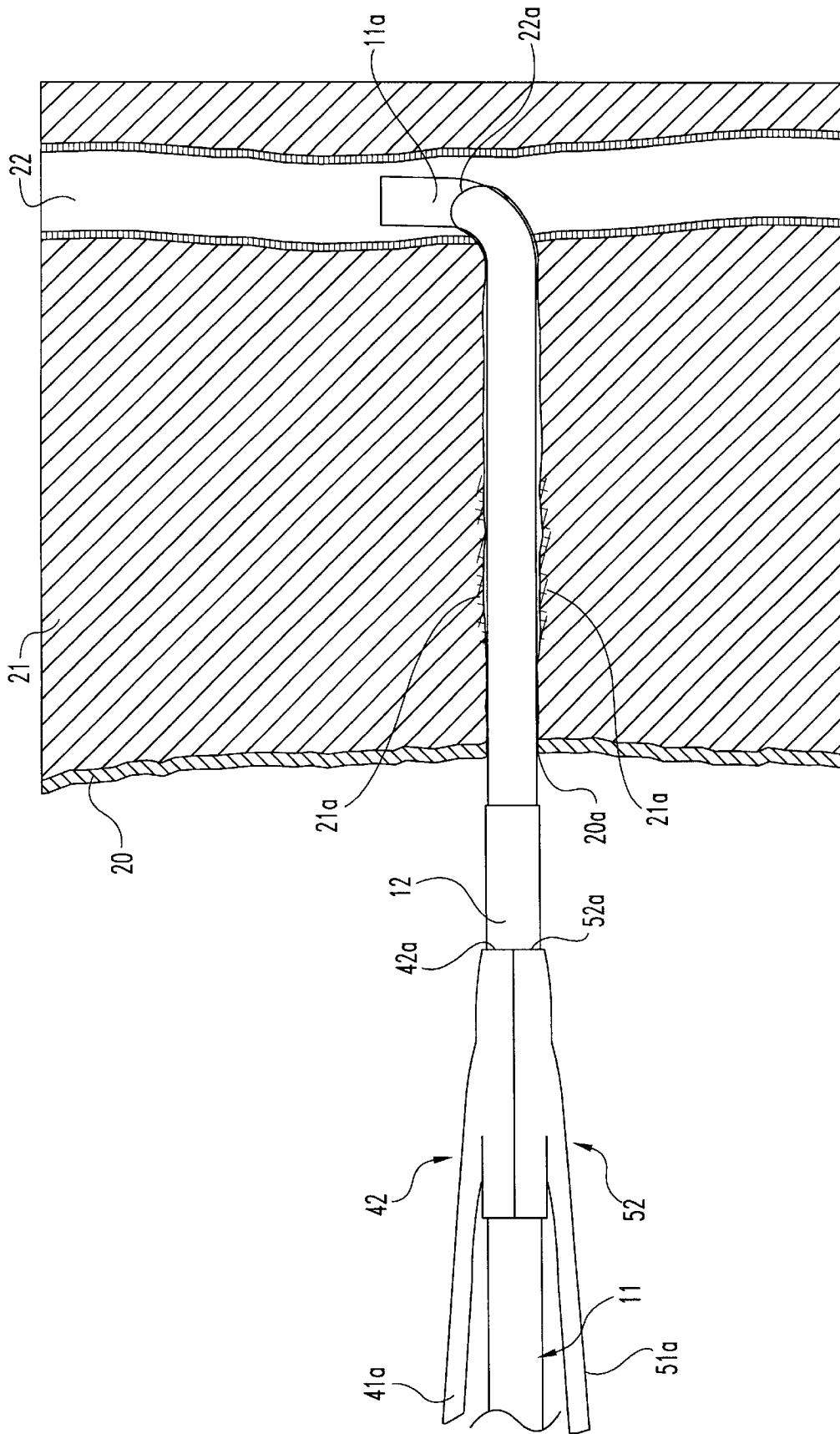
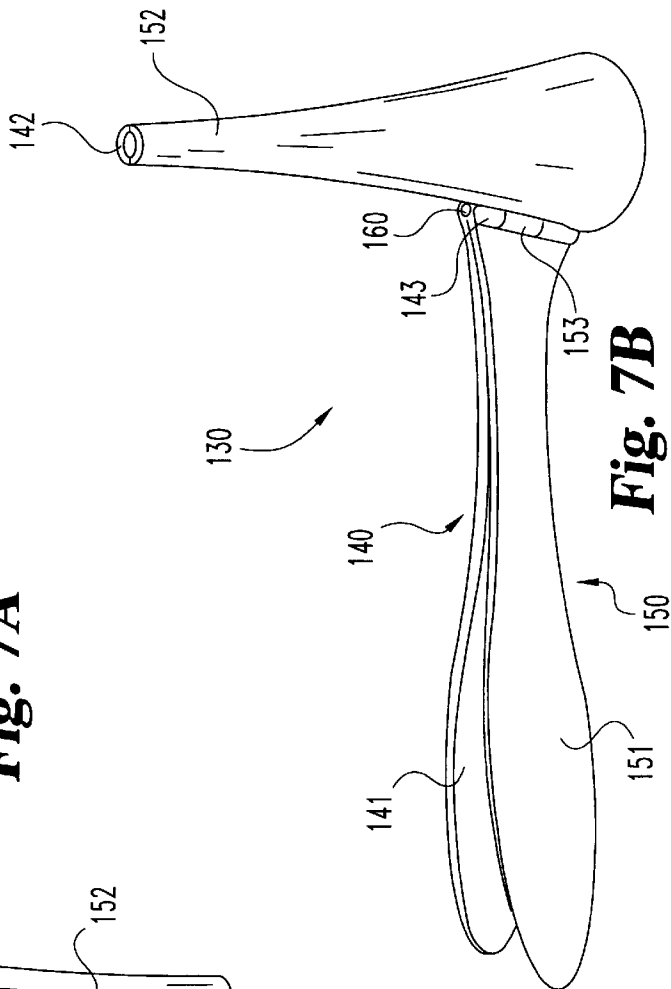
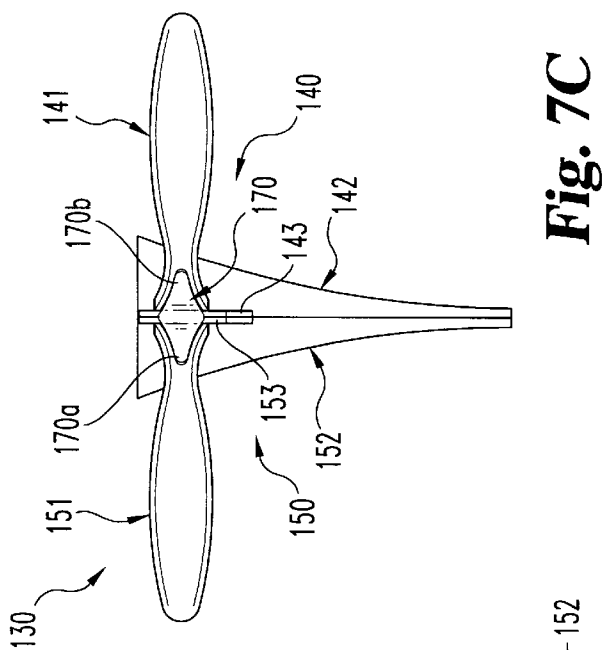
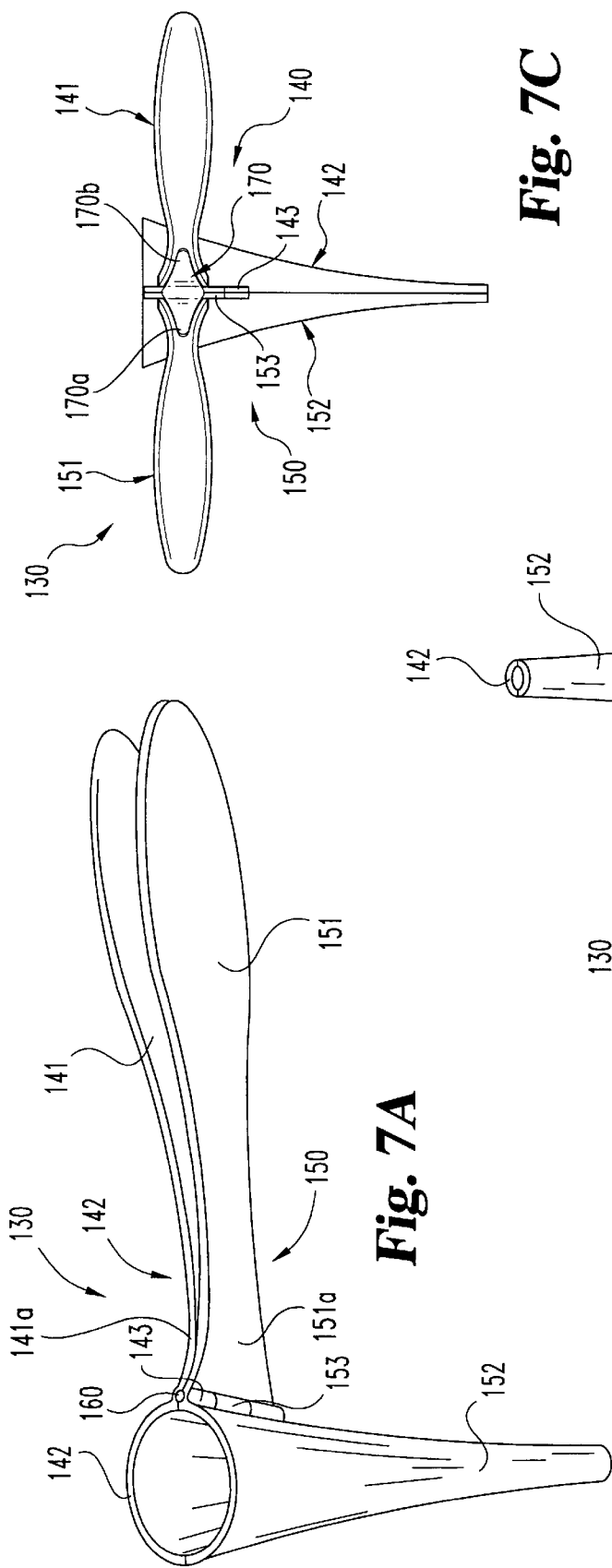
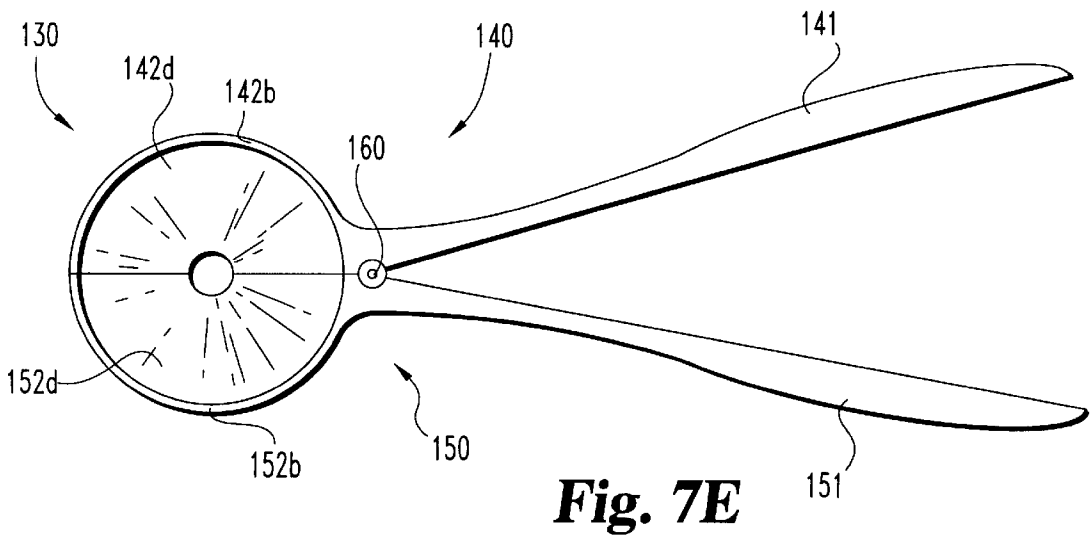
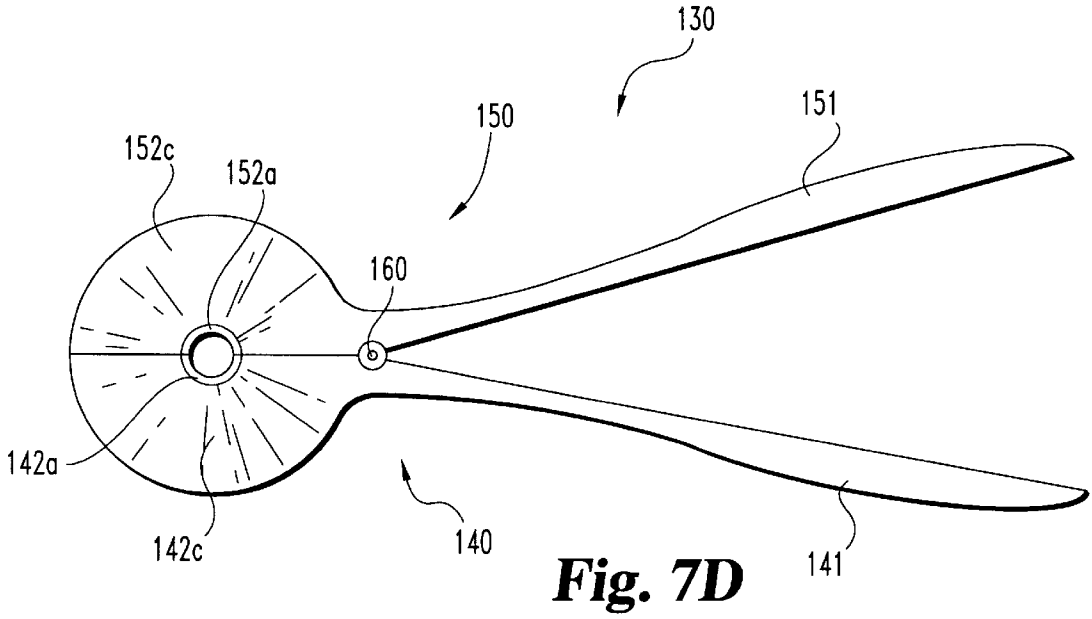


Fig. 6F





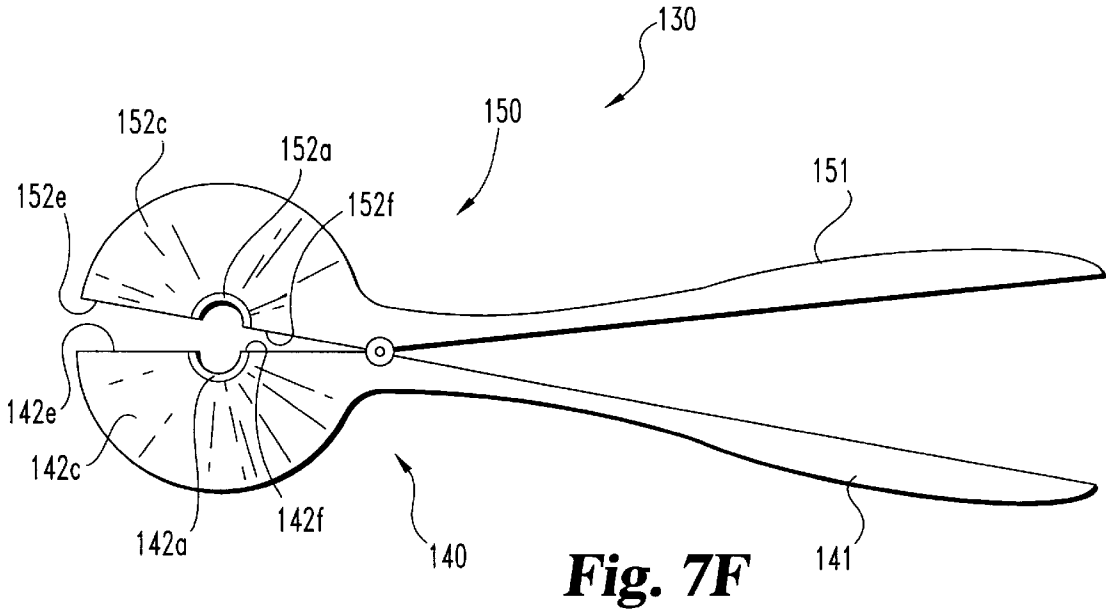


Fig. 7F

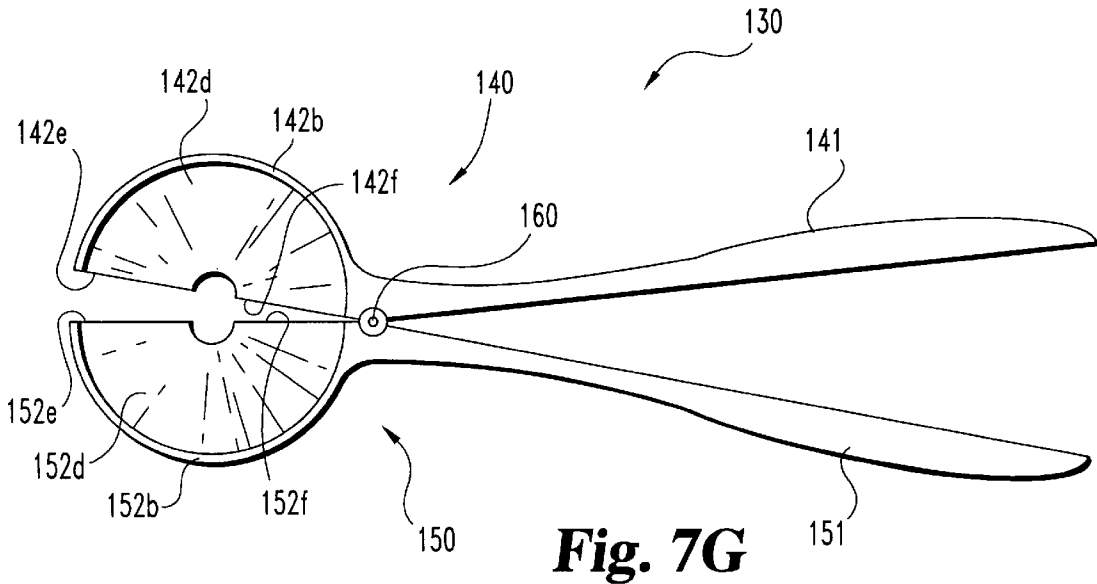


Fig. 7G

**SURGICAL INSTRUMENT FOR
EXTRACTING TISSUE INGROWTH FROM A
PERMEABLE MEMBER OF AN IMPLANTED
CATHETER**

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of surgical instrumentation. More particularly, the present invention relates to surgical instruments which are used to remove an implanted catheter from a patient.

2. Background

Catheters are surgically implanted in a patient when it is necessary to provide medications, blood products, liquid food, etc. to the patient for a significant amount of time. It is essential in such cases that the implanted catheter is anchored within the patient. One approach to anchoring the implanted catheter is the placement of a permeable member of the implanted catheter inside the patient to promote tissue ingrowth within the permeable member. Typically, the permeable member is either a catheter tube or a cuff affixed around the catheter tube as described in U.S. Pat. Nos. 4,266,999, and 4,405,313, hereby incorporated by reference. A commercial example of a cuff is a Dacron® cuff **12** of a Cook TPN™ (Total Parenteral Nutrition) single lumen catheter **10** as shown in FIG. 1. Referring to FIGS. 1 and 2, an illustrative implantation of catheter **10** involves surgically creating a subcutaneous tunnel **23** through a skin **20** and a tissue **21** of the patient to a blood vessel **22** of the patient, inserting a distal end **11a** of a catheter tube **11** of catheter **10** through subcutaneous tunnel **23** into blood vessel **22**, and positioning cuff **12** midway between a skin entry point **20a** and a blood vessel entry point **22a**. Subsequently, tissue adhesion occurs along an interface A of cuff **12** and tissue **21** to promote ingrowth of a portion **21a** of tissue **21** within cuff **12** as shown in FIG. 2. As a result, portion **21a** of tissue **21** anchors catheter tube **11** within the patient. Upon completion of the treatment, catheter tube **11** must be removed from the patient. Presently, a cutting instrument, e.g. a scalpel, is utilized to dissect cuff **12** away from tissue **21**. Referring to FIG. 3, the drawbacks associated with the utilization of a cutting instrument are the concurrent dissection of portion **21a** and a portion **21b** of tissue **21** away from tissue **21**, the difficulty in minimizing the amount of portion **21b** of tissue **21** that is dissected with cuff **12**, and the promotion of a substantial amount of bleeding at **24** throughout subcutaneous tunnel **23**.

SUMMARY OF THE INVENTION

The present invention provides a new and unique surgical instrument for removing an implanted catheter which operates to extract tissue ingrowth from a permeable member of an implanted catheter. The surgical instrument is easy and convenient to use, and overcomes the aforementioned drawbacks associated with the utilization of a scalpel to dissect tissue adhering to the permeable member of the implanted catheter.

As shown in the following description of the preferred embodiments, a surgical instrument is operable to extract a tissue ingrowth out of a permeable member of a catheter implanted in a patient by forcibly pulling the tissue ingrowth out the permeable member. The surgical instrument comprises a first extracting component including a first wedge having a blunted leading edge, and a second extracting component including a second wedge having a blunted leading edge. The extracting components are pivotally

coupled to move the wedges to a closed position or to an open position. The blunted leading edges of the wedges are sized and shaped to be lodged adjacent an adhesion interface of the permeable member and the tissue of the patient when the wedges are in the closed position. As a result, the wedges can be pivotally moved to the open position to forcibly pull the tissue ingrowth out of the permeable member.

It is an object of the present invention to provide a surgical instrument for removing a catheter implanted within a patient which is operable to forcibly pull tissue ingrowth out of a permeable member of the catheter without any deliberate dissection of the permeable member away from the tissue of the patient.

It is another object of the present invention to provide a surgical instrument for removing a catheter implanted within a subcutaneous tunnel of a patient which minimizes the amount of blood induced throughout the subcutaneous tunnel as the catheter is being removed.

These and other objects and advantages of the present invention will become more apparent from a review of the following description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal view of a Cook TPN™ (Total Parenteral Nutrition) single lumen catheter.

FIG. 2 is a view of a catheter tube and a Dacron™ cuff of the catheter of FIG. 1 implanted in a fragmented, cross-sectional view of a patient.

FIG. 3 is a view of the catheter tube and the cuff of the implanted catheter of FIG. 2 dissected from the patient of FIG. 2.

FIGS. 4A-4B are longitudinal views of a first preferred embodiment of a surgical instrument for extracting tissue ingrowth from the cuff of the implanted catheter of FIG. 2.

FIGS. 5A-5C are views of a first wedge and a second wedge of the surgical instrument of FIGS. 4A and 4B.

FIGS. 6A-6F are views of an exemplary illustration of an utilization of the surgical instrument of FIGS. 4A and 4B extracting tissue ingrowth from the cuff of the implanted catheter of FIG. 2.

FIGS. 7A-7G are views of a second preferred embodiment of a surgical instrument for extracting tissue ingrowth from the cuff of the implanted catheter of FIG. 2.

DESCRIPTION OF THE PREFERRED
EMBODIMENTS

For the purposes of promoting an understanding of the principles of the present invention, reference will now be made to the preferred embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the present invention is thereby intended, such alterations and further modifications in the illustrated embodiments and such further applications of the principles of the present invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the present invention relates.

FIGS. 4A and 4B are longitudinal views of a surgical instrument **30** according to a first preferred embodiment of the present invention. Referring to FIGS. 4A and 4B, surgical instrument **30** comprises a first extracting component **40**, and a second extracting component **50**. First extracting component **40** includes an arm **41**, a wedge **42** integrated to a distal end **41a** of arm **41**, a finger hole **43** integrated to a

proximal end **41b** of arm **41**, a saw tooth **44** integrated to proximal end **41b** of arm **41**, and a pivot pin **45** integrated to a middle section **41c** of arm **41**. Second extracting component **50** includes an arm **51**, a wedge **52** integrated to a distal end **51a** of arm **51**, a finger hole **53** integrated to a proximal end **51b** of arm **51**, and a saw tooth **54** integrated to proximal end **51b** of arm **51**. A middle section **51c** of arm **51** is pivotally coupled to pivot pin **45** to thereby allow a user of surgical instrument **30** to move wedge **42** and wedge **52** to an open position and a closed position via finger hole **43** and finger hole **53**. An open position of wedge **42** and wedge **52** is with an engagement of saw tooth **44** and saw tooth **54** to some extent as shown, for example, in FIG. **4A**. A closed position of wedge **42** and wedge **52** is with a disengagement of saw tooth **44** and saw tooth **54** to some extent as shown, for example, in FIG. **4B**. Wedge **42** and wedge **52** constitute a radially expandable wedge assembly when in the closed position.

FIG. **5A** is an enlarged side view of wedge **42** and wedge **52** in a closed position, FIG. **5B** is an enlarged front view of wedge **42** and wedge **52** in a closed position, and FIG. **5C** is an enlarged rear view of wedge **42** and wedge **52** in a closed position. Referring to FIGS. **5A–5C**, wedge **42** has a blunted leading edge **42a**, a rear edge **42b**, a convex surface **42c** tapering from rear edge **42b** to blunted leading edge **42a**, a concave surface **42d** tapering from rear edge **42b** to blunted leading edge **42a**, a first side edge **42e** and a second side edge **42f**. Wedge **52** has a blunted leading edge **52a**, a rear edge **52b**, a convex surface **52c** tapering from rear edge **52b** to blunted leading edge **52a**, a concave surface **52d** tapering from rear edge **52b** to blunted leading edge **52a**, a first side edge **52e** and a second side edge **52f**. Concave surface **42d** and concave surface **52d** are proximally positioned to some extent when wedge **42** and wedge **52** are in a closed position. Preferably, first side edge **42e** of wedge **42** and first side edge **52e** of wedge **52** abut, and second side edge **42f** of wedge **42** and second side edge **52f** of wedge **52** abut when wedge **42** and wedge **52** are in a closed position as best shown in FIGS. **5B** and **5C**. Convex surface **42c** of wedge **42** is integrated to distal end **41a** of arm **41** (not shown in FIGS. **5A–5C**), and convex surface **52c** of wedge **52** is integrated to distal end **51a** of arm **51** (not shown in FIGS. **5A–5C**) as best shown in FIGS. **4A** and **4B**.

Referring back to FIGS. **5A–5C**, blunted leading edge **42a** of wedge **42** and blunted leading edge **52a** of wedge **52** are sized and shaped to be lodged adjacent an adhesion interface of a patient's tissue and a permeable member of a catheter when wedge **42** and wedge **52** are in a closed position as further described in FIGS. **6A–6F**, and accompanying text. It is to be appreciated and understood that the size and shape of a permeable member of a catheter can vary. Thus, the present invention contemplates that the size and shape of blunted leading edge **42a** and blunted leading edge **52a** can vary. For purposes of describing surgical instrument **30**, blunted leading edge **42a** and blunted leading edge **52a** are shown in FIGS. **5B** and **5C** as having a semi-circular configuration whereby blunted leading edge **42a** and blunted leading edge **52a** can be lodged adjacent an adhesion interface of a patient's tissue and a substantially cylindrical permeable member of a catheter, e.g. cuff **12** of catheter **10** as shown in FIG. **1**, when wedge **42** and wedge **52** are in a closed position.

Referring back to FIGS. **5A–5C**, concave surface **42d** of wedge **42** and concave surface **52d** of wedge **52** are sized and shaped to clench a permeable member of a catheter when wedge **42** and wedge **52** are in a closed position as further described in FIGS. **6A–6F**, and accompanying text.

Again, it is to be appreciated and understood that the size and shape of a permeable member of a catheter can vary. Thus, the present invention contemplates that the size and shape of concave surface **42d** and concave surface **52d** can vary. For purposes of describing surgical instrument **30**, concave surface **42d** and concave surface **52d** are shown as having a semi-cylindrical configuration in FIGS. **5B** and **5C** whereby concave surface **42d** and concave surface **52d** can clench a substantially cylindrical permeable member of a catheter, e.g. cuff **12** of catheter **10** as shown in FIG. **1**, when wedge **42** and wedge **52** are in a closed position.

An exemplary illustration of an utilization of surgical instrument **30** to extract tissue ingrowth **21a** from cuff **12** of an implanted catheter **10** as shown in FIG. **2** will now be described herein. Referring to FIG. **6A**, wedge **42** and wedge **52** are pivotally moved to an open position via finger hole **43** (not shown) and finger hole **53** (not shown) to receive catheter tube **11**, and then wedge **42** and wedge **52** are pivotally moved to a closed position to secure catheter tube **11** between wedge **42** and wedge **52**. Referring to FIG. **3B**, antecedently, concurrently or subsequently to securing catheter tube **11** between wedge **42** and wedge **52**, skin entry point **20a** is expanded as necessary to receive wedge **42** and wedge **52**. The present invention contemplates that the expansion of skin entry point **20a** may be partially or entirely achieved by closing and opening wedge **42** and wedge **52** as needed. Wedge **42** and wedge **52** are then inserted through skin entry point **20a**, and advanced through subcutaneous tunnel **23** until blunted leading edge **42a** and blunted leading edge **52a** are lodged adjacent an adhesion interface **A** of cuff **12** and tissue **21**. The present invention contemplates that wedge **42** and wedge **52** can be opened and closed as needed to facilitate the insertion and advancement of wedge **42** and wedge **52** through subcutaneous tunnel **23**.

Referring to FIG. **6C**, upon lodging blunted leading edge **42a** and blunted leading edge **52a** adjacent adhesion interface **A**, wedge **42** and wedge **52** are pivotally moved to an open position whereby portion **21a** of tissue **21** is forcibly pulled out of cuff **12**. It is to be appreciated and understood that depending on the length of cuff **12**, all of portion **21a** of tissue **21** may or may not be forcibly pulled out of cuff **12** when wedge **42** and wedge **52** are pivotally moved to an open position. For this exemplary illustration, half of portion **21a** of tissue **21** is shown as being forcibly pulled out of cuff **12**. Therefore, wedge **42** and wedge **52** are pivotally moved to a closed position and further advanced through subcutaneous tunnel **23** until blunted leading edge **42a** and blunted leading edge **52a** are reloaded adjacent adhesion interface **A** of cuff **12** and tissue **21** as shown in FIG. **6D**. Subsequently, wedge **42** and wedge **52** are again pivotally moved to an open position whereby the remaining half of portion **21a** of tissue **21** is forcibly pulled out of cuff **12** as shown in FIG. **6E**. Referring to FIG. **6F**, upon the complete extraction of portion **21a** of tissue **21** from cuff **12**, wedge **42** and wedge **52** are pivotally moved to a closed position whereby concave surface **42d** and concave surface **52d** clench cuff **12** and cuff **12** can be removed from subcutaneous tunnel **23**. It is to be appreciated and understood that the lodging of blunted leading edge **42** and blunted leading edge **52** and the forcible pulling of portion **21a** of tissue **21** from cuff **12** by wedge **42** and wedge **52** should not dissect any portion of tissue **21**. Consequently, it is to be further appreciated and understood that the likelihood of bleeding through subcutaneous channel **23** is significantly reduced.

FIG. **7A** is a user end or perspective view of a surgical instrument **130** in accordance with a second preferred

embodiment of the present invention, FIG. 7B is a working tip end or front perspective view of surgical instrument 130, and FIG. 7C is a between-handle view of surgical instrument 130. Referring to FIGS. 7A–7C, surgical instrument 130 comprises a first extracting component 140, a second extracting component 150, a pivot pin 160, and a spring 170. First extracting component 140 includes a handle 141, a wedge 142, and a hinge component 143 integrated to a top end 141a of handle 141 and to wedge 142. Second extracting component 150 includes a handle 151, a wedge 152, and a hinge component 153 integrated to a top end 151a of handle 151 and to wedge 152. Hinge component 143 and hinge component 153 are mated to constitute a hinge. Pivot pin 160 is inserted into hinge component 143 and hinge component 153 to thereby allow a user of surgical instrument 130 to pivotally move wedge 142 and wedge 152 to a closed position or to an open position via handle 141 and handle 151. A closed position of wedge 142 and wedge 152 occurs when wedge 142 and wedge 152 are proximally positioned to some extent. Preferably, wedge 142 and wedge 152 abut when in a closed position, for example, as shown in FIGS. 7A–7E. Wedge 142 and wedge 152 constitute a radially expandable wedge assembly when in a closed position. An open position of wedge 142 and wedge 152 occurs when wedge 142 and wedge 152 are spaced apart to some extent, for example, as shown in FIGS. 7F and 7G, and described in accompanying text. Spring 170 has a first end 170a affixed to handle 151 of extracting component 150, and a second end 170b affixed to handle 141 of extracting component 140 to thereby bias wedge 142 and wedge 152 into a closed position.

FIG. 7D is a front view of wedge 142 and wedge 152 in a closed position, and FIG. 7E is a rear view of wedge 142 and wedge 152 in a closed position. FIG. 7F is front view of wedge 142 and wedge 152 in an open position, and FIG. 7G is a rear view of wedge 142 and wedge 152 in an open position. Referring to FIGS. 7D–7G, wedge 142 has a blunted leading edge 142a, a rear edge 142b, a convex surface 142c tapering from rear edge 142b to blunted leading edge 142a, a concave surface 142d tapering from rear edge 142b to blunted leading edge 142a, a first side edge 142e and a second side edge 142f. Wedge 152 has a blunted leading edge 152a, a rear edge 152b, a convex surface 152c tapering from rear edge 152b to blunted leading edge 152a, a concave surface 152d tapering from rear edge 152b to blunted leading edge 152a, a first side edge 152e and a second side edge 152f. Preferably, side edge 142e of wedge 142 and side edge 152e of wedge 152 abut, and side edge 142f of wedge 142 and side edge 152f of wedge 152 abut when wedge 142 wedge 152 are in a closed position as shown in FIGS. 7D and 7E. Side edge 142e of wedge 142 and side edge 152e of wedge 152 are spaced apart, and side edge 142f of wedge 142 and side edge 152f of wedge 152 are spaced apart when wedge 142 wedge 152 are in an open position as shown in FIGS. 7F and 7G.

As with blunted leading edge 42a of wedge 42 and blunted leading edge 52a of wedge 52, blunted leading edge 142a of wedge 142 and blunted leading edge 152a of wedge 152 are sized and shaped to be lodged adjacent an adhesion interface of a patient's tissue and a permeable member of a catheter when wedge 142 and wedge 152 are in a closed position. It is to be appreciated and understood that the size and shape of a permeable member of a catheter can vary. Thus, the present invention contemplates that the size and shape of blunted leading edge 142a and blunted leading edge 152a can vary. For purposes of describing surgical instrument 130, blunted leading edge 142a and blunted

leading edge 152a are shown in FIGS. 7D–7G as having semi-circular configurations whereby blunted leading edge 142a and blunted leading edge 152a can be lodged adjacent an adhesion interface of a patient's tissue and a substantially cylindrical permeable member of a catheter, e.g. cuff 12 of catheter 10 as shown in FIG. 1, when wedge 142 and wedge 152 are in a closed position.

Referring back to FIGS. 7D–7G, as with concave surface 42d of wedge 42 and concave surface 52d of wedge 52, concave surface 142d of wedge 142 and concave surface 152d of wedge 152 are sized and shaped to clench a permeable member of a catheter when wedge 142 and wedge 152 are in a closed position. Again, it is to be appreciated and understood that the size and shape of a permeable member of a catheter can vary. Thus, the present invention contemplates that the size and shape of concave surface 142d and concave surface 152d can vary. For purposes of describing surgical instrument 130, concave surface 142d and concave surface 152d are shown in FIGS. 7D–7G as having semi-cylindrical configuration whereby concave surface 142d and concave surface 152d can clench a substantially cylindrical permeable member of a catheter, e.g. cuff 12 of catheter 10 as shown in FIG. 1, when wedge 142 and wedge 152 are in a closed position.

While the present invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that the preferred embodiments have been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.

What is claimed is:

1. A method for extracting a catheter from an animal body site in which there has been tissue ingrowth in a permeable member affixed around the catheter, said method comprising the steps of:

- (a) mounting a radially expandable wedge assembly on the catheter;
- (b) inserting a working end of the wedge assembly into the tissue at the body site; and
- (c) spreading the working end of the wedge assembly radially with respect to the catheter at the site to thereby pull the tissue ingrowth out of the permeable member.

2. The method of claim 1 further comprising a step (d) of clenching the catheter with the working end of the wedge assembly following a complete extraction of the tissue ingrowth from the permeable member and then pulling the catheter out of the body site.

3. A method for extracting a tissue ingrowth out of a permeable member affixed around a catheter tube, the catheter tube having a first portion outside of the patient and a second portion inserted through a subcutaneous tunnel of a patient, the permeable member being disposed within the subcutaneous tunnel of the patient, the permeable member having an adhesion interface with a tissue of the patient, said method utilizing a surgical instrument comprising a first extracting component including a first wedge and a second extracting component including a second wedge, the first extracting component and the second extracting component pivotally coupled to move the first wedge and the second wedge to an open position or a closed position, said method comprising the steps of:

- (a) mounting the first wedge and the second wedge on the first portion of the catheter tube;
- (b) inserting the first wedge and the second wedge into the subcutaneous tunnel;

- (c) advancing the first wedge and the second wedge along the second portion of the catheter tube;
- (d) pivotally moving the first wedge and the second wedge to the closed position as the first wedge and the second wedge are advanced along the second portion of the catheter tube to lodge the first wedge and the second wedge adjacent the adhesion interface of the permeable member and the tissue of the patient; and
- (e) subsequently pivotally moving the lodged first wedge and second wedge to the open position to forcibly pull the tissue ingrowth out of the permeable member.

4. The method of claim 3 wherein said step (a) includes pivotally moving the first wedge and the second wedge to the open position to receive the first portion of the catheter tube therebetween, and pivotally moving the first wedge and the second wedge to the closed position to secure the first portion of the catheter tube therebetween.

5. The method of claim 3 wherein said step (b) includes pivotally moving the first wedge and the second wedge to the open position and/or the closed position as needed to

facilitate said insertion of the first wedge and the second wedge into the subcutaneous tunnel of the patient.

6. The method of claim 3 wherein said step (c) includes pivotally moving the first wedge and the second wedge to the open position and/or the closed position as needed to facilitate said advancement of the first wedge and the second wedge along the second portion of the catheter tube.

7. The method of claim 3 further comprising a step (f) of repeating steps (c), and (e) as required to completely extract the tissue ingrowth out of the permeable member.

8. The method of claim 7 further comprising a step (g) of pivotally moving the first wedge and the second wedge to a closed position upon a complete extraction of the tissue ingrowth from the permeable member to clench the permeable member whereby the second portion of the catheter tube can be removed from the subcutaneous tunnel of the patient.

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