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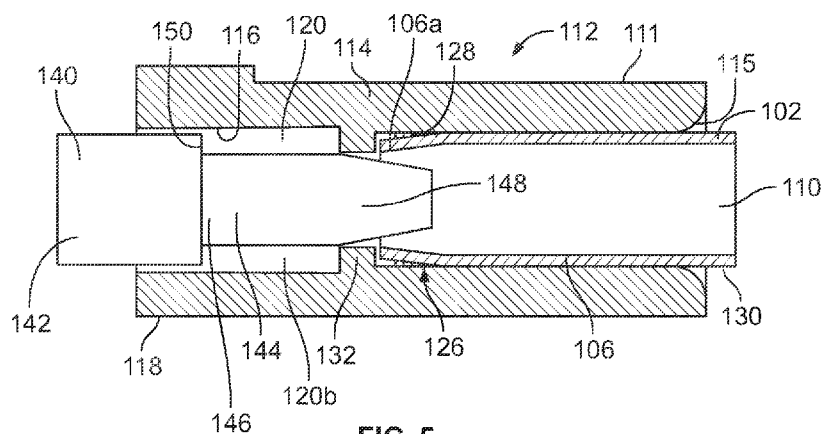


FIG. 5

(57) Abstract: A drainage member (112) including energy receivers (128) for bonding to a catheter shaft (102) using energy, and a urinary catheter including such a drainage member. A method for energy welding a drainage member to a catheter shaft wherein the drainage member includes energy receivers.

**URINARY CATHETER HAVING A SHAFT AND DRAINAGE MEMBER  
WELDED TO EACH OTHER AND METHODS OF MAKING THE SAME**

The present application claims the benefit of and priority to U.S. Provisional Patent Application No. 63/513,783, filed July 14, 2024, the disclosure of which is hereby incorporated herein by reference.

**FIELD OF DISCLOSURE**

[0001] The present disclosure generally relates to urinary catheter products. More particularly, the present disclosure generally relates to intermittent urinary catheters having a drainage member welded to the shaft of the catheter. The present disclosure also relates to a drainage member having energy receivers for assisting in welding of the drainage member to the catheter shaft. The present disclosure also relates to methods of making a urinary catheter.

**BACKGROUND**

[0002] Generally, urinary catheters are manufactured to include a drainage member, such as a funnel, at a distal drainage end of a urinary catheter shaft (also referred to as a catheter tube). In one method of making a urinary catheter, the drainage member is attached to the catheter shaft by solvent bonding. One of the challenges associated with solvent bonding is that the solvents used in the manufacturing process may be volatile, which creates safety issues with storing and using such solvents.

[0003] Another method of bonding a catheter shaft to a funnel is by welding, such as ultrasonic welding. The catheter shaft and drainage member are made from a polymer. Ultrasonic welding includes applying energy to seal the catheter shaft to the drainage member with a welding device, such as a sonotrode with an ultrasonic tip. There are challenges associated with ultrasonic welding. For example, there are challenges associated with being able to repeatedly form a strong and stable bond between the catheter shaft and the drainage member.

[0004] There is a need for an improved urinary catheter having a strong and stable connection between the shaft and the drainage member and methods of making the same.

**SUMMARY**

[0005] In one aspect, an intermittent urinary catheter with a catheter shaft having a catheter shaft proximal insertion end and a catheter shaft distal end. The urinary catheter also includes a drainage member having a wall defining a drainage member inner surface. The drainage member inner surface defining a drainage lumen having an opening in a proximal end of the drainage member. A bonding section of the drainage member inner surface comprising one or more energy receivers. The catheter shaft distal end is inserted through the opening of the proximal end of the drainage member and located in the drainage lumen of the drainage member and the catheter shaft distal end is in contact with the bonding section of the drainage member inner surface.

[0006] In another aspect, a drainage member for an intermittent urinary catheter includes a wall defining a drainage member inner surface. The drainage member inner surface defining a drainage lumen having an opening in a proximal end of the drainage member. The opening is configured to receive a distal end of a catheter shaft. A bonding section of the drainage member inner surface comprising one or more energy receivers, wherein the bonding section is configured to be welded to the distal end of the catheter shaft.

[0007] In another aspect, a method of welding a urinary catheter shaft to a drainage member includes inserting a distal end of a catheter shaft into a drainage member through a proximal opening of the drainage member, wherein the drainage member includes a wall defining a drainage member inner surface. The drainage member inner surface defining a drainage lumen in communication with the proximal opening of the drainage member, and the drainage member inner surface including a bonding section comprising energy receivers. The distal end of the catheter surface and the energy receivers are brought into contact. Energy is applied to weld the distal end of the catheter shaft and the bonding section of the drainage member inner surface together.

#### BRIEF DESCRIPTION OF DRAWINGS

[0008] Fig. 1 is perspective view of an intermittent urinary catheter in accordance with the present disclosure.

[0009] Fig. 2 is an enlarged cross-sectional view of the drainage member of the urinary catheter shown in Fig 1.

[0010] Fig. 2A is a partial enlarged cross-sectional view of the drainage member of Fig. 2.

[0011] Fig. 3 is a partial enlarged cross-sectional view of the drainage member of Fig. 2 shown with the catheter shaft in cross-section and located in the  
5 drainage lumen of the drainage member.

[0012] Fig. 4 is a partial enlarged cross-sectional view of the drainage member of Fig. 2 shown with the catheter shaft located in the drainage lumen of the drainage member.

[0013] Fig. 5 is a partial enlarged cross-sectional view of the drainage member  
10 of Fig. 2 shown with the catheter shaft located in the drainage lumen of the drainage member and an energy device advanced through the distal portion of the drainage lumen of the drainage lumen and into the distal opening of the catheter shaft.

[0014] Fig. 6 is a partial enlarged cross-sectional view of the drainage member  
15 of Fig. 2 shown with the catheter shaft located in the proximal compartment of the drainage member and an energy device advanced through the distal portion of the drainage lumen of the drainage lumen and into the distal opening of the catheter shaft.

#### DETAILED DESCRIPTION

[0015] While the subject matter of the present disclosure is susceptible to  
20 embodiments in various forms, there will hereinafter be described presently preferred embodiments with the understanding that the present disclosure is to be considered an exemplification and is not intended to limit the disclosure to the specific embodiments illustrated. The words "a" or "an" are to be taken to include  
25 both the singular and the plural. Conversely, any reference to plural items shall, where appropriate, include the singular.

[0016] Fig. 1 shows an embodiment of an intermittent urinary catheter 100. Urinary catheter 100 comprises a catheter shaft 102 (also referred to as a catheter tube) having a proximal insertion end 104 and a catheter shaft distal end 106.  
30 Proximal insertion end 104 includes eyelets or drainage openings 108 for draining urine from a bladder. Eyelets 108 are in fluid communication with a catheter lumen 110 (Fig. 3) of catheter shaft 102. Proximal insertion end 104 of catheter shaft 102 is inserted through the urethra and into the bladder. When proximal

insertion end 104 of catheter shaft 102 is located in the bladder, urine drains from the bladder through eyelets 108 and catheter lumen 110 of catheter shaft 102.

[0017] Referring to Figs. 1 and 2, urinary catheter 100 also comprises a drainage member 112, which may be a funnel or a connector for connecting to a urine collection receptacle. Proximal end portion 111 of drainage member 112 is attached to catheter shaft distal end 106. Drainage member 112 includes a drainage lumen 120 that extends from proximal opening 115 to distal drainage opening 117 and is in communication with catheter drainage catheter lumen 110 of catheter shaft 102. Urine draining through catheter lumen 110 flows into drainage lumen 120 and out of distal drainage opening 117. Drainage member 112 and catheter shaft 102 may be made of polymers. For example, drainage member 112 and catheter shaft 102 may be made of Thermoplastic elastomers (TPE), Thermoplastic urethanes (TPU), Thermoplastic Polyolefin (TPO), Polyvinyl chloride (PVC), polyether block amides (PEBA).

[0018] Figs. 2 shows an enlarged cross-section of drainage member 112 and Fig. 2A shows a partial enlarged cross-section of drainage member 112. Figs. 3-6 show partial enlarged cross-sections of drainage member 112 having catheter shaft distal end 106 inserted into drainage member 112.

[0019] Drainage member 112 includes a wall 114 having an inner surface 116 and an outer surface 118. Drainage member inner surface 116 defines the drainage lumen 120 in communication with opening 115 in proximal end 111 of drainage member 112. Catheter shaft distal end 106 may be inserted through opening 115 of proximal end 111 of drainage member 112.

[0020] Drainage member inner surface 116 includes a bonding section 126 that has one or more energy receivers 128 associated with drainage member inner surface 116. Energy receivers 128 may be raised energy receivers that may extend from or by raised from drainage member inner surface 116. As will be described in further detail below, when energy is applied to weld or bond catheter shaft 102 and bonding section 126, energy receivers 128 are in contact with catheter shaft 102. Energy receivers 128 absorb energy and melt to form a bond with catheter shaft 102. Energy receivers 128 have an initial configuration prior to the application of energy and have a melted or bonded configuration after the

application of energy. The energy may be any suitable form of energy such as ultrasonic, radio frequency frictional and/or thermal.

**[0021]** In the illustrated embodiment, one or more energy receivers 128 comprise a plurality of energy receivers 128. In some alternatives, one or more  
5 energy receivers 128 are one or more protrusions extending from drainage member inner surface 116. For example, in some alternatives, one or more energy receivers 128 may be one or more ridges extending from drainage member inner surface 116. The one or more energy receivers 128 may be one or more contact points or raised contact points that are extend from the drainage  
10 member inner surface and are in contact with an outer surface 130 of catheter shaft 102. In the illustrated embodiment, one or more energy receivers 128 extend circumferentially around drainage member inner surface 116. For example, energy receivers may be continuous raised ridges separated by valleys, wherein the raised ridges form rings extending from drainage member inner  
15 surface 116 and around catheter shaft distal end 106. The peaks of the ridges contact the surface 130 of catheter shaft 102. In some embodiments, the ridges contact and compress catheter shaft 102. In other alternatives, one or more energy receivers 128 may extend at least partially around drainage member inner surface 116 or have spaced apart interruptions. In some alternatives, one or  
20 more energy receivers 128 include at least two energy receivers that are spaced apart from one another. For example, the at least two energy receivers 128 may be axially spaced and/or longitudinally spaced from one another.

**[0022]** In some embodiments, drainage lumen 120, optionally, includes a proximal compartment 120a and a distal compartment 120b. When drainage  
25 lumen 120 includes proximal compartment 120a, catheter shaft distal end 106 and bonding section 126 of the drainage member inner surface 116 are located in proximal compartment 120a. In some alternatives, a shoulder 132 separates proximal compartment 120a and distal compartment 120b. Shoulder 132 may extend from drainage member inner surface 116. In some alternatives, shoulder  
30 132 is continuous and in other alternatives, shoulder 132 includes segments with interruptions therebetween. Shoulder 132 defines a passageway 134 that is in communication with proximal compartment 120a and distal compartment 120b. Furthermore, catheter lumen 110 of catheter shaft 102 is in fluid communication

with passageway 134 so that urine may flow out of catheter lumen 110 and through drainage lumen 120 of drainage member 112. When a shoulder 132 is present, a terminal distal end 106a of catheter shaft 102 may be in contact with the shoulder 132.

5   **[0023]**   In some alternatives, the minimum cross-sectional width X (Fig. 2A) of bonding section 126 of drainage member inner surface 116 is less than the maximum outer cross-sectional width Y of catheter shaft 102. For example, the minimum inner diameter X of bonding section 126 of drainage member inner surface 116 may be less than the maximum outer diameter of catheter shaft 102.

10   In some alternatives, bonding section 126 of drainage member inner surface 116 contacts and compresses catheter shaft distal end 106. For example, when catheter shaft distal end portion 106 is inserted into drainage lumen 120, energy receivers 128 may contact the outer surface of catheter shaft 102 and compress catheter shaft 102. In some alternatives, energy receivers 128 “hug” or a forced  
15   against catheter shaft distal end 106.

**[0024]**   Referring to Figs. 5 and 6, in one alternative method of manufacturing a catheter, catheter shaft distal end 106 of a catheter shaft 102 is inserted into the drainage member 112 through proximal opening 115 of the drainage member 112. Catheter shaft distal end 106 is energy receivers 128 are brought into  
20   contact. In some embodiments bonding section 126 and/or energy receivers 128 compress catheter shaft distal end portion 106. Energy is applied to weld together the catheter shaft distal end 106 and the bonding section 126 of the drainage member inner surface 116.

**[0025]**   In one alternative, the energy is ultrasonic energy. For example, a sonotrode 140 may be used to apply ultrasonic energy. Sonotrode 140 may  
25   include a main body 142 and a tip 144. In some embodiments, main body 142 has a larger diameter than tip 144. Tip 144 and main body 142 may be inserted through distal opening 117 of drainage member 112 and advanced through drainage lumen 120. Sonotrode tip 144 is advanced through passageway 134 in  
30   shoulder 132 and into catheter lumen 110. When shoulder 132 is present, sonotrode 140 is advanced until main body 142 contacts shoulder 132. Optionally, sonotrode 140 may be turned on and emitting ultrasonic energy as tip 144 enters and is advanced into catheter lumen 110 so that energy is applied

during insertion of sonotrode 140. In some alternatives, tip 144 is of sufficient shape and size to push or force the catheter shaft distal end 106 against bonding section 126 and energy receivers 128. For example, at least a portion of tip 144 has a larger outer diameter than the inner diameter of catheter shaft 102. In some  
5 alternatives, tip 144 is tapered from the proximal end 146 to the distal end 148. As tip 144 enters catheter lumen 110 it pushes the catheter wall into the energy receivers 128.

**[0026]** Ultrasonic energy from sonotrode 140 and sonotrode tip 144 is received by energy receivers 128, which melt to form a bond with catheter shaft 102. For  
10 example, energy receivers 128 change from their initial configuration to the melted configuration, thereby forming a bond between bonding section 126 and catheter shaft distal end 106.

**[0027]** In some alternatives, the distal end 150 of main body 142 of sonotrode 140 contacts shoulder 132 and emits ultrasonic energy that bonds shoulder 132 to  
15 catheter shaft terminal distal end 106a. After bonding has taken place, sonotrode 140 is removed.

**[0028]** In an alternative method, the energy may be other forms of energy, such as radio frequency energy or any other suitable energy.

**[0029]** It should be understood that various changes and modifications to the  
20 presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the invention disclosed herein.

## CLAIMS

1. An intermittent urinary catheter, comprising:  
a catheter shaft having a catheter shaft proximal insertion end and a catheter shaft distal end;  
5 a drainage member including a wall defining a drainage member inner surface, the drainage member inner surface defining a drainage lumen having an opening in a proximal end of the drainage member;  
a bonding section of the drainage member inner surface comprising one or more energy receivers; and  
10 the catheter shaft distal end being inserted through the opening of the proximal end of the drainage member and located in the drainage lumen of the drainage member, the catheter shaft distal end being in contact with the bonding section of the drainage member inner surface.
2. The intermittent urinary catheter of claim 1, wherein the catheter shaft is  
15 bonded to the bonding section of the drainage member inner surface.
3. The intermittent urinary catheter of any one of claims 1 and 2, wherein a minimum cross-sectional width of the drainage lumen at the bonding section is less than an outer cross-sectional width of the catheter shaft distal end.
4. The intermittent urinary catheter of any one of claims 1-3, wherein the  
20 bonding section of the drainage member inner wall contacts and compresses the catheter shaft distal end.
5. The intermittent urinary catheter of any one of claims 1-4, wherein one or more energy receivers comprise a plurality of energy receivers.
6. The intermittent urinary catheter of any one of claims 1-5, wherein the  
25 one or more energy receivers comprise one or more protrusions extending from the drainage member inner surface.
7. The intermittent urinary catheter of any one of claims 1-5, wherein the one or more energy receivers comprise one or more ridges extending from the drainage member inner surface.

8. The intermittent urinary catheter of any one of claims 1-5, wherein the one or more energy receivers comprise one or more contact points in contact with an outer surface of the catheter shaft.

9. The intermittent urinary catheter of any one of claims 1-8, wherein the one or more energy receivers extend circumferentially around the drainage member inner surface.

10. The intermittent urinary catheter of any one of claims 1-9, wherein the one or more energy receivers comprise at least two energy receivers that are spaced apart from one another.

11. The intermittent urinary catheter of any one of claims 1-10, wherein the drainage lumen comprises a proximal compartment and a distal compartment, wherein the catheter shaft distal end and the bonding section of the drainage member inner surface are located in the proximal compartment.

12. The intermittent urinary catheter of claim 11, wherein the proximal compartment and the distal compartment are separated by a shoulder.

13. The intermittent urinary catheter of claim 12, wherein a terminal distal end of the catheter shaft is in contact with the shoulder.

14. The intermittent urinary catheter of claim 13, wherein the terminal distal end of the catheter shaft is bonded to the shoulder.

15. The intermittent urinary catheter of any one of claims 12-14, wherein the shoulder defines a passageway that is in communication with the proximal compartment and the distal compartment.

16. A drainage member for an intermittent urinary catheter, comprising:  
a wall defining a drainage member inner surface, the drainage member inner surface defining a drainage lumen having an opening in a proximal end of the drainage member, wherein the opening is configured to receive a distal end of a catheter shaft; and

a bonding section of the drainage member inner surface comprising one or more energy receivers, wherein the bonding section is configured to be welded to the distal end of the catheter shaft.

17. The drainage member of claim 16, wherein a minimum cross-sectional width of the drainage lumen at the bonding section is less than an outer cross-sectional width of the distal end of the catheter shaft.

18. The drainage member of any one of claims 16-17, wherein the bonding  
5 section of the drainage member inner wall contacts and compresses the catheter shaft distal end.

19. The drainage member of any one of claims 16-18, wherein one or more energy receivers comprise a plurality of energy receivers.

20. The drainage member of any one of claims 16-19, wherein the one or  
10 more energy receivers comprise one or more protrusions extending from the drainage member inner surface.

21. The drainage member of any one of claims 16-19, wherein the one or more energy receivers comprise one or more ridges extending from the drainage member inner surface.

22. The drainage member of any one of claims 16-19, wherein the one or  
15 more energy receivers comprise one or more contact points in contact with an outer surface of the catheter shaft.

23. The drainage member of any one of claims 16-22, wherein the one or more energy receivers extend circumferentially around the drainage member inner  
20 surface.

24. The drainage member of any one of claims 16-23, wherein the one or more energy receivers comprise at least two energy receivers that are spaced apart from one another.

25. The drainage member of any one of claims 16-24, wherein the drainage  
25 lumen comprises a proximal compartment and a distal compartment, wherein the bonding section of the drainage member inner surface is located in the proximal compartment.

26. The drainage member of claim 25, wherein the proximal compartment and the distal compartment are separated by a shoulder.

27. The drainage member of claim 26, wherein the shoulder is configured to be bonded to a terminal distal end of the catheter shaft.

28. The drainage member of any one of claims 26-27, wherein the shoulder defines a passageway that is in communication with the proximal compartment  
5 and the distal compartment.

29. A method of welding a urinary catheter shaft to a drainage member, comprising:

inserting a distal end of a catheter shaft into a drainage member through a proximal opening of the drainage member, wherein the drainage member  
10 includes a wall defining a drainage member inner surface, the drainage member inner surface defining a drainage lumen in communication with the proximal opening of the drainage member, and the drainage member inner surface including a bonding section comprising energy receivers;

bringing the distal end of the catheter surface and the energy receivers  
15 into contact; and

applying energy to weld the distal end of the catheter shaft and the bonding section of the drainage member inner surface together.

30. The method of claim 29, wherein the energy comprises ultrasonic energy.

31. The method of claim 30, wherein the applying energy comprising applying  
20 energy from a sonotrode.

32. The method of claim 31, wherein the sonotrode is inserted into the distal end of the catheter shaft.

33. The method of any one of claims 31 and 32, wherein the energy is applied during insertion of the sonotrode into the distal end of the catheter shaft.

25 34. The method of claim 31, wherein the sonotrode has a tapered tip.

35. The method of any one of claims 32-34, wherein the sonotrode pressures the distal end of the catheter shaft against the energy receivers.

36. The method of claim 29, wherein the energy comprises radio frequency energy.

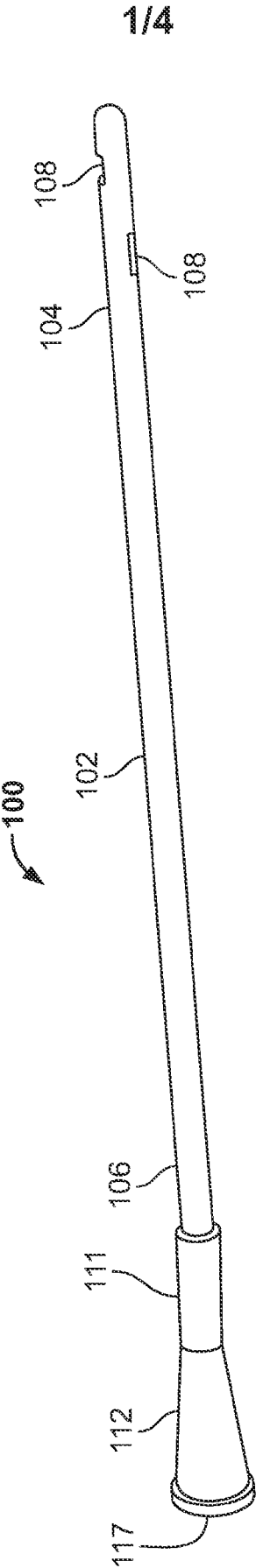
37. The method of any one of claims 29-36, wherein the bonding section compresses the distal end of the catheter shaft.

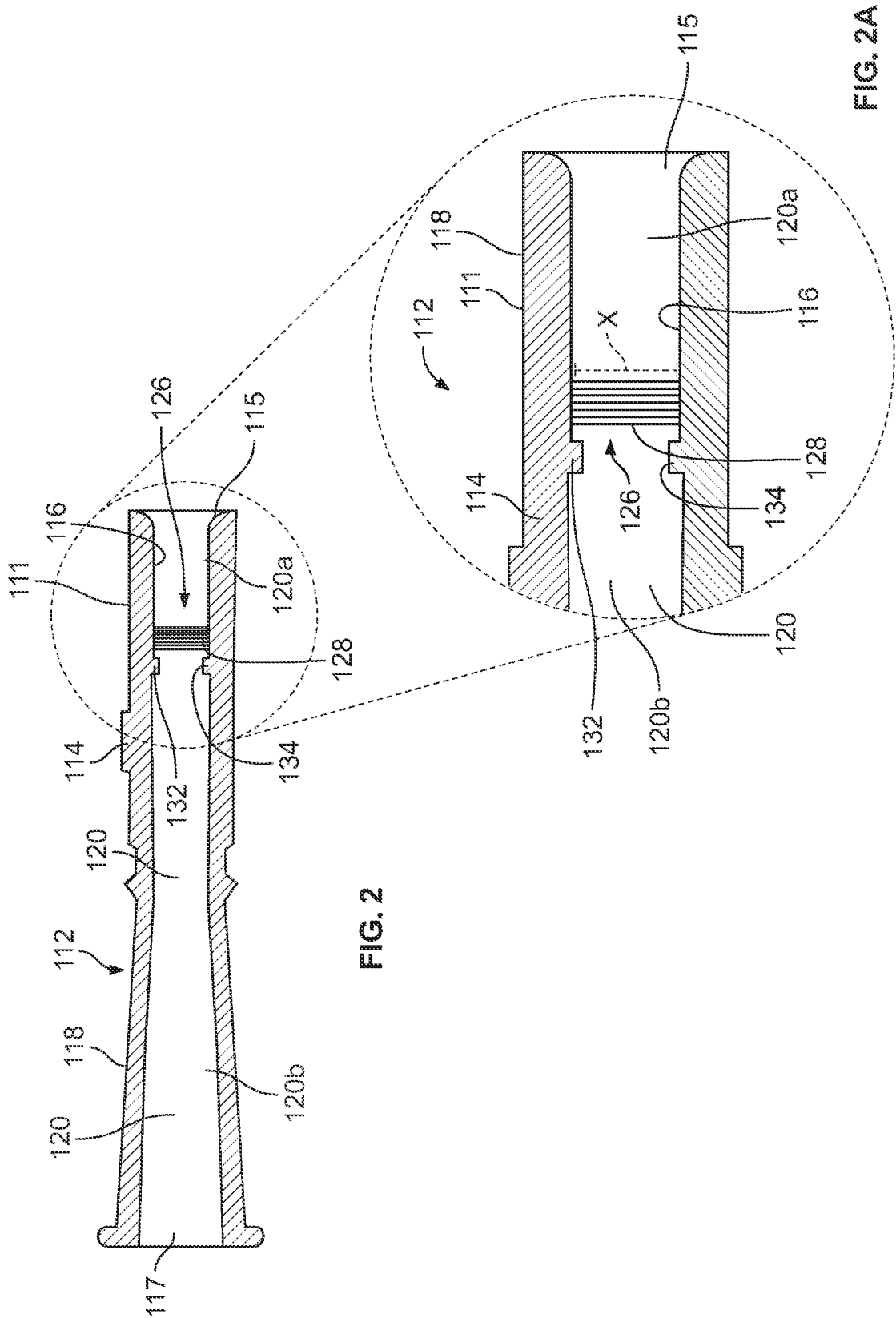
38. The method of any one of claims 29-36, wherein the drainage member includes a shoulder located in the drainage lumen.

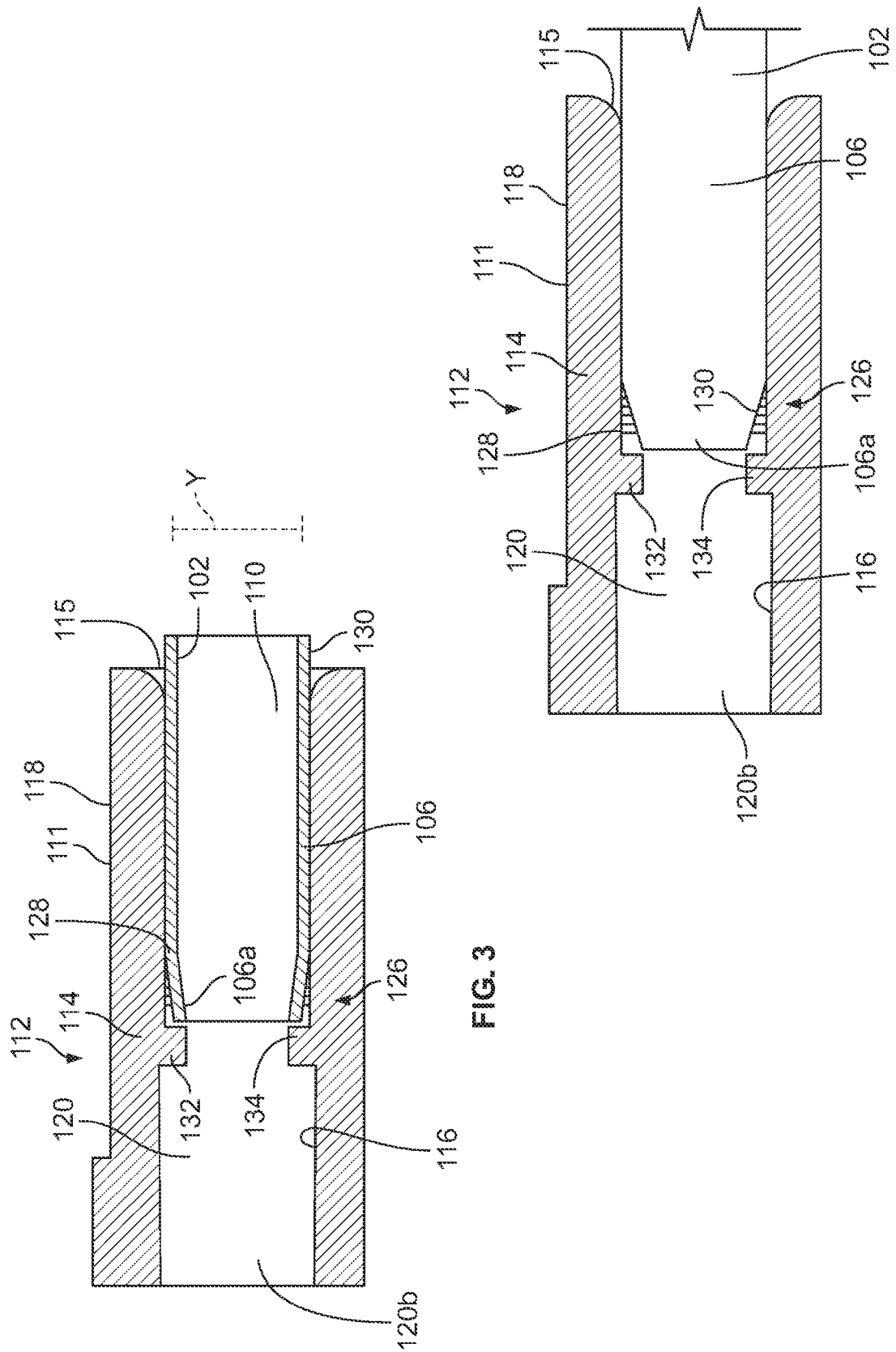
5      39. The method of claim 38, wherein the catheter shaft is inserted into the drainage member so that it contacts the shoulder located in the drainage lumen.

40. The method of any one of claims 38 and 39, further including bonding a terminal distal end of the catheter shaft to the shoulder located in the drainage lumen.

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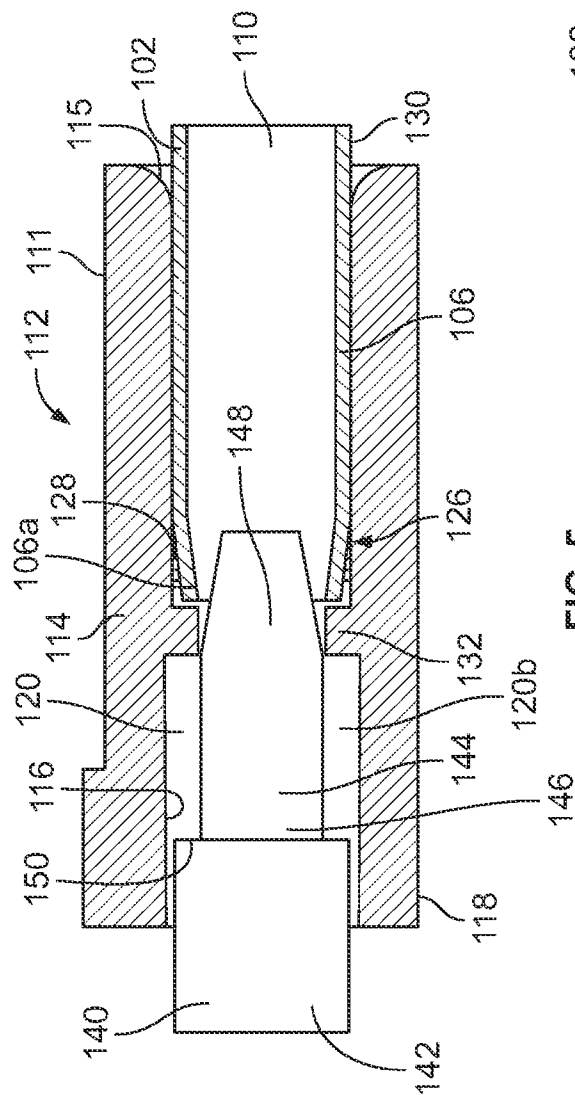


FIG. 5

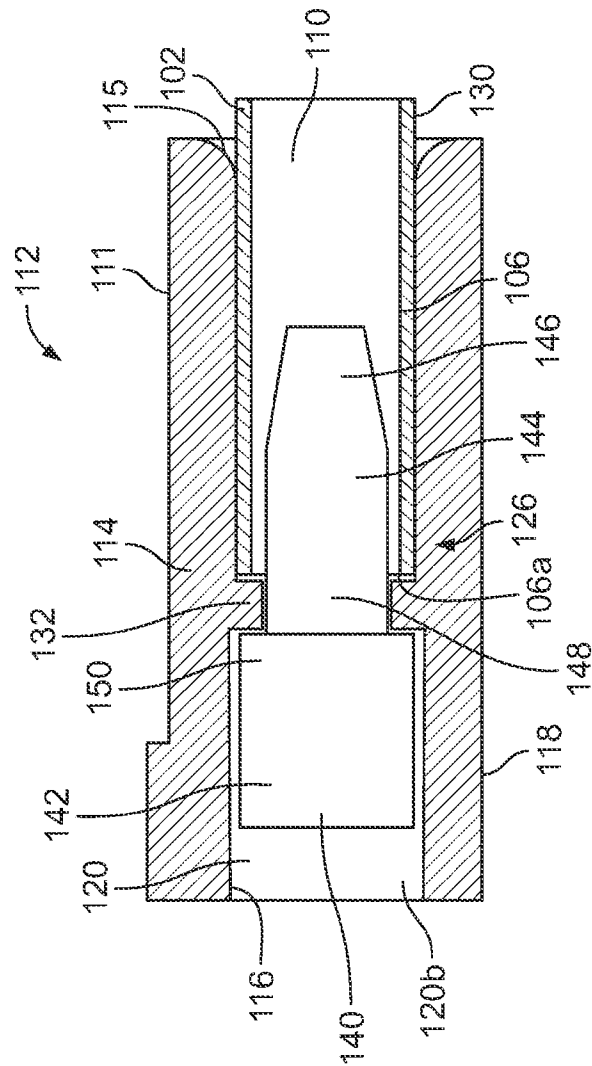


FIG. 6

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2024/037186

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>INV. A61M25/00 A61M27/00<br>ADD.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                        |                                                                      |
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                        |                                                                      |
| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br>A61M F16L<br><br>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br><br>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)<br>EPO-Internal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                        |                                                                      |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                        |                                                                      |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Citation of document, with indication, where appropriate, of the relevant passages                                     | Relevant to claim No.                                                |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | US 2023/191079 A1 (O'DONNELL PAUL M [IE]<br>ET AL) 22 June 2023 (2023-06-22)                                           | 1-40                                                                 |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | paragraphs [0005], [0020]; figures 1-4<br>-----                                                                        | 31-35                                                                |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CN 214 181 455 U (ZHAO ZHENYU)<br>14 September 2021 (2021-09-14)<br>figures 1-3<br>-----                               | 16,17,<br>19-25                                                      |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CN 212 439 009 U (2ND XIANGYA HOSPITAL<br>CENTRAL SOUTH UNIV)<br>2 February 2021 (2021-02-02)<br>claim 2<br>-----      | 16                                                                   |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | US 2009/234432 A1 (PACETTI STEPHEN D [US]<br>ET AL) 17 September 2009 (2009-09-17)<br>paragraph [0074]<br>-----<br>-/- | 31-35                                                                |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                        |                                                                      |
| <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> |                                                                                                                        |                                                                      |
| Date of the actual completion of the international search<br><br>17 October 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                        | Date of mailing of the international search report<br><br>31/10/2024 |
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## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2024/037186

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                               |                       |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------|
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