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CA 2809636 C 2016/07/26

(11)(21) 2 809 636

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2011/09/13
(87) Date publication PCT/PCT Publication Date: 2012/03/22
(45) Date de délivrance/Issue Date: 2016/07/26
(85) Entrée phase nationale/National Entry: 2013/02/26
(86) N° demande PCT/PCT Application No.: US 2011/051338
(87) N° publication PCT/PCT Publication No.: 2012/037082
(30) Priorités/Priorities: 2010/09/14 (US61/382,720); 2010/12/02 (US29/380,242); 2010/12/02 (US61/418,963)

(51) Cl.Int./Int.Cl. *A61M 5/31* (2006.01), *A61M 5/145* (2006.01), *A61M 5/315* (2006.01)

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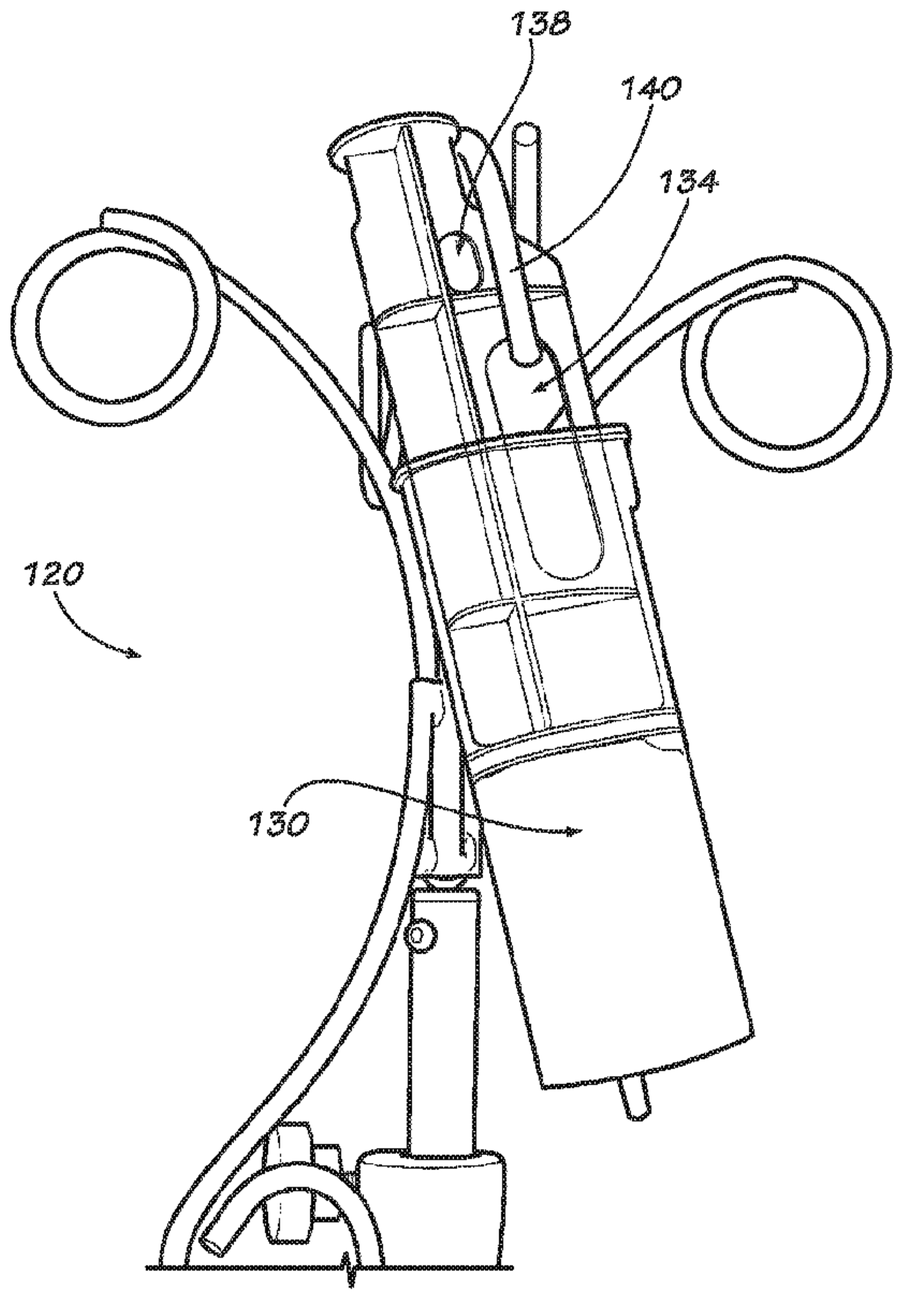
(54) Titre : SERINGUE ENTERALE
(54) Title: ENTERAL SYRINGE



(57) Abrégé/Abstract:
The present invention is an enteral syringe that can include an elongated body having a hollow cavity therein and at least one vent extending from the hollow cavity to an outside surface of the syringe body. The elongated body can have a first non-circular cross-section. The enteral syringe can also have a plunger operable to selectively travel within the hollow cavity. The plunger can additionally have a second non-circular cross-section that substantially mirrors the first non-circular cross-section. The enteral syringe can additionally have at least one support feature for hanging the syringe from a support structure.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 March 2012 (22.03.2012)

PCT

(10) International Publication Number
WO 2012/037082 A1

(51) International Patent Classification:
A61M 5/31 (2006.01) *A61M 5/315* (2006.01)
A61M 5/145 (2006.01)

(21) International Application Number:
PCT/US2011/051338

(22) International Filing Date:
13 September 2011 (13.09.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/382,720 14 September 2010 (14.09.2010) US
61/418,963 2 December 2010 (02.12.2010) US
29/380,242 2 December 2010 (02.12.2010) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title**: ENTERAL SYRINGE

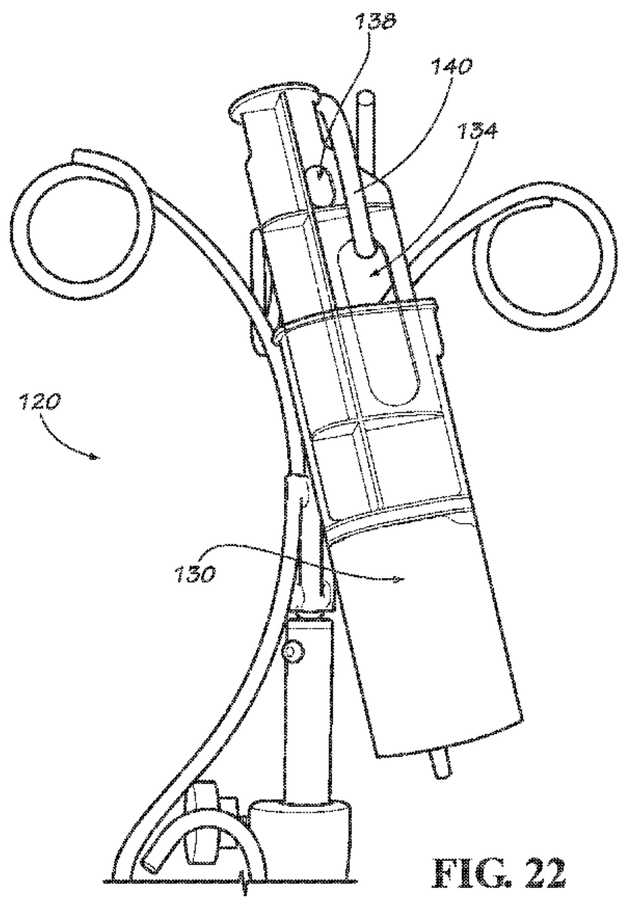

FIG. 22

(57) **Abstract**: The present invention is an enteral syringe that can include an elongated body having a hollow cavity therein and at least one vent extending from the hollow cavity to an outside surface of the syringe body. The elongated body can have a first non-circular cross-section. The enteral syringe can also have a plunger operable to selectively travel within the hollow cavity. The plunger can additionally have a second non-circular cross-section that substantially mirrors the first non-circular cross-section. The enteral syringe can additionally have at least one support feature for hanging the syringe from a support structure.

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ENTERAL SYRINGE

Technical Field

[0002] The present invention relates generally to the field of containment and dispensing of fluids, and more particularly to a containment and dispensing system for biological fluids such as breast milk, and/or other dietary or medicinal materials.

Background of the Invention

[0003] Syringe pumps, or drivers, are small infusion pumps used to gradually administer small amounts of fluid to a patient. When administering drugs (e.g. painkillers, antiemetics, etc.) syringe pumps prevent periods during which the medication levels in the blood are too high or too low, and prevent a patient from having to repeatedly take tablets or pills. Additionally, syringe pumps are effective at administering medication over many minutes or hours and often reduce errors by caretakers.

[0004] One particular use of syringe pumps is in the field of enteral feeding administration. For example, syringe pumps are especially useful for the administration of breast milk (or suitable substitutes) in the care and treatment of neonatal children. An example of a syringe pump and syringe used for neonatal enteral feeding is shown in **Figure 1**, which depicts a Medfusion® brand (Model No. 3500) syringe pump. One drawback to known syringe pumps/syringes is that known pumps have a very limited range

of syringe sizes (diameter, height, length, etc.) and shapes that they will receive and operate in conjunction therewith. In particular, commercially-known pumps typically accept round syringes that have a maximum volume of about 75 mL. As such, users wishing to dispense more than 75 mL of fluid in a single setting must monitor the pump and change the syringe(s) out as needed. Accordingly, it can be seen that needs exist for syringes that are compatible with known syringe pumps but have larger capacities to permit longer enteral infusion sessions.

[0005] Alternatively, enteral syringes can be used with gravity feed systems, for example, when administering nutrients and/or medications to a neonatal patient. When administering fluids to a patient via a gravity-feed system, the syringe plunger is typically removed from the syringe body to prevent a vacuum from developing inside the syringe as the fluid leaves the syringe and enters the patient. The removal of the plunger from the syringe body is often seen as a drawback to this process and requires that a user take special care in storing the plunger while the syringe is being utilized. In the past, users have strapped the plunger to the syringe body or otherwise stored the plunger on a sterile tray or other location to avoid permanently separating these components. Additionally, removing the plunger from the syringe body can expose the contents of the syringe to unwanted pathogens, dust or other foreign matter, which can be harmful to a patient. Thus, it can be seen that needs exist for an improved syringe for fluid delivery.

[0006] When administering fluids to a patient, the plunger must be removed from the syringe body to prevent a vacuum from developing inside the syringe as the fluid leaves the syringe and enters the patient. The removal of the plunger from the syringe body is often seen as a drawback to this process and requires that a user take special care in storing the plunger while the syringe is being utilized. In the past, users have strapped the plunger to the syringe body or otherwise stored the same on a sterile tray or other location to avoid permanently separating these components. Additionally, removing the plunger from the syringe body can expose the contents of the syringe to unwanted pathogens or other

foreign matter, which can be harmful to a patient. Thus, it can be seen that needs exist for an enteral syringe that prevents a vacuum from developing within the syringe during use, while permitting a user to leave the plunger within the syringe body at all times during such use.

[0007] It is to the provision of improved devices and methods of fluid delivery meeting these needs and others that the present invention is primarily directed.

Summary of the Invention

[0008] In example embodiments, the present invention provides improved devices and methods to administer fluids to a patient.

[0009] In a first aspect, the present invention relates to an enteral syringe for use with a syringe pump having an elongated body and a plunger. The elongated body includes a first non-circular cross-section and a hollow cavity therein. The plunger includes a second non-circular cross-section that substantially mirrors the first non-circular cross-section and is operable to travel within the hollow cavity. Optionally, the first and second cross-sections are tear-drop shaped or key-way shaped to accommodate more fluid than a circular cross-section.

[0010] In a second aspect, the present invention relates to a self-venting enteral syringe that includes a syringe body having a hollow internal cavity therein and at least one vent extending from the hollow cavity to an outside surface of the syringe body. The enteral syringe also includes a plunger operable to selectively travel within the hollow cavity.

[0011] In a third aspect, the present invention relates to a syringe that includes a barrel defining an interior chamber for receiving a fluid, and a discharge port for discharging the fluid therethrough. The syringe also includes a plunger adapted to slide inwardly and outwardly within the barrel. The plunger has a seal for sealing engagement

with an interior surface of the barrel. The syringe also has at least one support feature for hanging the syringe from a support structure.

[0012] In a fourth aspect, the present invention relates to a method of delivery of fluid from a syringe. The method includes hanging the syringe from a support by engagement of the support with a support feature of the syringe and delivering fluid from a discharge port of the syringe.

[0013] In a fifth aspect, the present invention relates to an enteral syringe that includes an elongated body having and a hollow cavity therein and at least one vent extending from the hollow cavity to an outside surface of the syringe body. The elongated body has a first non-circular cross-section. The enteral syringe also includes a plunger operable to selectively travel within the hollow cavity. The plunger has a second non-circular cross-section that substantially mirrors the first non-circular cross-section. The enteral syringe also has at least one support feature for hanging the syringe from a support structure.

[0014] These and other aspects, features and advantages of the invention will be understood with reference to the drawing figures and detailed description herein, and will be realized by means of the various elements and combinations particularly pointed out in the appended claims. It is to be understood that both the foregoing general description and the following brief description of the drawings and detailed description of the invention are exemplary and explanatory of preferred embodiments of the invention, and are not restrictive of the invention, as claimed.

Brief Description of the Drawings

[0015] **FIGURE 1** is a perspective view of an enteral syringe and syringe pump of known form.

[0016] **FIGURE 2** is a perspective view of an enteral syringe according to a first example embodiment of the present invention.

[0017] **FIGURE 3** is a top view of the enteral syringe of **Figure 2**.

[0018] **FIGURE 4** is a bottom view of the enteral syringe of **Figure 2**.

[0019] **FIGURE 5** is a first side view of the enteral syringe of **Figure 2**.

[0020] **FIGURE 6** is a second side view of the enteral syringe of **Figure 2**.

[0021] **FIGURE 7** is a back view of the enteral syringe of **Figure 2**.

[0022] **FIGURE 8** is a front view of the enteral syringe of **Figure 2**.

[0023] **FIGURE 9A** is a side view of a first example embodiment plunger that can be inserted into a body of an enteral syringe.

[0024] **FIGURE 9B** is a bottom view of the plunger of **Figure 9A**.

[0025] **FIGURE 9C** is a cross-sectional view of the plunger of **Figure 9A** taken at line A-A.

[0026] **FIGURE 9D** is a bottom view of the plunger of **Figure 9A**.

[0027] **FIGURE 9E** is a top view of the plunger of **Figure 9A**.

[0028] **FIGURE 10A** is a first cross-sectional side view of the body of **Figure 2**.

[0029] **FIGURE 10B** is a second cross-sectional side view of the body of **Figure 10A**.

[0030] **FIGURE 10C** is a top view of the body of **Figure 10B**.

[0031] **FIGURE 10D** is a cross-sectional view of the body of **Figure 10A** taken at line B-B.

[0032] **FIGURE 10E** is an enlarged cross-sectional side view of the distal end of the body of **Figure 10A**.

[0033] **FIGURE 11A** is a cross-sectional side view of the enteral syringe of **Figure 2**, shown with the plunger inserted into the body.

[0034] **FIGURE 11B** is a top view of the enteral syringe of **Figure 11A**.

[0035] **FIGURE 12A** is a top cross-sectional side view of the enteral syringe of **Figure 2**, shown with the plunger in a retracted state from the body.

[0036] **FIGURE 12B** is a top view of the enteral syringe of **Figure 12A**.

[0037] **FIGURE 13A** is a cross-sectional side view of a gasket head seal for use with the plunger of **Figure 9A**.

[0038] **FIGURE 13B** is a top view of the seal of **Figure 13A**.

[0039] **FIGURE 14A** is a perspective view of an enteral syringe according to a second example embodiment of the present invention.

[0040] **FIGURE 14B** is a cross-sectional view of the body of the enteral syringe of **Figure 14A** taken at line C-C.

[0041] **FIGURES 14C-14D** are cross-sectional side views of the enteral syringe of **Figure 14A**.

[0042] **FIGURE 15A** is a side view of an enteral syringe according to a third example embodiment of the present invention.

[0043] **FIGURE 15B** is cross-section view of the enteral syringe of **Figure 15A** taken at lines A-A.

[0044] **FIGURE 15C** is a top view of the enteral syringe of **Figure 15A**.

[0045] **FIGURE 16A** is cross-sectional side view of the enteral syringe of **Figure 15A**, shown with the plunger in a first position.

[0046] **FIGURE 16B** is cross-sectional side view of the enteral syringe of **Figure 15A**, shown with the plunger in a second position.

[0047] **FIGURE 17A** is a perspective view of the enteral syringe of **Figure 15A**.

[0048] **FIGURE 17B** is a close up perspective view of the enteral syringe of **Figure 15A**.

[0049] **FIGURE 18A** is a perspective view of an enteral syringe according to a fourth example embodiment of the present invention.

[0050] **FIGURE 18B** is a longitudinal cross-section view of the enteral syringe of **Figure 18A** taken at line D-D.

[0051] **FIGURE 18C** is an isolated cross-sectional side view of the enteral syringe of **Figure 18A**, shown with the plunger in a first position.

[0052] **FIGURE 18D** is an isolated cross-sectional side view of the enteral syringe of **Figure 18A**, shown with the plunger in a second position.

[0053] **FIGURE 19** is a perspective view of a second example embodiment plunger that can be inserted into an enteral syringe body.

[0054] **FIGURE 20A** is a side view of the plunger of **Figure 19**.

[0055] **FIGURE 20B** is a top view of the plunger of **Figure 19**.

[0056] **FIGURE 21A** is a cross-sectional view of the plunger of **Figure 20A** taken at section E-E.

[0057] **FIGURE 21B** is a top view of the plunger of **Figure 19**.

[0058] **FIGURE 21C** is a bottom view of the plunger of **Figure 19**.

[0059] **FIGURE 22** is a perspective view of the plunger of **Figure 19**, shown supporting a syringe body and hanging from a hook at a first angle.

[0060] **FIGURE 23** is a perspective view of the plunger of **Figure 19**, shown supporting a syringe body and hanging from a hook at a second angle.

Detailed Description of Example Embodiments

[0061] The present invention may be understood more readily by reference to the following detailed description of the invention taken in connection with the accompanying drawing figures, which form a part of this disclosure. It is to be understood that this invention is not limited to the specific devices, methods, conditions or parameters described and/or shown herein, and that the terminology used herein is for the purpose of describing particular embodiments by way of example only and is not intended to be limiting of the claimed invention. Any and all patents and other publications identified in this specification are incorporated by reference as though fully set forth herein.

[0062] Also, as used in the specification including the appended claims, the singular forms “a,” “an,” and “the” include the plural, and reference to a particular numerical value includes at least that particular value, unless the context clearly dictates otherwise. Ranges may be expressed herein as from “about” or “approximately” one particular value and/or to “about” or “approximately” another particular value. When such a range is expressed, another embodiment includes from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by use of the antecedent “about,” it will be understood that the particular value forms another embodiment.

[0063] With reference now to the drawing figures, wherein like reference numbers represent corresponding parts throughout the several views, **Figures 2-8** depict an improved syringe **10** according to a first example embodiment of the present invention. As briefly discussed above, known syringe pumps (such as the Mefusion® brand syringe

pump) only accept syringes that incorporate a particular set of parameters. As a result, known syringes are traditionally circular in cross-section to fit within these parameters. Thus, in the past, syringes for use with traditional syringe pumps have been limited in their capacities to hold fluids. For example, known syringes have a maximum capacity of only about 75 mL. In contrast, the improved syringes according to example embodiments of the present invention utilize a non-circular cross-sectional shape, such as a tear-drop shape or key-way shape, to expand their capacity over known syringes—while still maintaining compatibility with typical known pumps. In effect, the syringe of the present invention can be used with various known syringe pumps, such as the Medfusion® brand pump depicted in **Figure 1**, and is capable of storing and administering significantly more fluid than known syringes.

[0064] In example embodiments, the syringe includes an elongated body. The cross-section of the syringe is preferably non-symmetrical along both axes, as exemplified in the embodiment shown in **Figure 4**. In other example embodiments, the cross-section of the syringe is non-symmetrical along only one axis. As shown, an example syringe **10** of the present invention includes an elongated body **20** having a non-circular substantially tear-drop shaped cross-section and at least one correspondingly-shaped plunger **30** for slidable insertion therein. Because of the unique tear-drop shaped cross-section, the syringe **10** of the present invention is capable of storing and administering over about 100 mL of fluid in one setting while still maintaining compatibility with the predetermined parameters of known syringe pumps. In alternate embodiments, the syringe **10** is capable of storing over about 80 mL, and more preferably over about 90 mL of fluid(s).

[0065] As shown, the elongate body **20** includes a first distal end **22** that is operable to releasably couple with a syringe pump and a second proximal end **24** for receiving the at least one plunger **30** therein. At the proximal end **24**, the syringe body **20** also includes a flange **25** to provide a finger hold to permit manual operation by a user as is typical with known syringes or to engage a syringe pump. While the flange **25** depicted in **Figures 2-8**

includes a substantially tear-drop shaped rim **29** that is truncated at each end, other embodiments can include a rim that is key-way shaped, circular, elliptical, having a constant width, or can be otherwise shaped as desired. An elongate cavity **26** generally extends within the body **20** along the length of the same from the proximal end **24** towards the distal end **22**. In preferred example embodiments, the cavity **26** mirrors, or substantially mirrors, the cross-section of the syringe body **20** providing a substantially constant outer-wall thickness of the same. As shown, the distal end **22** can include a semi-pointed face. At the distal end **22** of the syringe body, the cavity **26** terminates and at least one tip or nipple **28** is provided for insertion into a suitable syringe pump (not shown) and/or enteral feeding tube for delivery of the fluid contents contained therein. In preferred example embodiments, the tip **28** is sized and shaped to correspond to a Medfusion® branded syringe pump, but can be sized and shaped as desired to operate with other syringe pumps. In depicted embodiments, the tip **28** is located away from the cross-sectional center of gravity, and more preferably near the perimeter of the syringe body distal end **22**.

[0066] As intended, when the syringe **10** is oriented for use within a suitable syringe pump the tip **28** is preferably positioned above the cross-sectional center of gravity. It has been found that colostrum contained within breast milk rises to the top of the syringe, and thus, locating the tip **28** above the center of gravity, and more preferably at the top of the distal end **22** perimeter, permits the controlled feeding of colostrum during a particular enteral feeding session. The tip **28** can also include a removable cap for selectively covering the tip **28** as desired. In alternative embodiments, the tip **28** can be located as desired to cooperate with various syringe pumps. In other alternative embodiments, the syringe **10** can include two or more tips **28** to permit operational flexibility with multiple brands/units of syringe pumps. In still other embodiments, the syringe **10** can include three or more tips **28** or the tip(s) can be interchangeable.

[0067] **Figures 9A-9E** depict the example plunger **30** in greater detail. The plunger includes a first distal end **32** and second proximal end **34**. The distal end **32** comprises a sealing head **35** for tightly engaging the inner wall of the body cavity **26**. As shown in **Figure 9D**, the sealing head and/or gasket **35** substantially mirrors the cross-section and diameter of the cavity **26** to provide an appropriate seal between the head and the cavity, and in example embodiments, is substantially tear-drop shaped as shown. As depicted in **Figures 13A-13B**, the gasket **35** is shown to include a sealing material **39** that creates a seal between the gasket and the inner wall of the body **20**. As shown, the distal end **32** can include a slightly pointed face corresponding with the pointed face of the body distal end **22**. The plunger **30** also includes a plunger body **36** that comprises at least one, and preferably two or more ribs **37** that also substantially mirror the cross-section and diameter of the cavity **26**. As the plunger **30** is selectively inserted into the cavity **36** of the syringe body **20** and travels therein during use, the ribs **37** operate to keep the plunger **30** aligned within the cavity **26** and prevent the plunger from tipping within the same. As such, the ribs **37** help maintain a good seal between the plunger head **35** and the wall of the cavity **26**. At the proximal end **34** the plunger **30** includes a contact face **38** to engage a corresponding depressor of a syringe pump (or permit user manipulation for hand operation). In example embodiments, the contact face **38** is circular in shape. Alternatively, the contact face **38** can be any shape as desired.

[0068] **Figures 10A-10E** show a cross-sectional view of the syringe body **20** from a variety of angles. As shown in **Figures 10B, 10C and 10E**, the nipple **28** is positioned away from the central axis, which can be the cross-sectional center of gravity of the syringe **20**.

[0069] In operation as additionally shown in **Figures 11A-12B**, the syringe **10** is loaded into a syringe pump (not shown) in which the distal end **22** of the syringe body is coupled to a fluid dispenser (not shown) and the proximal end **24** is coupled to a corresponding depressor (not shown) of the pump. **Figure 12A** depicts the plunger **30** in a

withdrawn state from within the body **20**. **Figure 11A** show the plunger **30** pushed toward the distal end of the body **20**. The imaginary cross-sectional center of gravity is best exemplified with dashed lines in **Figure 12B**. In preferred example embodiments, the semi-pointed end of the tear-drop shaped body is aligned along the horizontal axis of the pump and generally points towards the user. In this configuration, the tip **28** is towards the top of the syringe **10** as previously discussed. The rounded side of the tear-drop shaped body can rest within a track or other retaining mechanism of the syringe pump, which is typically designed to receive and secure circular-shaped syringes (as seen in **Figure 1**). As a result, the syringe **10** of the present invention is able to maintain compatibility with the many known syringe pumps already in use throughout medical facilities across the world, while providing extra capacity to retain a larger quantity of dispensable fluid.

[0070] **Figures 14A-14D** depict a second example embodiment syringe having a syringe body **40** with a non-circular key-way shape and a correspondingly shaped plunger **46** to provide similar interaction as described in the embodiment depicted in **Figures 2-9**. As shown, the syringe body **40** has a rear carrier region **42** and a forward nose region **44**. The rear carrier region **42** and the forward nose region **44** both have rounded perimeter edges. The rear carrier region **42** has a larger diameter than the forward nose region **44**. The forward nose region **44** also has planar sides which taper from the rear carrier region **42**.

[0071] **Figures 15A-17B** depict a self-venting enteral syringe **50** according to a third example embodiment of the present invention. In general, the enteral syringe **50** includes an elongated syringe body **52** and a plunger **60**. The syringe body **52** defines an internal elongate cavity that stretches substantially along the length of the body from a proximal end **58** towards a distal end **53**. In preferred example embodiments, the cavity mirrors, or substantially mirrors, the cross-section of the syringe body **52** providing a substantially constant outer-wall thickness of the same. The distal end **53** of the syringe body **52** comprises a nozzle or tip **55** in communication with the internal elongate cavity

that is operable to be connected to one or more needles, hoses, and/or other implements as desired. In alternative embodiments, the syringe **50** can include two or more tips **55** to permit operational flexibility. In other embodiments, the syringe **50** can include three or more tips **55** or the tip(s) can be interchangeable. In still other embodiments, the one or more tips **55** can include a removable cap (not shown) to keep the contents of the syringe from leaking out before being connected to a needle, hose, etc.

[0072] The proximal end **58** of the syringe body **52** includes an opening for receiving the plunger **60** therein and also includes a flange **59** to provide a finger hold to permit manual operation by a user as is typical with known syringes or to engage a syringe pump. The syringe body **52** can have a substantially circular cross-section (as depicted in **Figures 15A-17B**), or can comprise a tear-drop, keyway, oval, elliptical, rectangular, or other non-circular or non-symmetrical cross-section (as depicted in **Figures 18A-18D**) as desired, and the opening generally has a cross-section that is sized and shaped to snugly receive an inserted complementary plunger **60** therein.

[0073] In example embodiments, the plunger **60** includes an elongated body **61** sized to be inserted into the opening of the syringe body **52**, the body having a first distal end **64** and second proximal end **62**. The distal end **64** comprises a sealing head **66** for tightly engaging an inner wall of the body cavity. As shown in **Figures 15A-17B** and discussed above, the sealing head and/or gasket **66** substantially mirrors the cross-section and diameter of the cavity to provide an appropriate seal between the head and the cavity. In example embodiments, the sealing head **66** frictionally engages the inner wall of the cavity, such that the plunger **60** remains in a particular position within the syringe body **52** absent user manipulation. The plunger body **61** also comprises at least one, and preferably two or more ribs **68** that extend to fit within the cross-section and/or diameter of the cavity (best seen in **Figure 16B**). Thus, as the plunger **60** is selectively inserted into the cavity of the syringe body **52** and travels therein during use, the ribs **68** operate to keep the plunger **60** aligned within the cavity and prevent the plunger from tipping within the

same. As such, the ribs **68** help maintain an adequate seal between the plunger head **66** and the wall of the cavity. At the proximal end **62** the plunger **60** includes a contact face to permit user manipulation of the syringe **50**. In example embodiments, the contact face is circular in shape. Alternatively, the contact face can be any shape as desired.

[0074] In order to permit the syringe **50** of the present invention to be vented during use (and without fully removing the plunger **60** from the syringe body **52**), the syringe body includes one or more vents **54** as shown in the drawing figures. The vents **54** selectively permit the transfer of air into the elongate syringe body cavity to prevent a vacuum from forming inside the same when in use. In depicted example embodiments, each vent **54** comprises a channel **56** that extends from the proximal end **58** a distance at least partially into the inner cavity of the syringe body **52**. The length of the vents **54** is sufficient to extend beyond the seal or gasket of the syringe plunger while the plunger is retained in the syringe barrel in its retracted state, to allow air to pass through the vents around the seal. In alternative embodiments, the vent channel **56** extends from another outside surface of the syringe body **52** into the inner cavity. While example embodiments depicted in **Figures 15A-17B** depict four vents **54**, alternative embodiments can include one vent, two vents, three vents, or five or more vents as desired.

[0075] **Figures 18A-18D** depict a self-venting enteral syringe **70** according to a fourth example embodiment of the present invention. The syringe **70**, as depicted, has a non-circular non-symmetrical key-way cross-sectional syringe body **73** and plunger **74** that has a gasket **76** at the distal end. The body **73** and plunger **74** have similar elements and coordinate with each other in a similar manner to the embodiment described in **Figures 14A-14D**. The syringe **70** also includes similar characteristics, for example at least one vent **72**, and operates through mechanics similar to the embodiment described in **Figures 15A-17B**.

[0076] **Figures 19-23** show a second example plunger **124** according to an example embodiment of the present invention. The example plunger **124** can operate as

the plunger in the embodiments described in **Figures 2-18D**. The plunger **124** has a proximal end **164** and a distal end **162**. The distal end **162** includes a sealing head or gasket **166** that conforms to and forms a seal along the interior surface of a syringe body as described in **Figures 2-18D**. The plunger **124** further includes lower **146** and upper **144** ribs and a vertical flange **142**, similar to the syringe described in **Figures 2-18D**. As shown the plunger **124** has a tear-dropped cross sectional profile, but can alternatively be designed to have a circular, elliptical, non-circular, non-symmetrical or key-way cross section as described in previous embodiments. The plunger **124** includes a fin or spine **170** that extends axially and perpendicular to the flange **142**. First and second apertures **138**, **134** extend through the spine **170** of the plunger **124**. The apertures **138,134** provide support for supporting the syringe from an IV hanger or other support (best shown in **Figures 22-23**). In further alternate embodiments, the support feature can be part of the syringe barrel or a separate part connected to the syringe.

[0077] As depicted, a first aperture or cut-out **134** defines an axially elongated oval shape with parallel sides. This first cut-out **134** is transversely offset from the central axis (or cross-sectional center of gravity shown as an example in **Figure 12B**) of the plunger **124**, between the upper rib **144** and the lower rib **146**. A second aperture or cut-out **138** has a more rounded oval shape with less elongated sides than the first cut-out **134**. The second cut-out **138** is positioned along or adjacent the central axis (or cross-sectional center of gravity shown as an example in **Figure 12B**) of the plunger **124**, above the upper rib **144**. In alternate embodiments of the invention, one, three or more apertures may be provided, and the position and configuration of the aperture(s) may vary.

[0078] In an example method of use, as depicted in **Figures 22-23**, a hook **140** from an IV stand can be inserted through either the first cut-out **138** or the second cut-out **134** as the plunger **124** is secured within a syringe body **130**. When the IV hook **140** is inserted through the first cut-out **138**, the syringe **120** hangs in a substantially vertical orientation (as shown in **Figure 23**); and when the IV hook **140** is inserted through the

second cut-out **134**, the syringe **120** hangs at an oblique angle relative to vertical (as shown in **Figure** 22). In this manner, the angular orientation of the hanging syringe can be selectively varied to control the discharge and draining from the syringe, as well as the orientation of the syringe vent(s) if provided, when in use.

[0079] All of the components discussed and embodiments described herein can be formed from a variety of materials as desired by a user. In example embodiments, the syringe can be formed from plastics (i.e. polypropolene), other polymers, glass, metals, metal alloys, resins, rubbers, rubber derivatives, elastomerics (i.e. santoprene), silicones or other known materials. In commercial embodiments, the syringe body is formed from polypropolene, the plunger is formed from the same, and the sealing head is formed from an elastomeric. Optionally, color additives may be added to provide protection from UV light and/or colorants may be added to the syringe as desired and/or to identify certain properties/characteristics (i.e. administration path) or contents. In alternative embodiments, the syringe can include external markings to indicate volume capacity and remaining content levels.

[0080] While the invention has been described with reference to preferred and example embodiments, it will be understood by those skilled in the art that a variety of modifications, additions and deletions are within the scope of the invention, as defined by the following claims.

CLAIMS:

1. A syringe comprising:

a barrel defining an interior chamber for receiving a fluid, and a discharge port for discharging the fluid therethrough; and

a plunger adapted to slide inwardly and outwardly within the barrel, the plunger having a seal for sealing engagement with an interior surface of the barrel; and

at least one support feature for hanging the syringe from a support structure,
wherein the at least one support feature comprises at least one aperture extending through the plunger.

2. The syringe of Claim 1, wherein the barrel comprises an extension having an interior surface portion comprising one or more vent channel, allowing passage of air around the seal of the plunger when the plunger is positioned with the seal within a venting portion.

3. The syringe of Claim 1, wherein the support features comprises first and second support features.

4. The syringe of Claim 3, wherein the first support features is configured to position the syringe generally vertically when hung therefrom, and the second support features is configured to position the syringe generally non-vertically when hung therefrom.

5. The syringe of Claim 1, wherein the barrel has a non-circular cross-sectional profile.

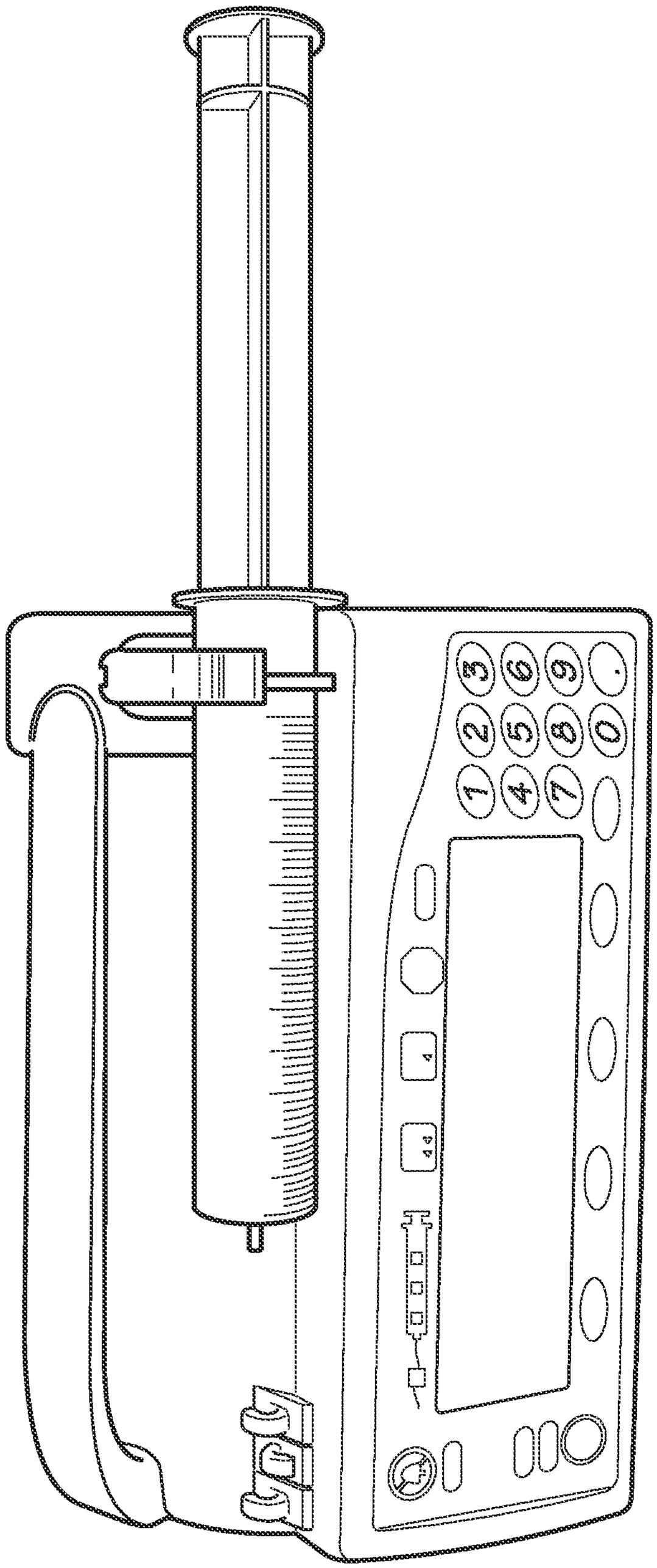
6. The syringe of Claim 5, wherein the barrel has a non-symmetrical cross-sectional profile.

7. The syringe of Claim 6, wherein the barrel has a substantially tear-drop shaped cross-sectional profile.

8. The syringe of Claim 6, wherein the barrel has a substantially key-way shaped cross-sectional profile.

9. The syringe of Claim 1, wherein the discharge port is eccentrically offset from a cross-sectional center of gravity of the barrel.

10. The syringe of Claim 1, wherein the barrel comprises at least one vent extending from the interior chamber to an outside surface of the barrel.



(PRIOR ART)
FIG. 1

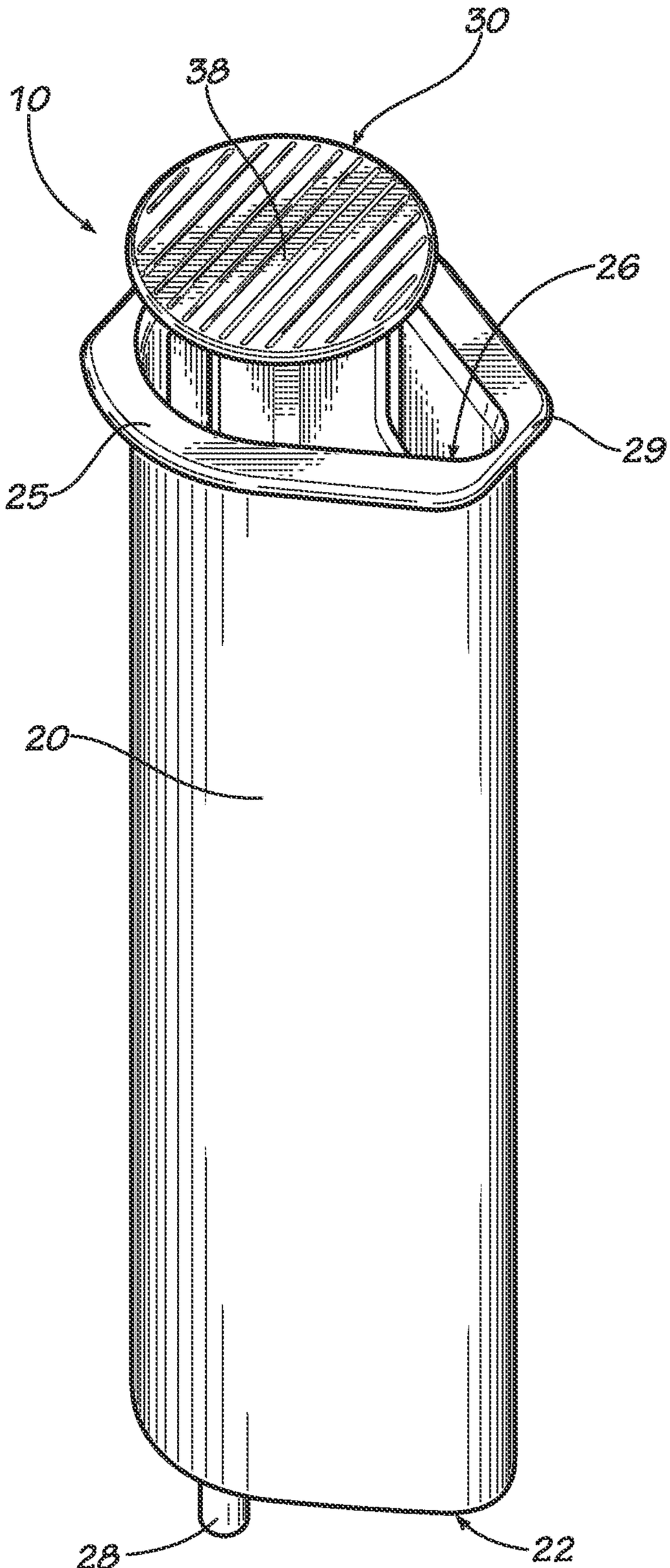


FIG. 2

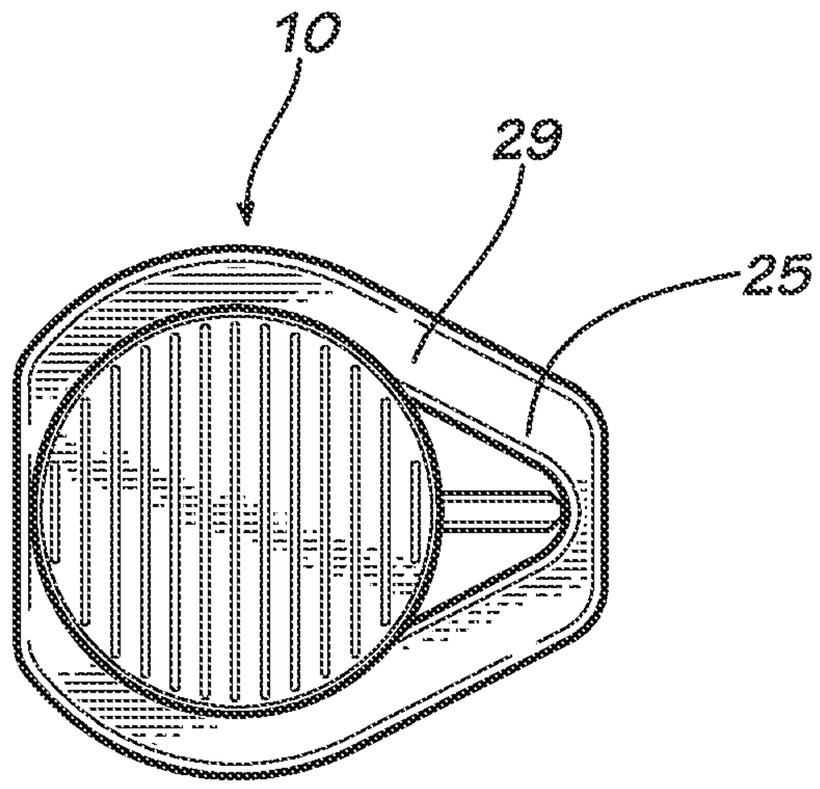


FIG. 3

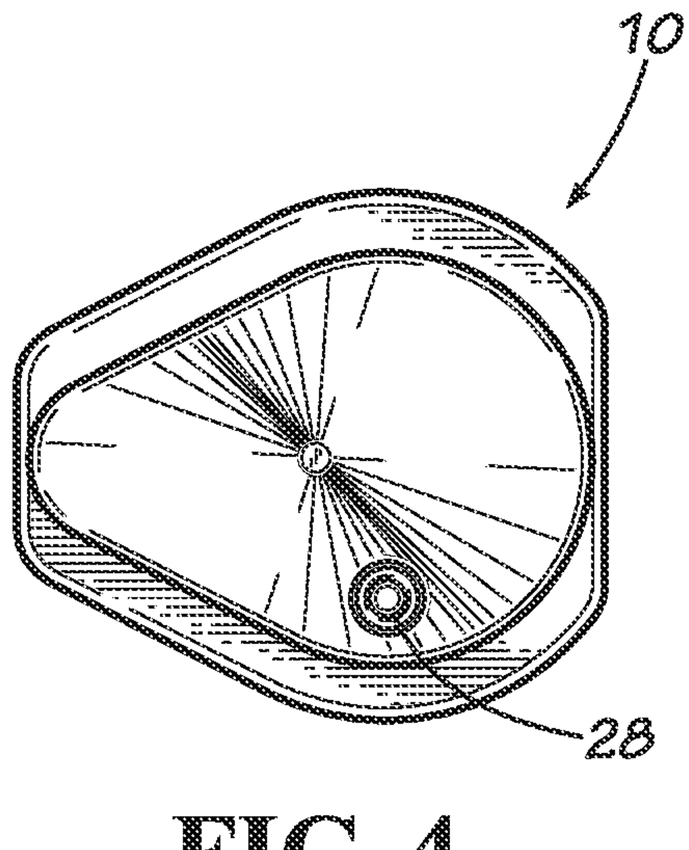


FIG. 4

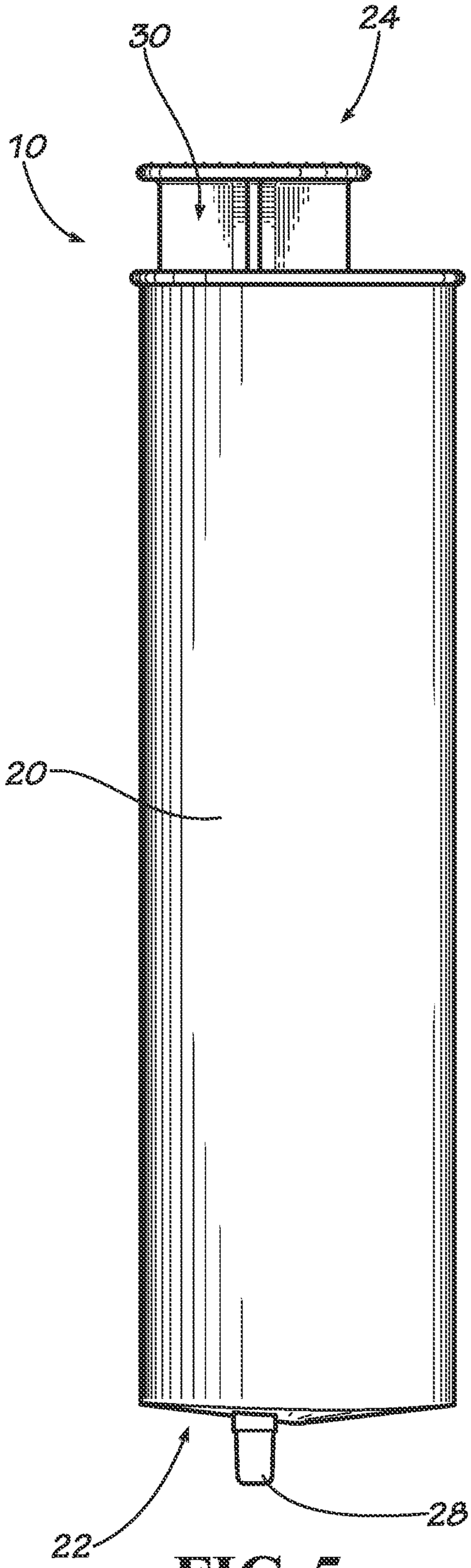


FIG. 5

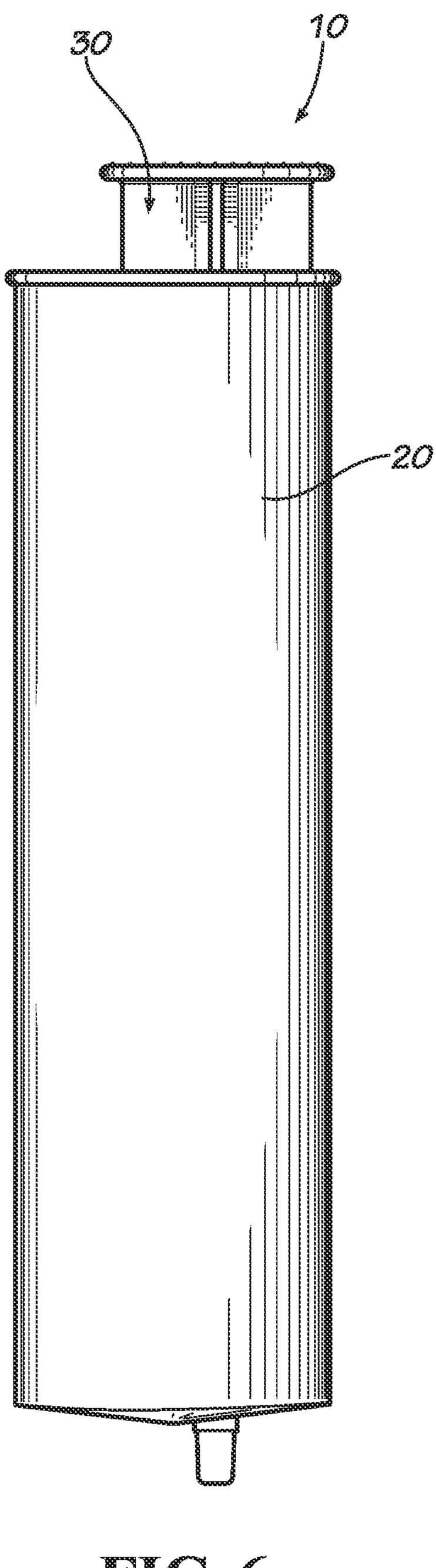


FIG. 6

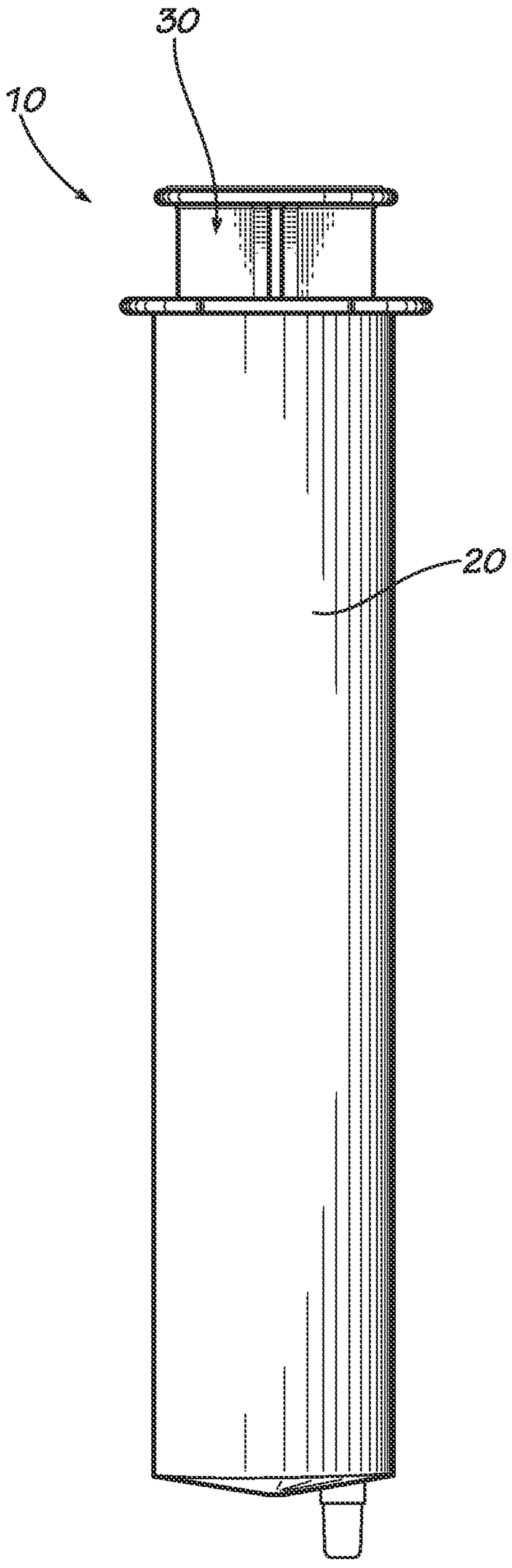


FIG. 7

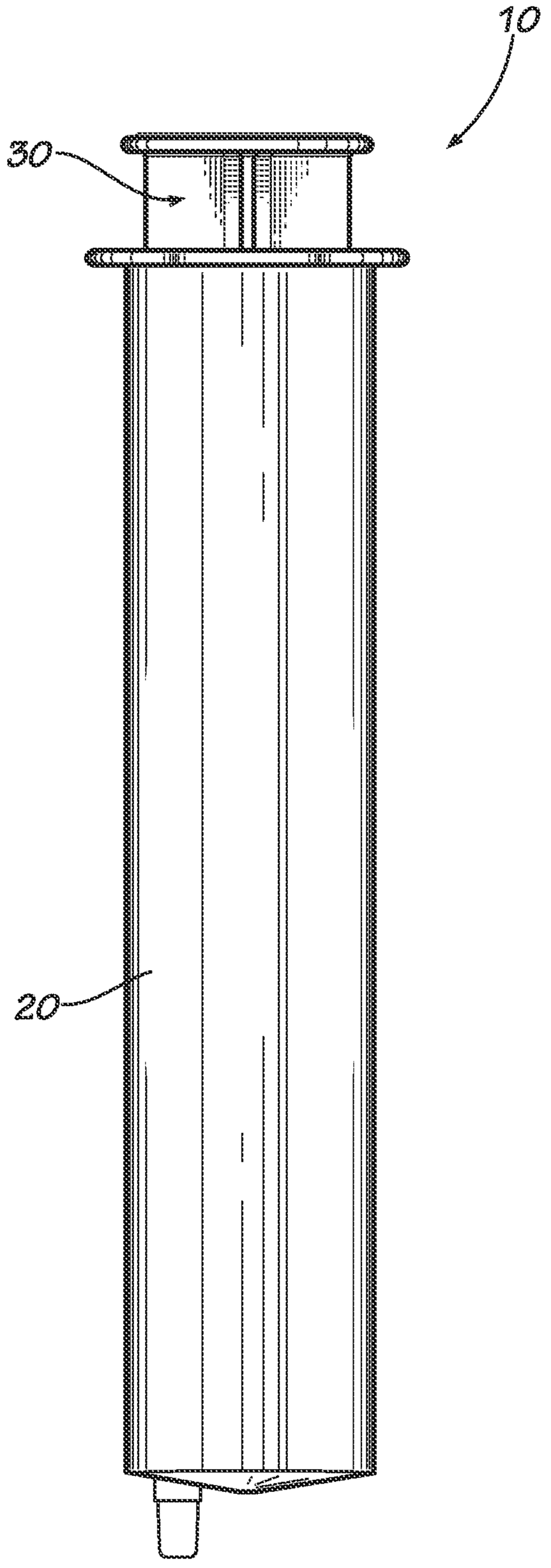


FIG. 8

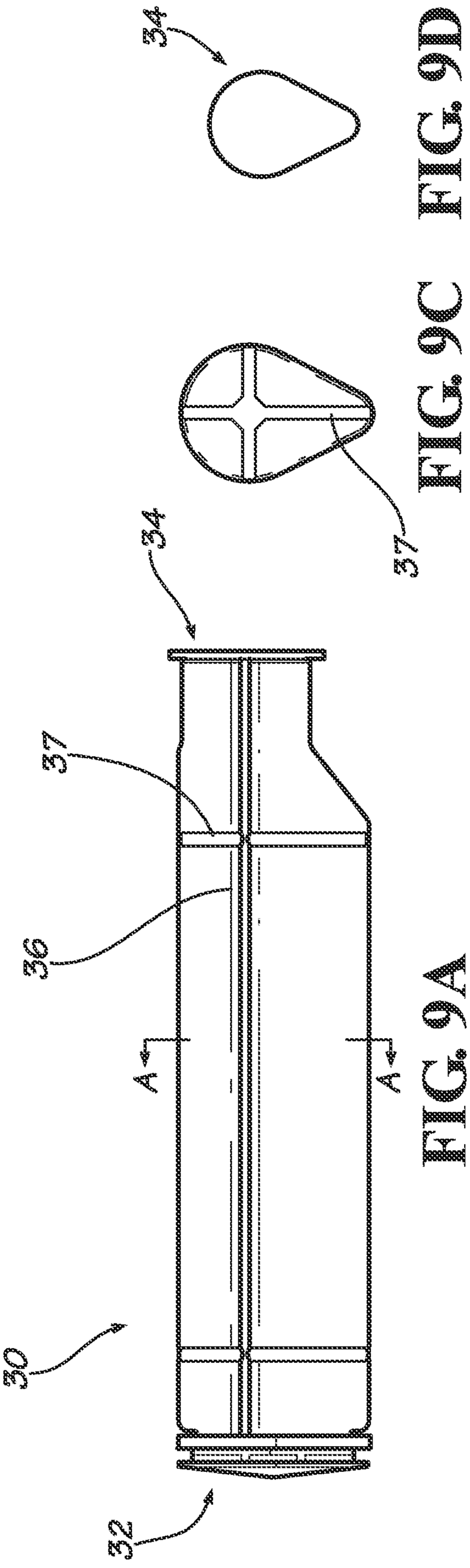


FIG. 9A

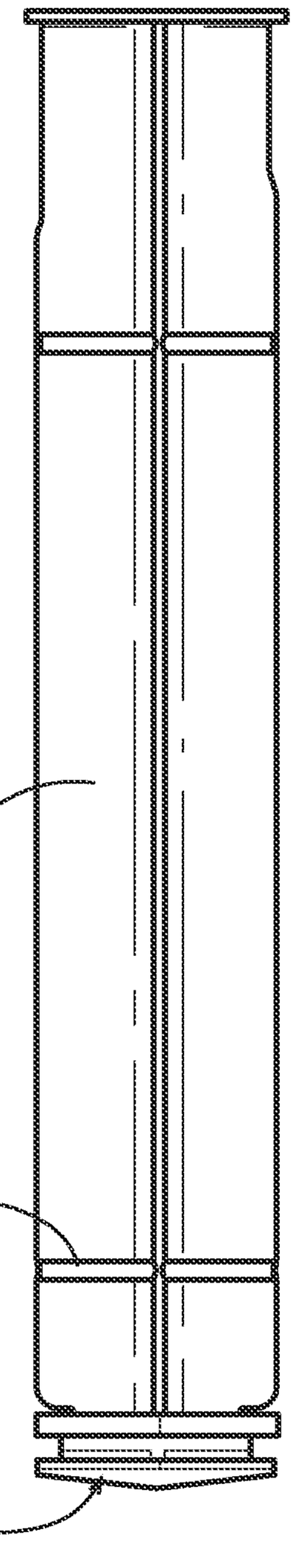


FIG. 9B

FIG. 9C

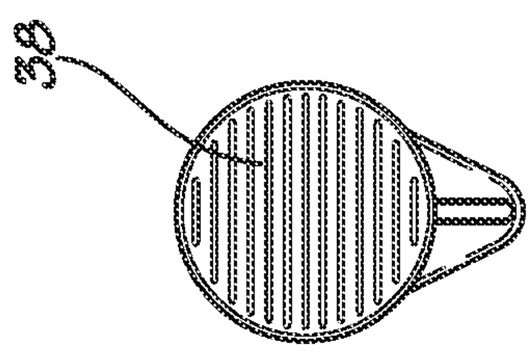


FIG. 9E

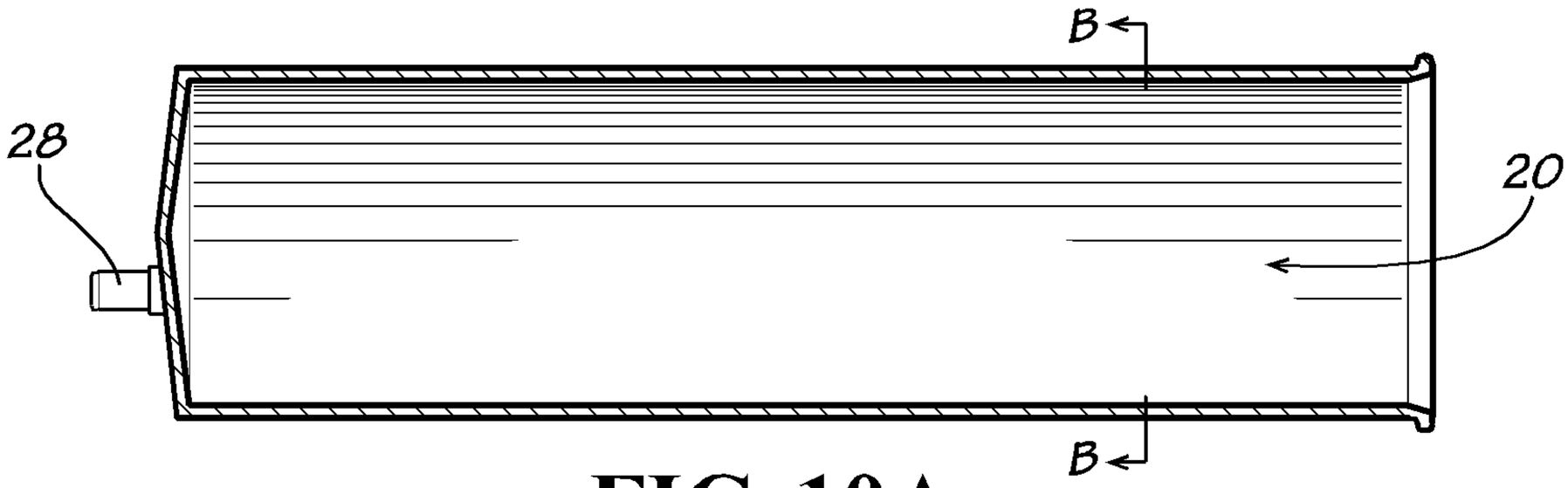


FIG. 10A

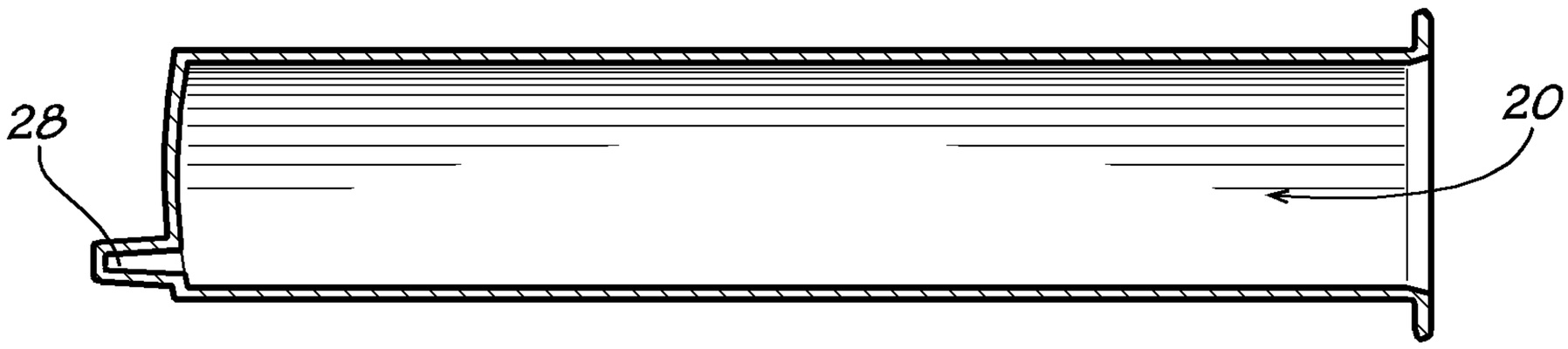


FIG. 10B

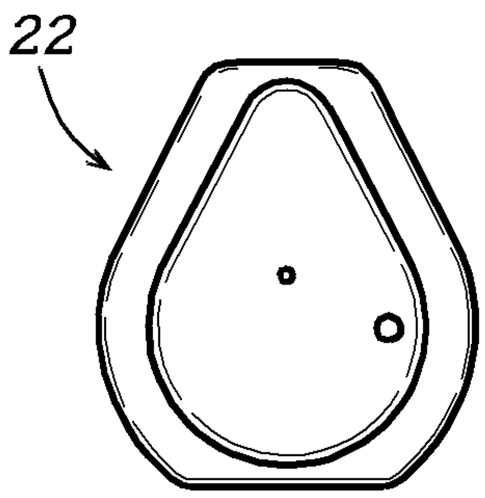


FIG. 10C

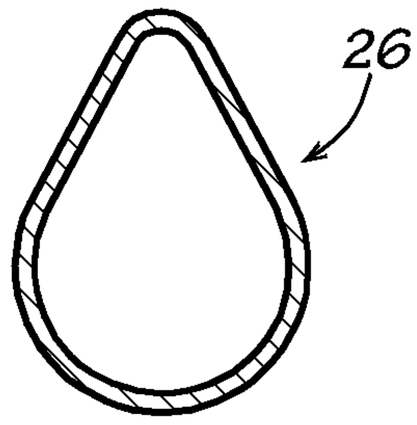
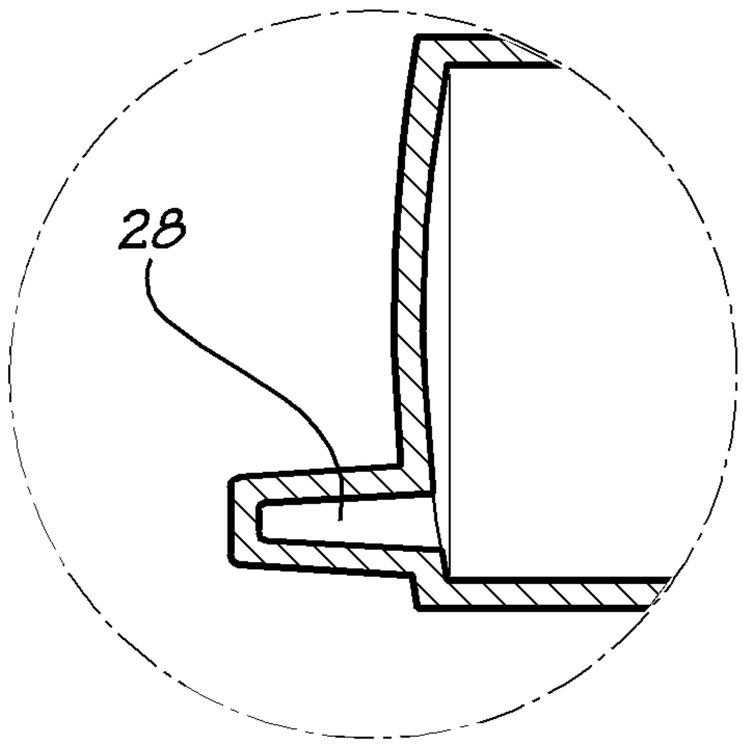


FIG. 10D

FIG. 10E



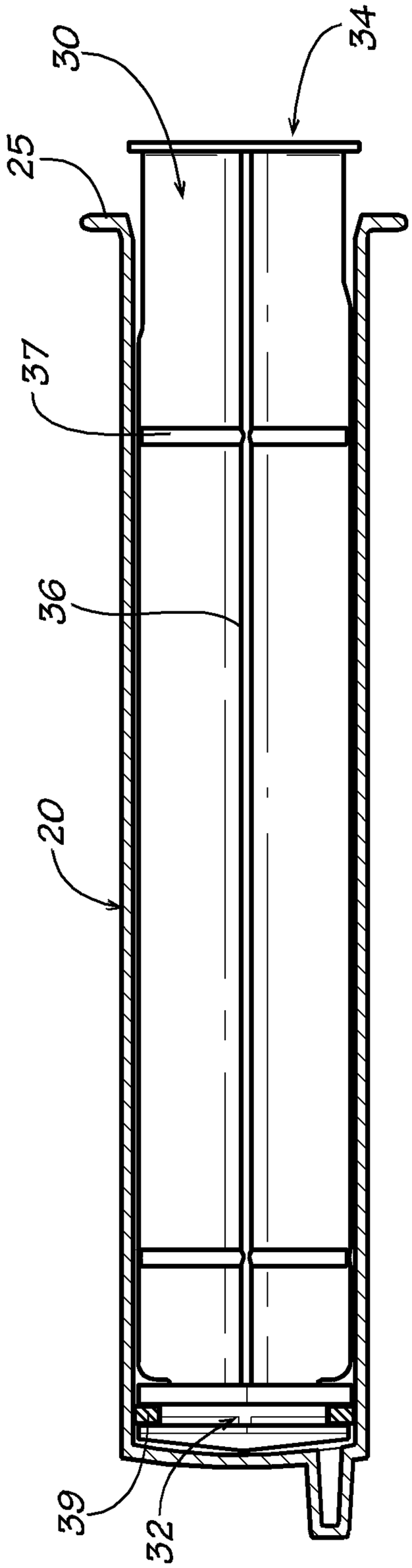


FIG. 11A

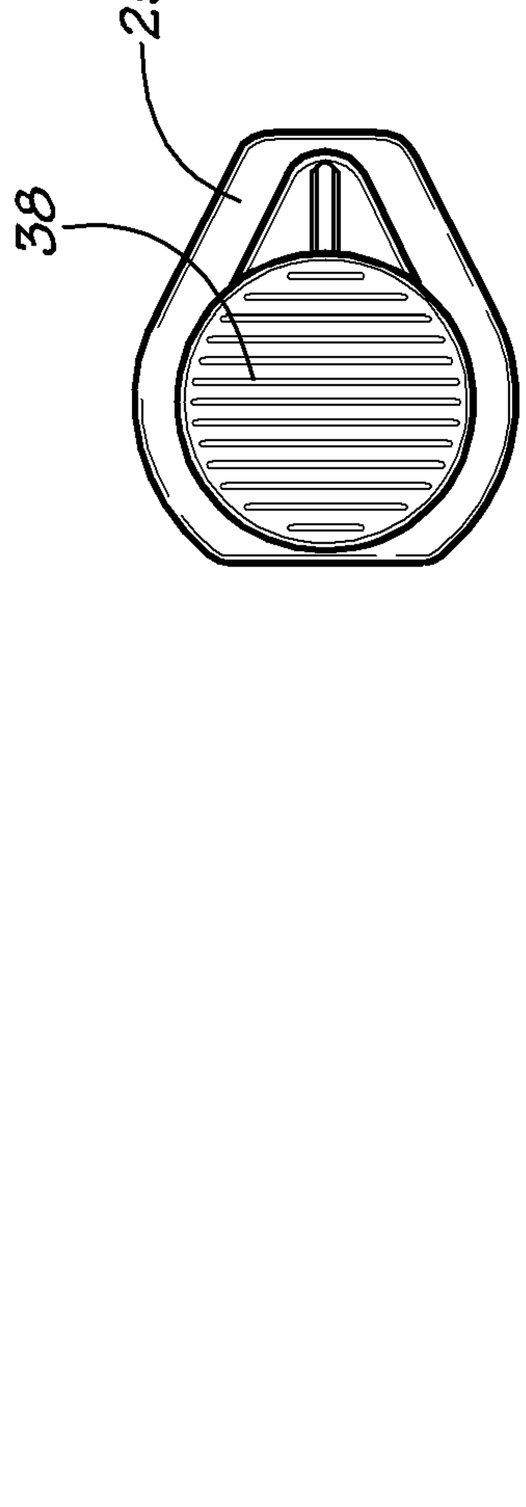


FIG. 11B

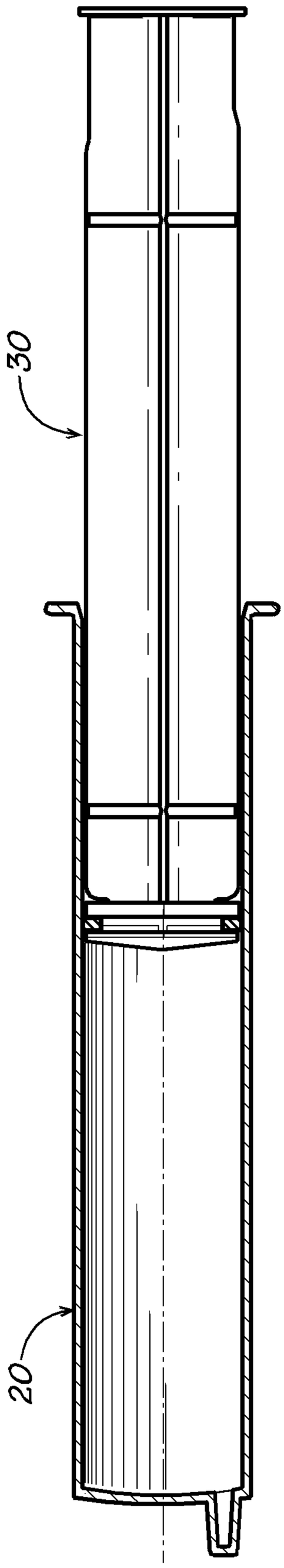


FIG. 12A

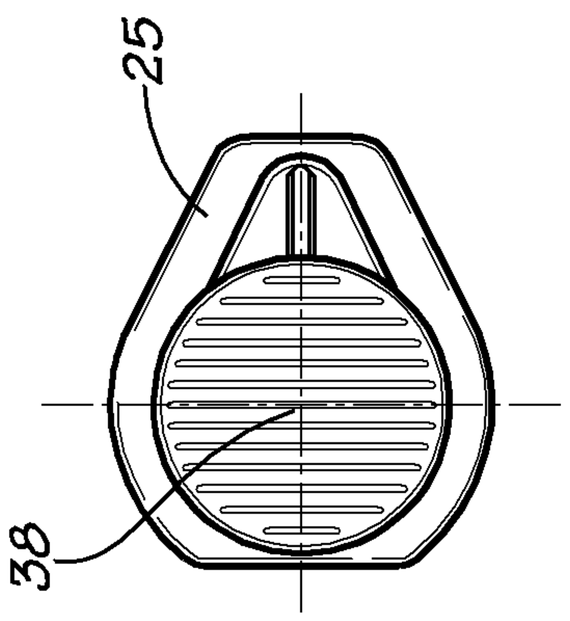


FIG. 12B

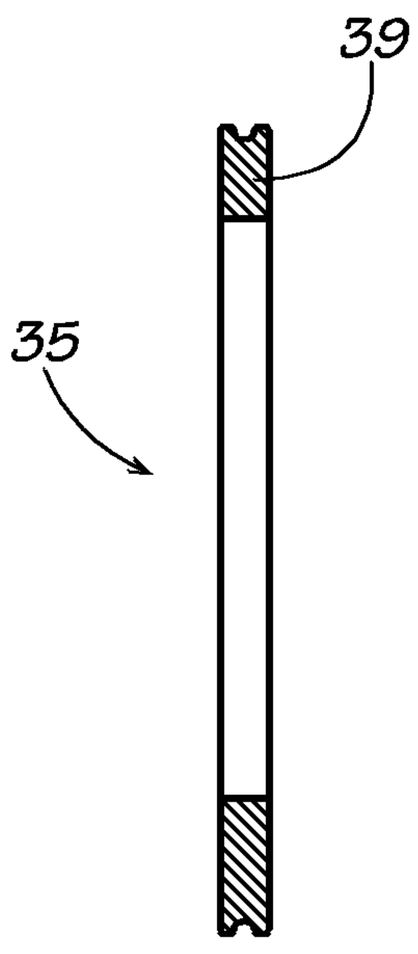


FIG. 13A

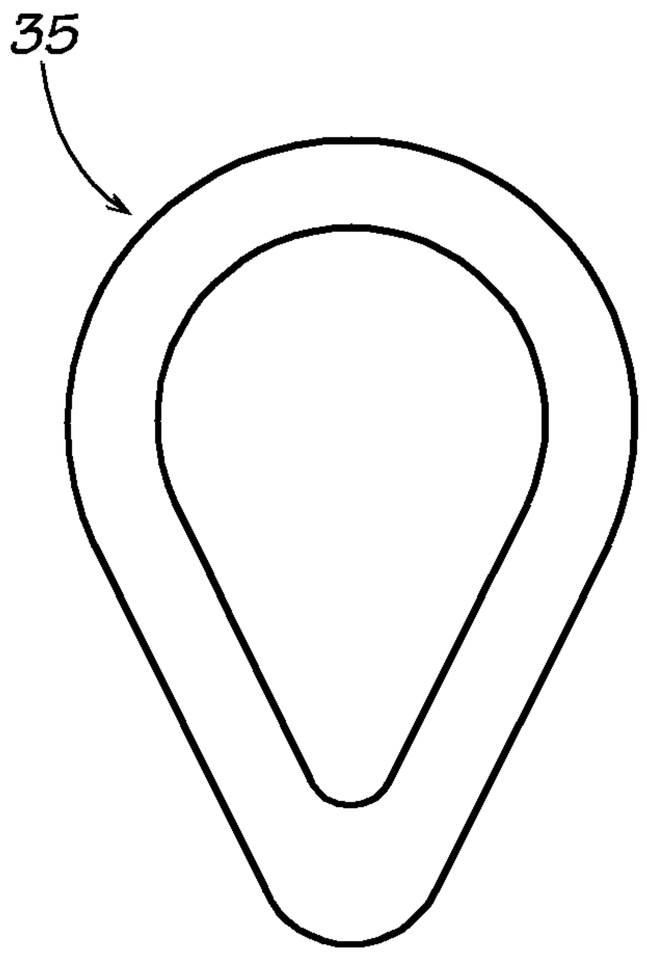


FIG. 13B

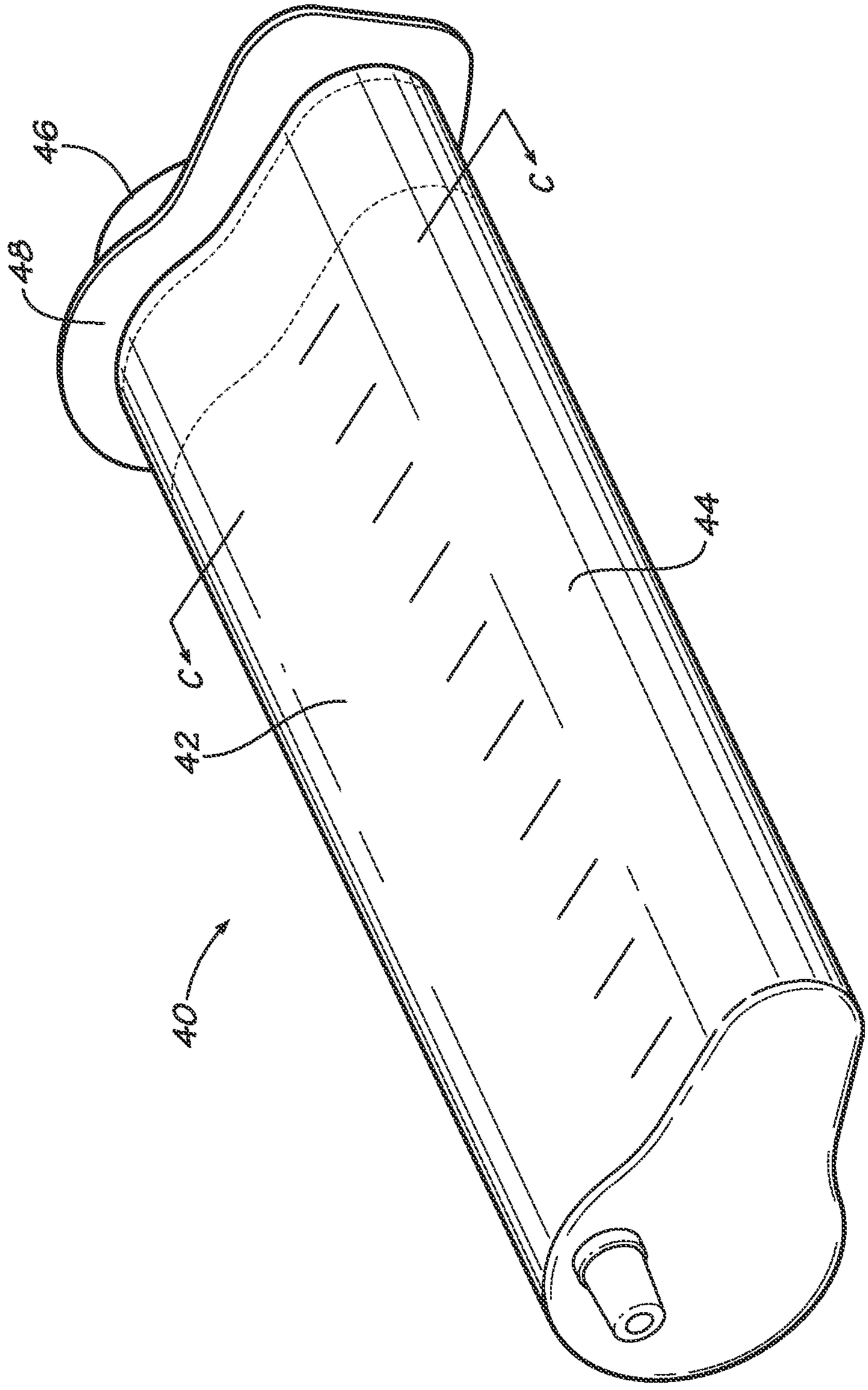


FIG. 14A

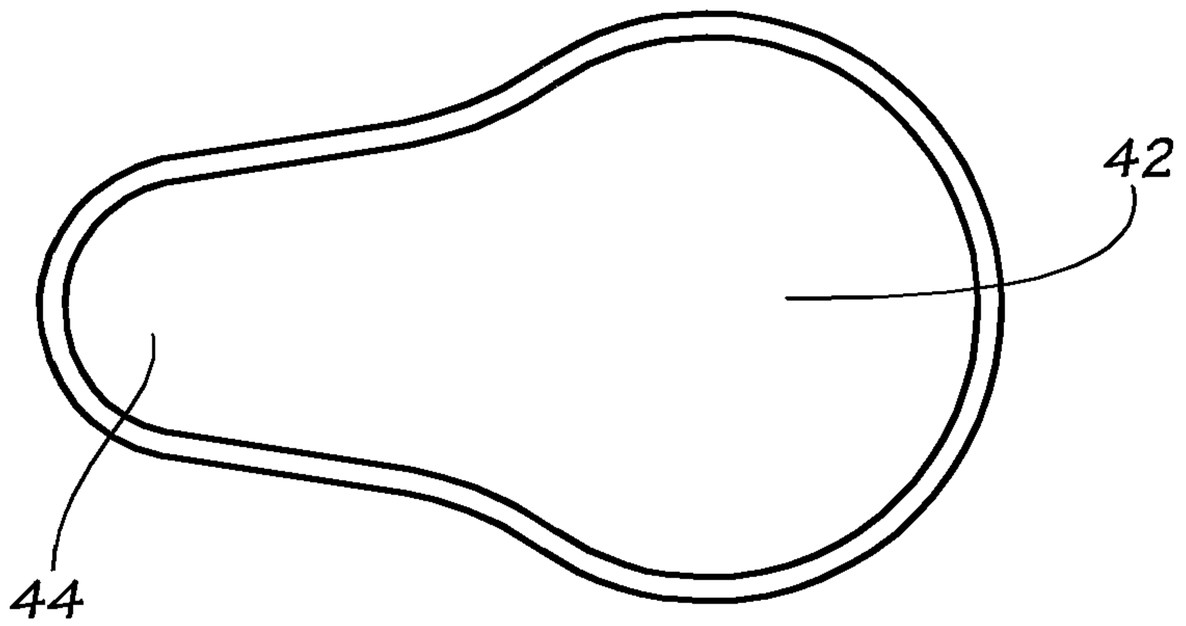


FIG. 14B

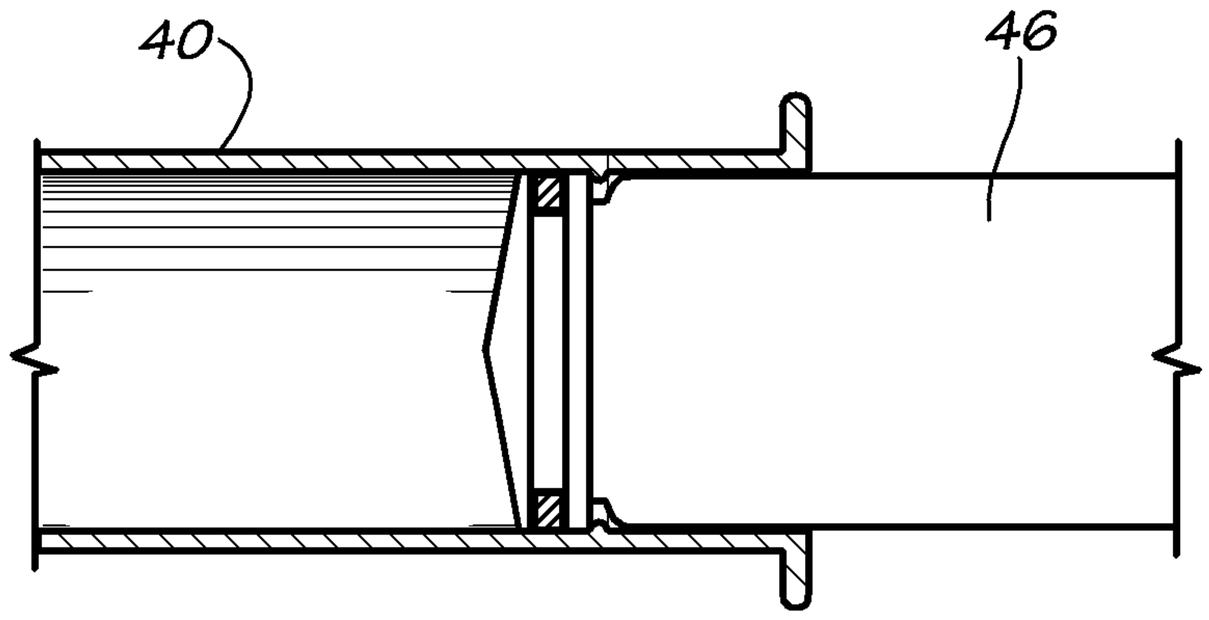


FIG. 14C

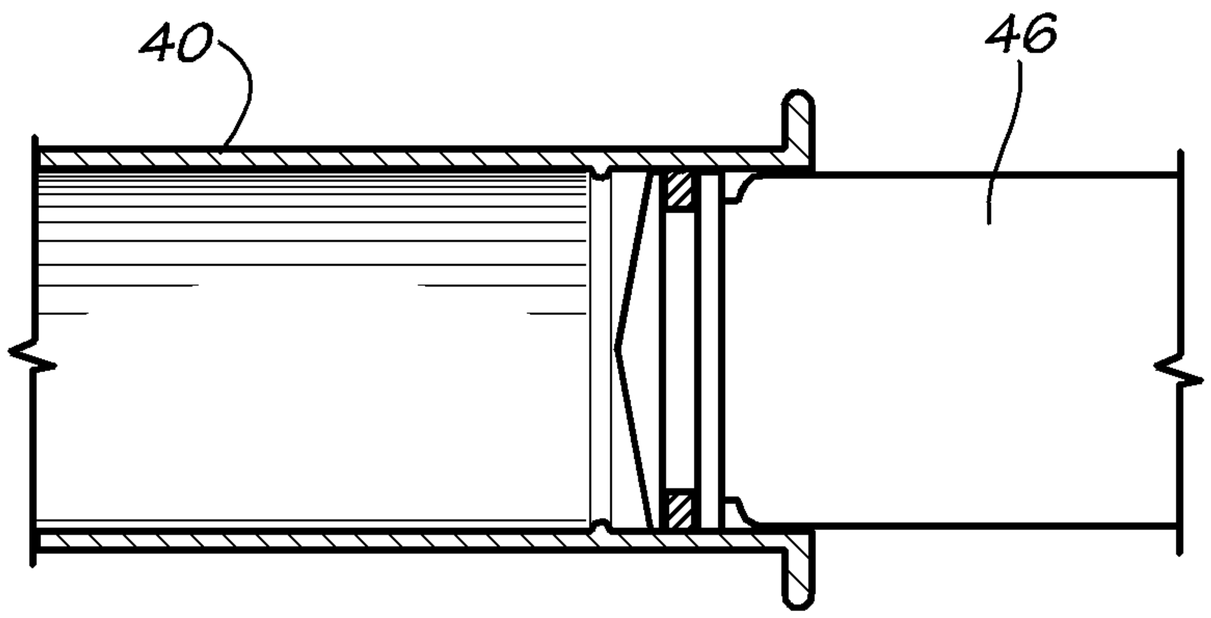


FIG. 14D

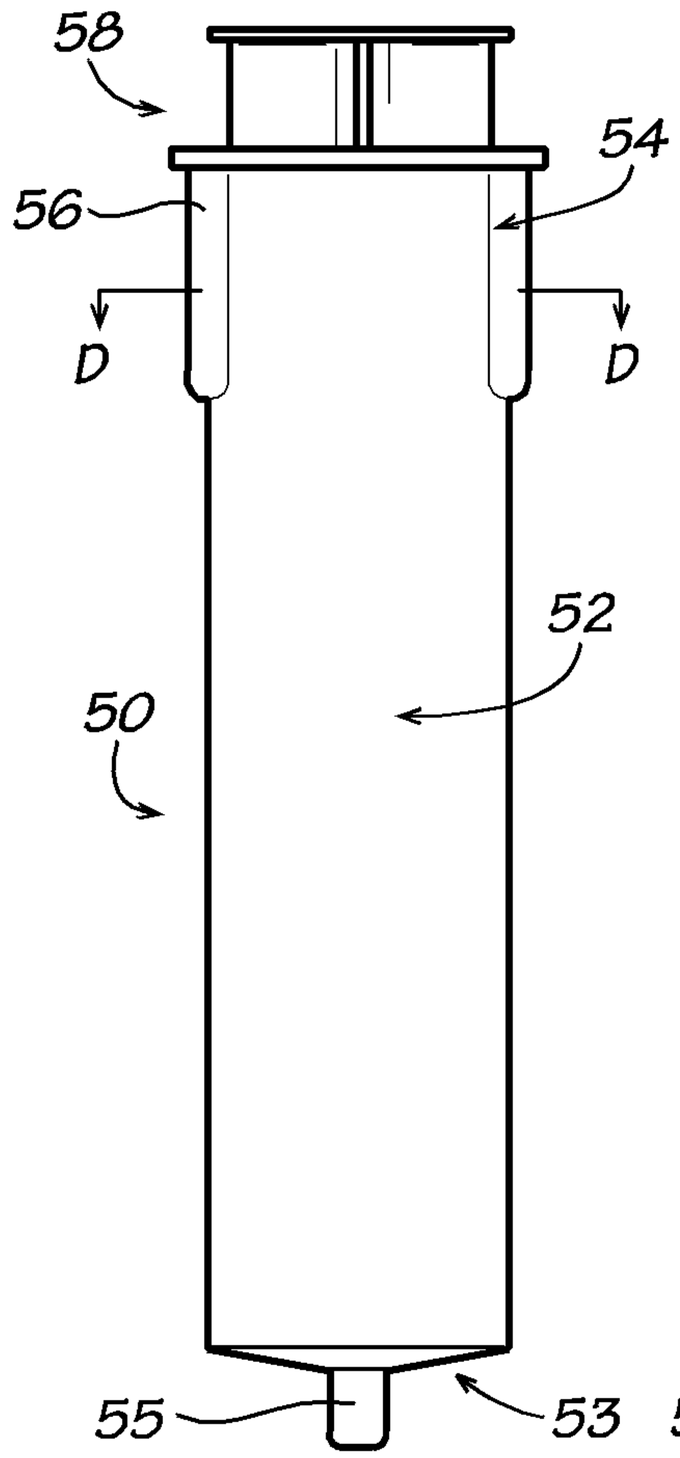


FIG. 15A

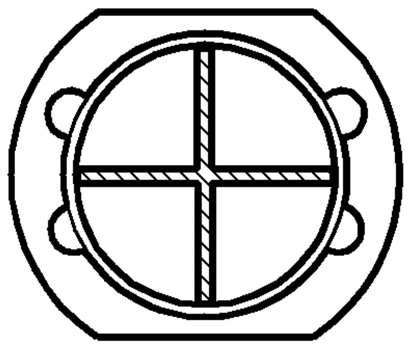


FIG. 15B

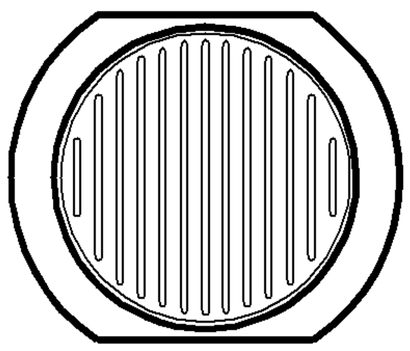


FIG. 15C

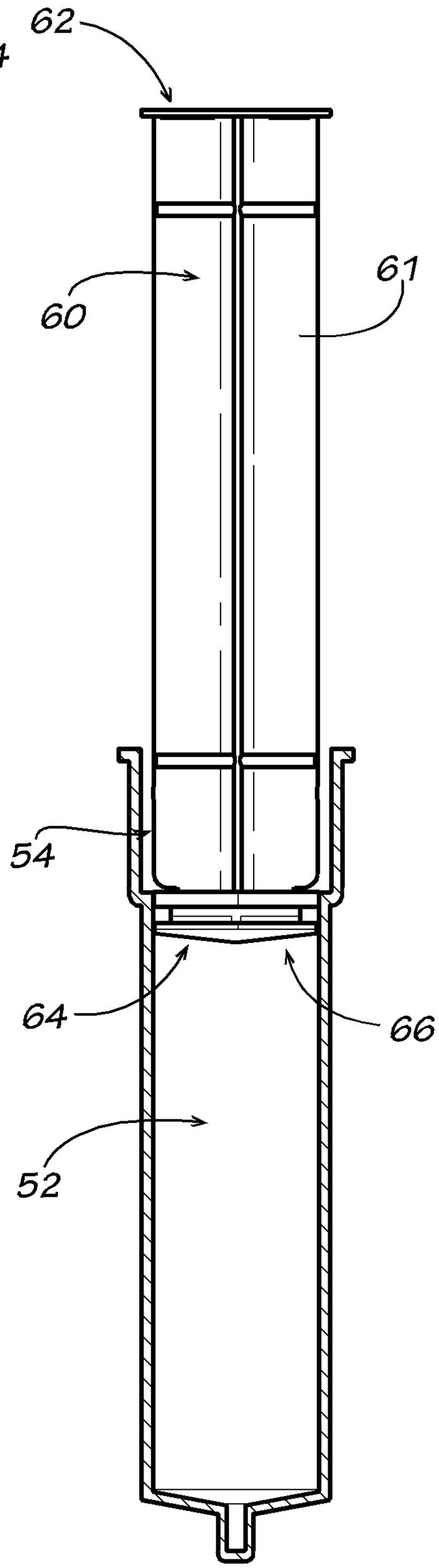


FIG. 16A

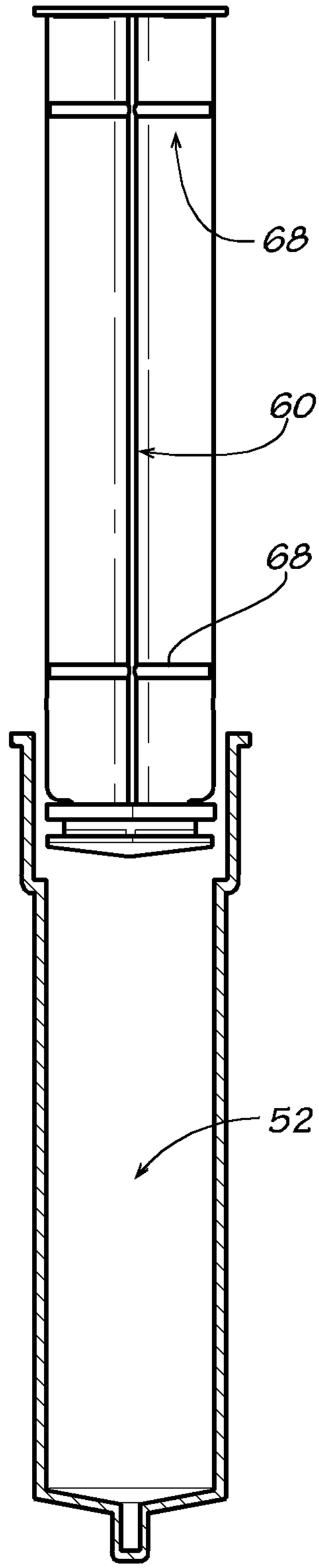


FIG. 16B

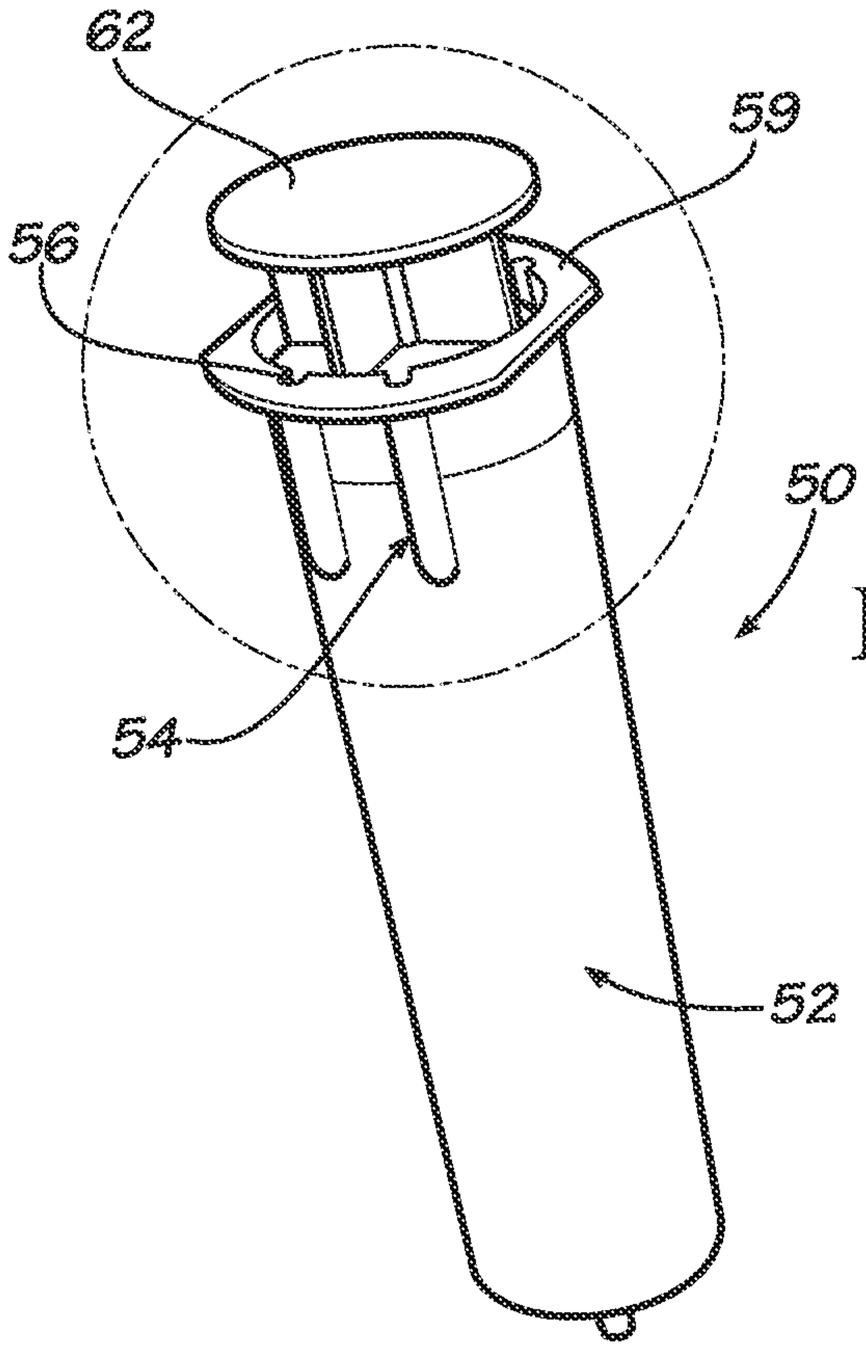
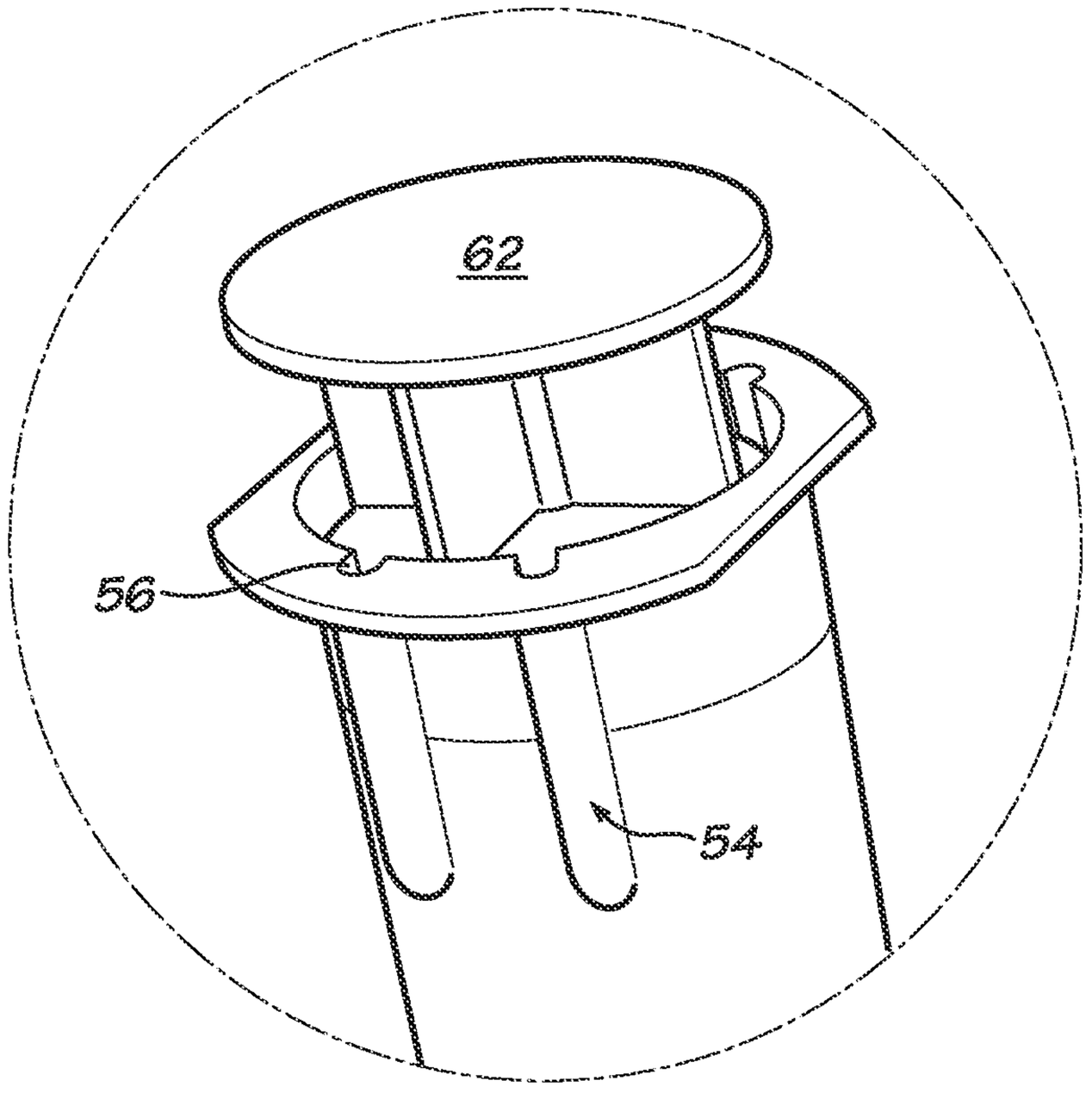


FIG. 17A

FIG. 17B



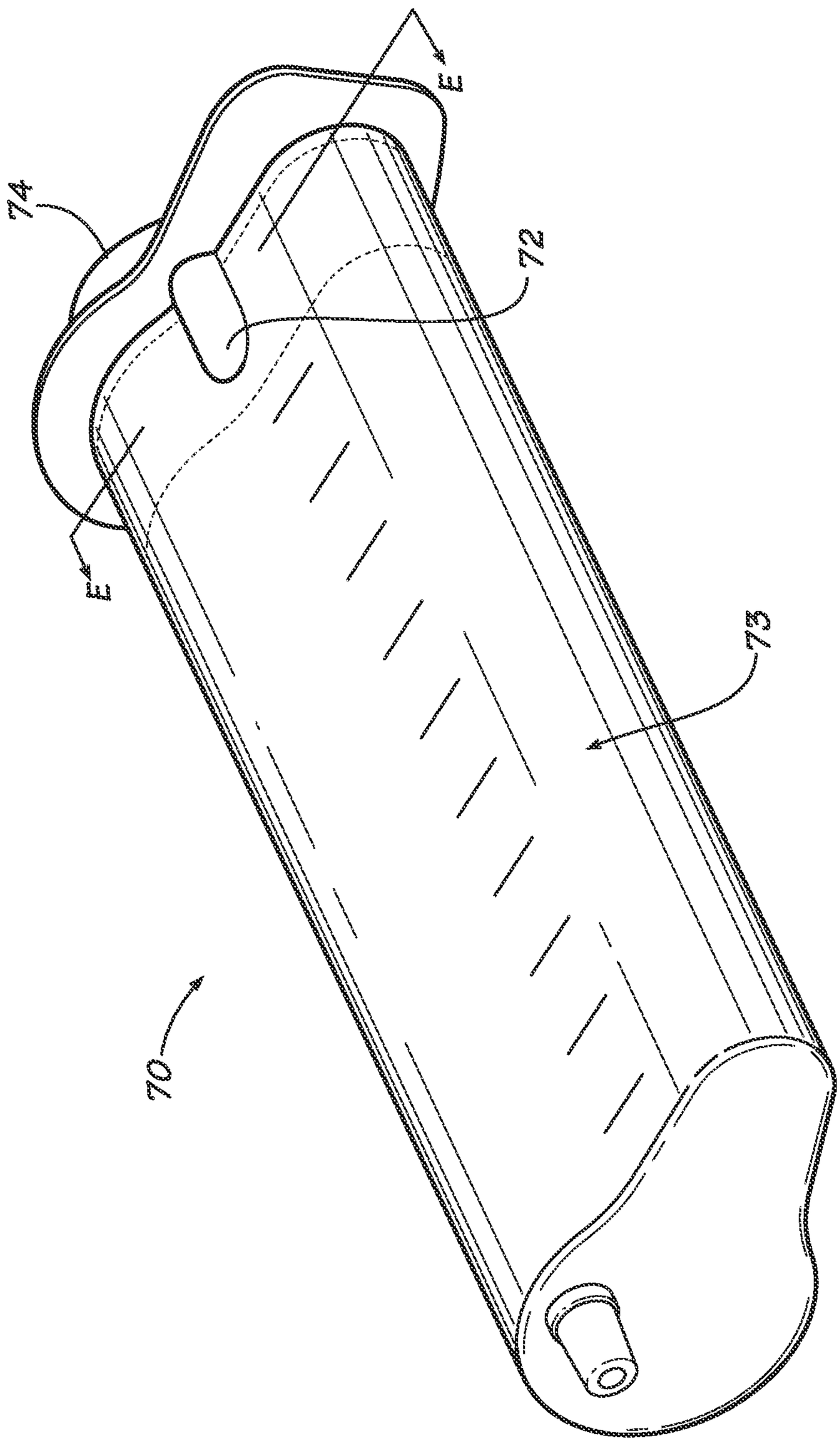


FIG. 18A

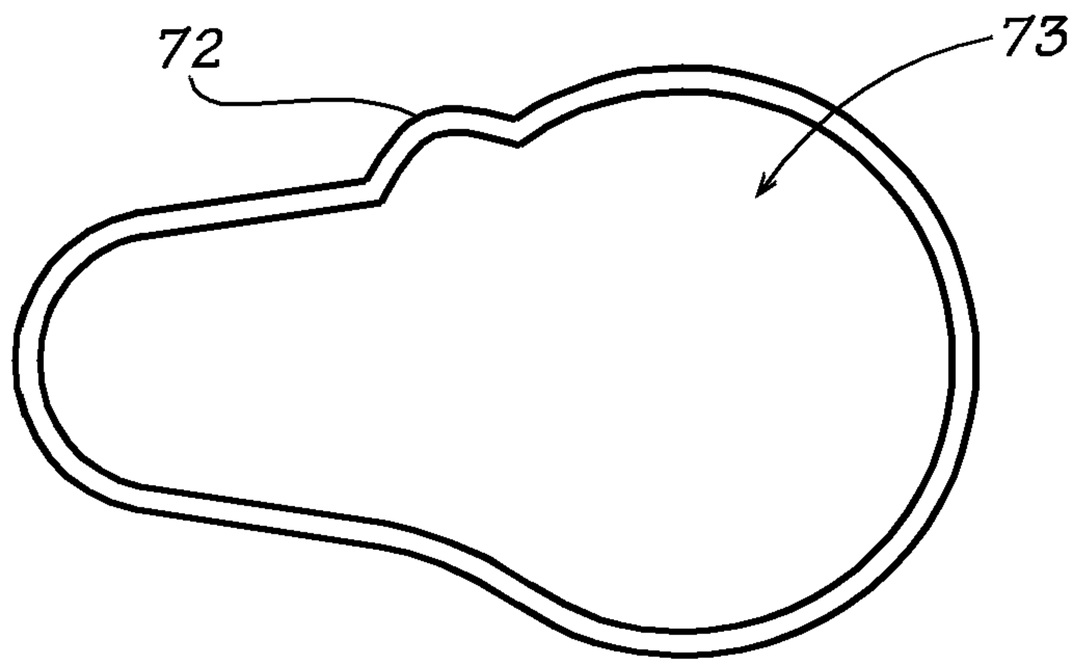


FIG. 18B

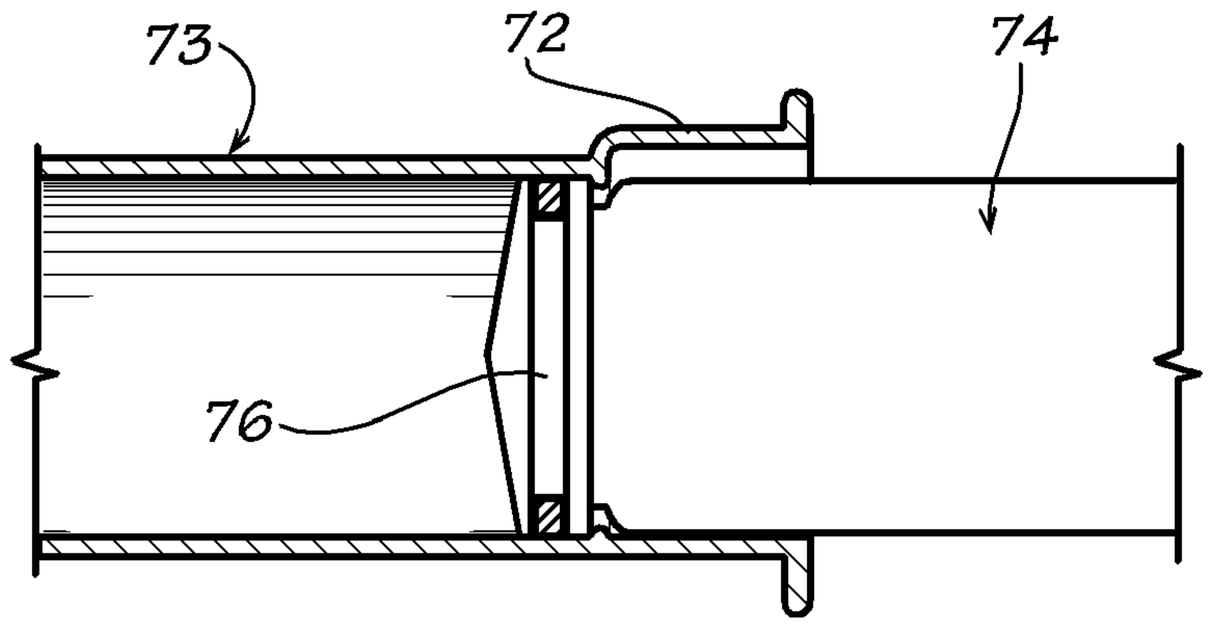


FIG. 18C

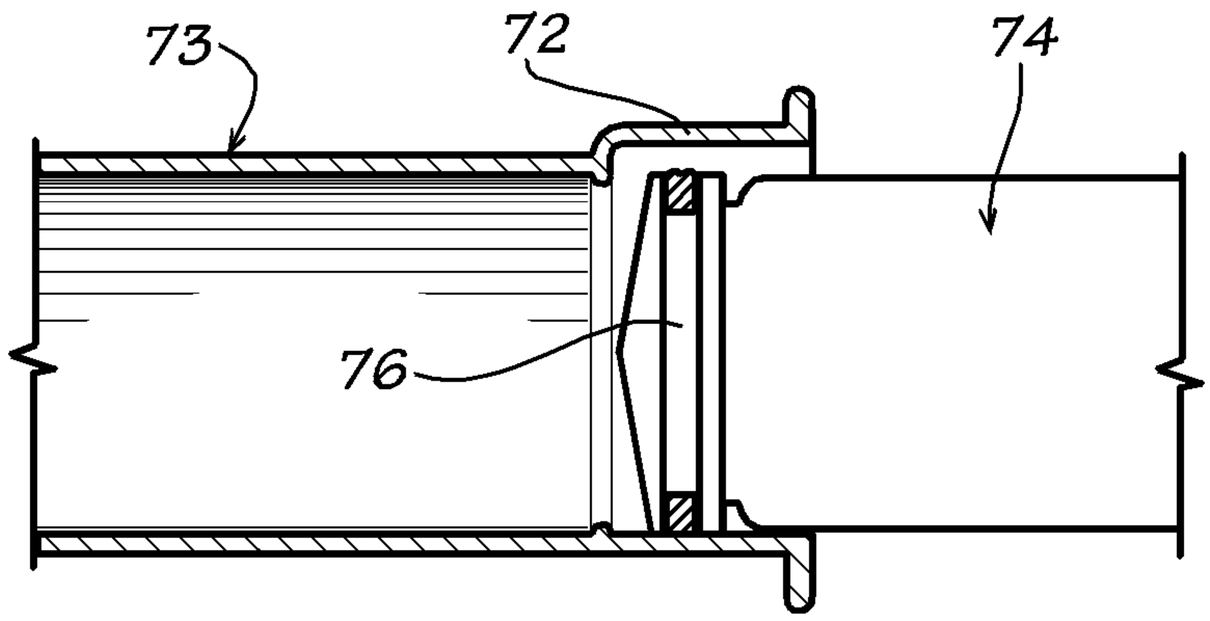


FIG. 18D

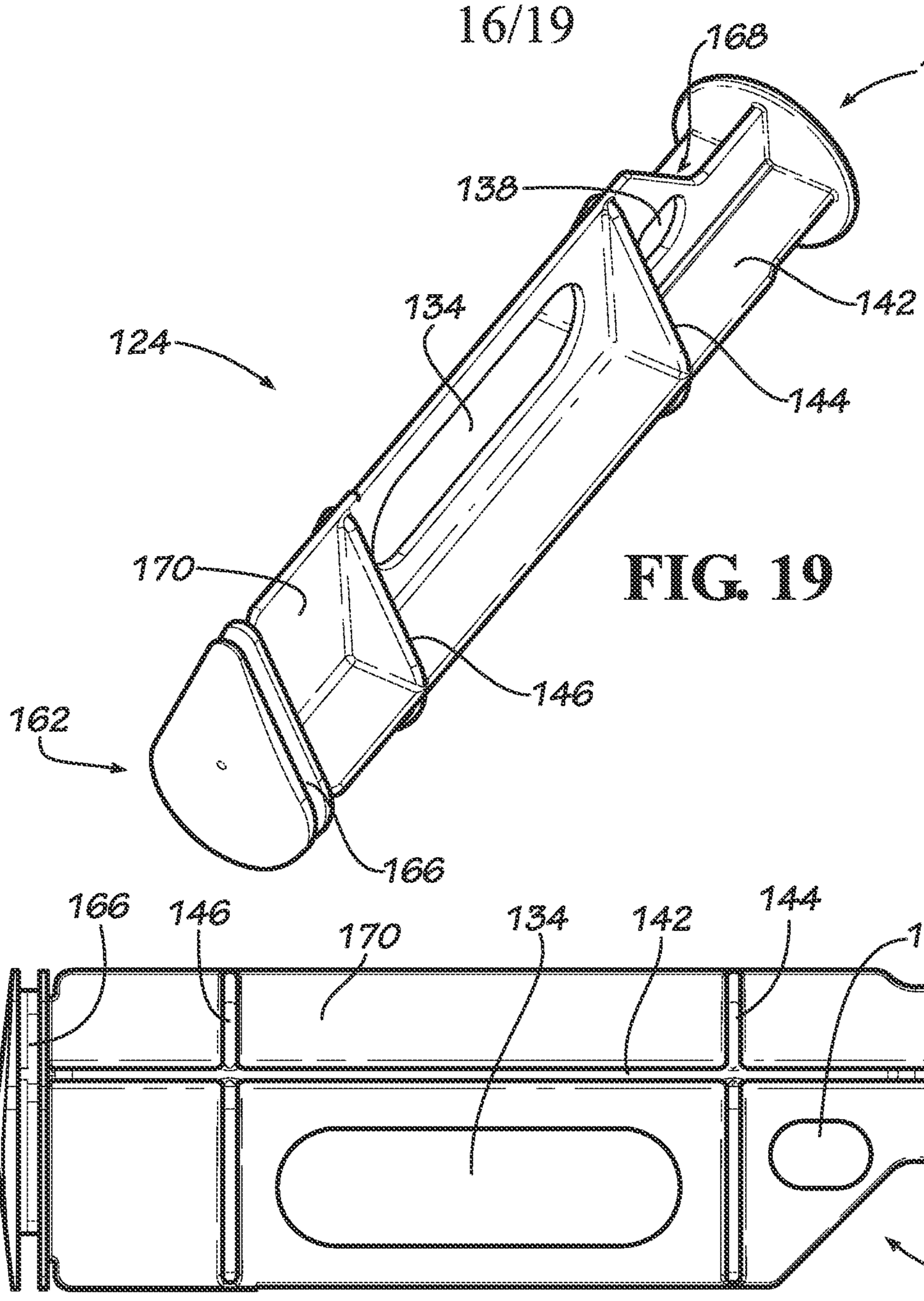


FIG. 19

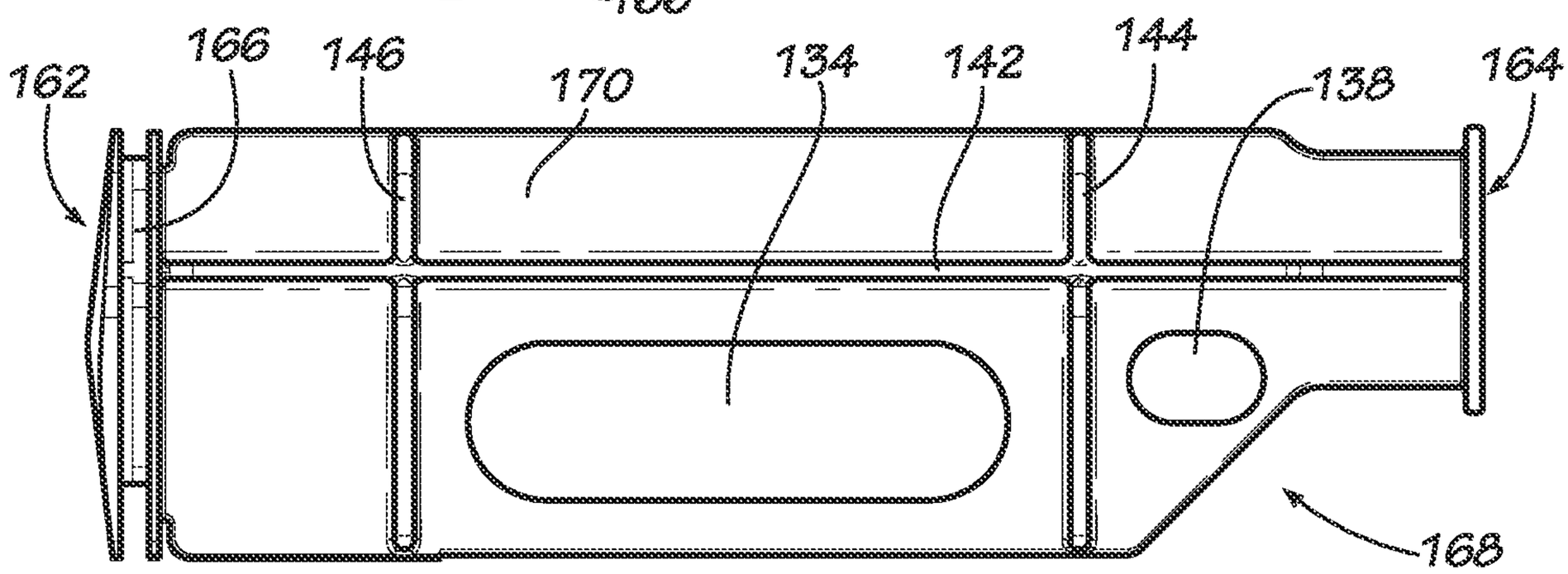


FIG. 20A

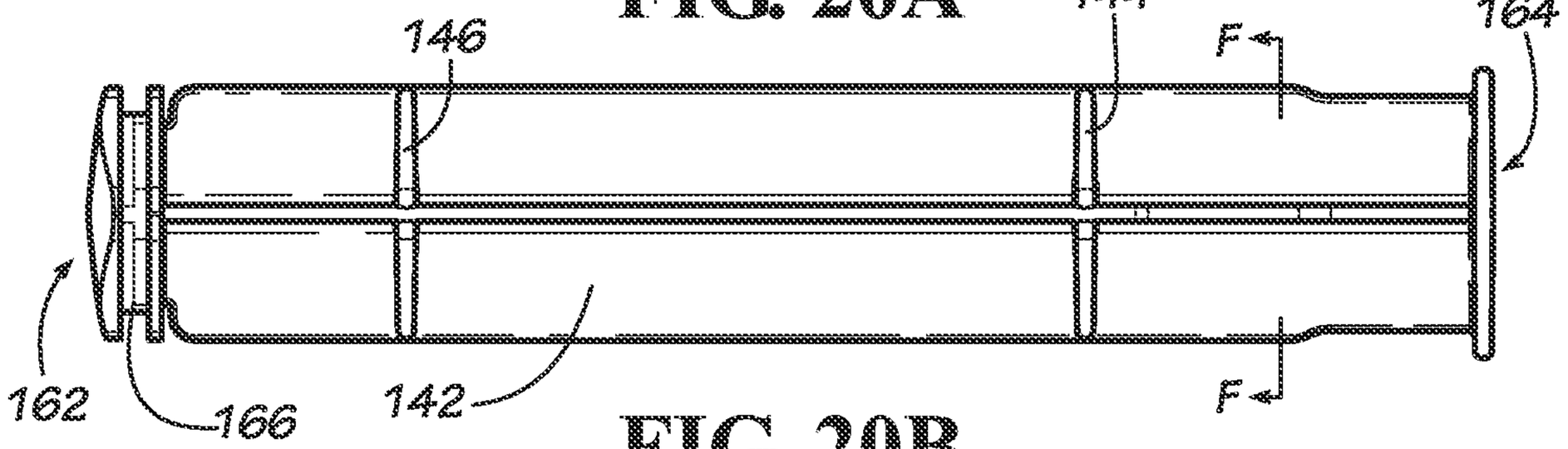


FIG. 20B

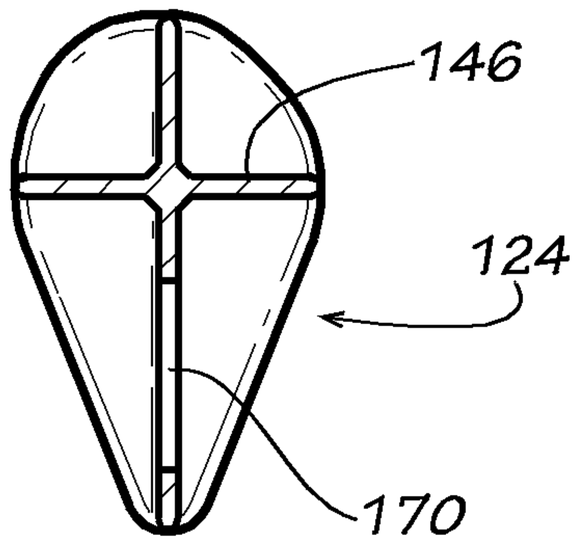


FIG. 21A

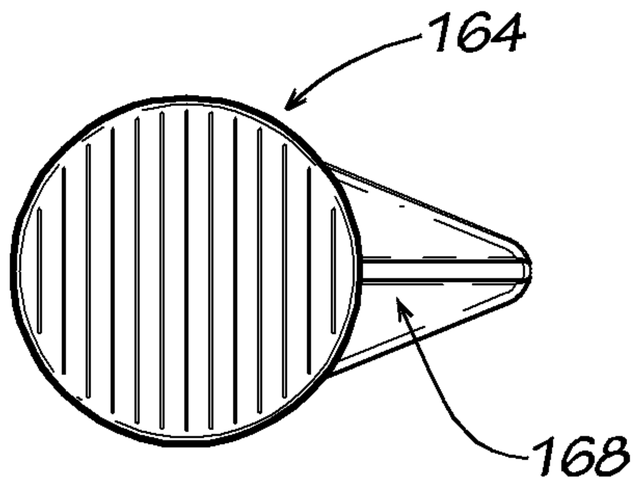


FIG. 21B

FIG. 21C

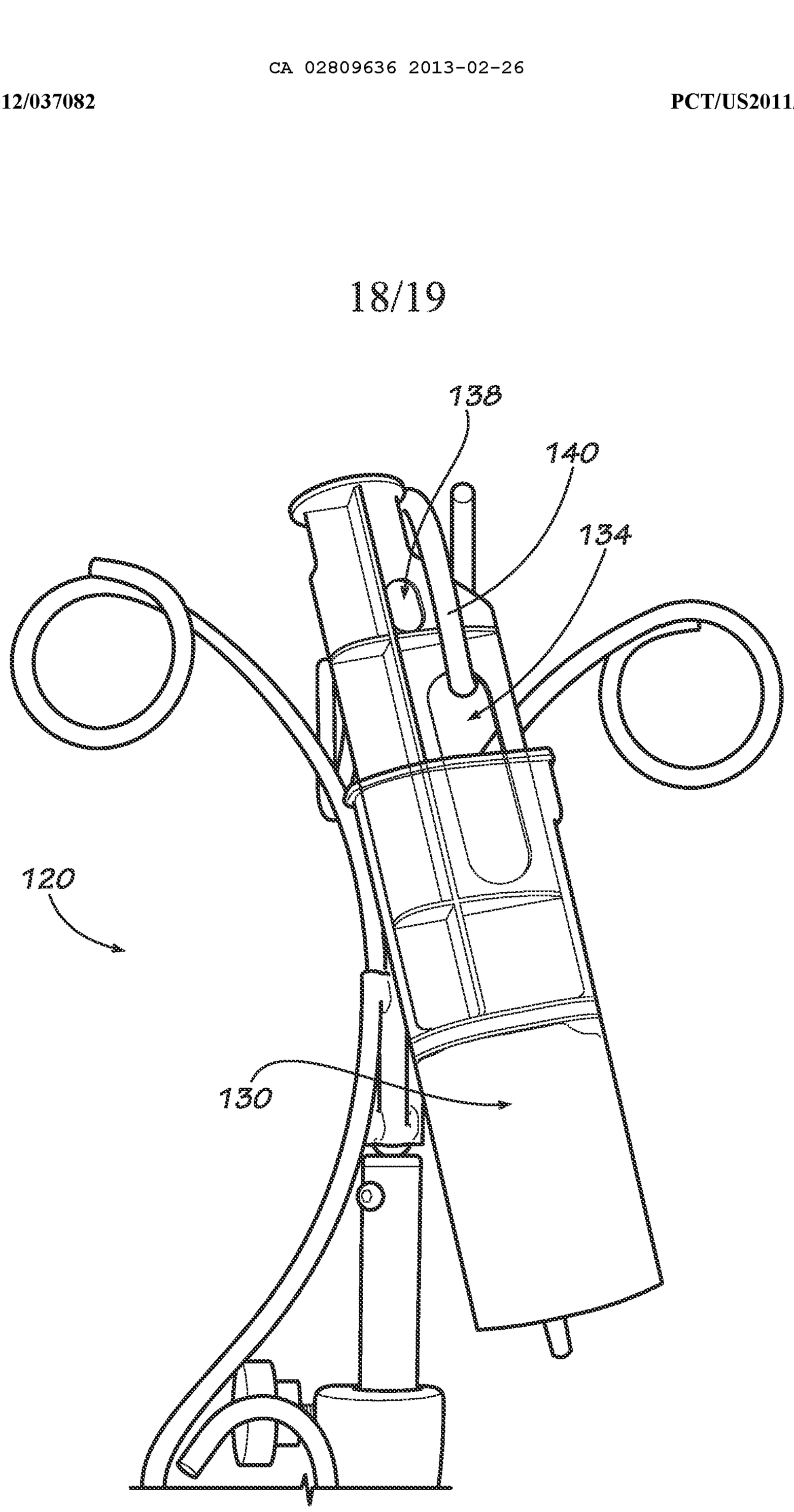


FIG. 22

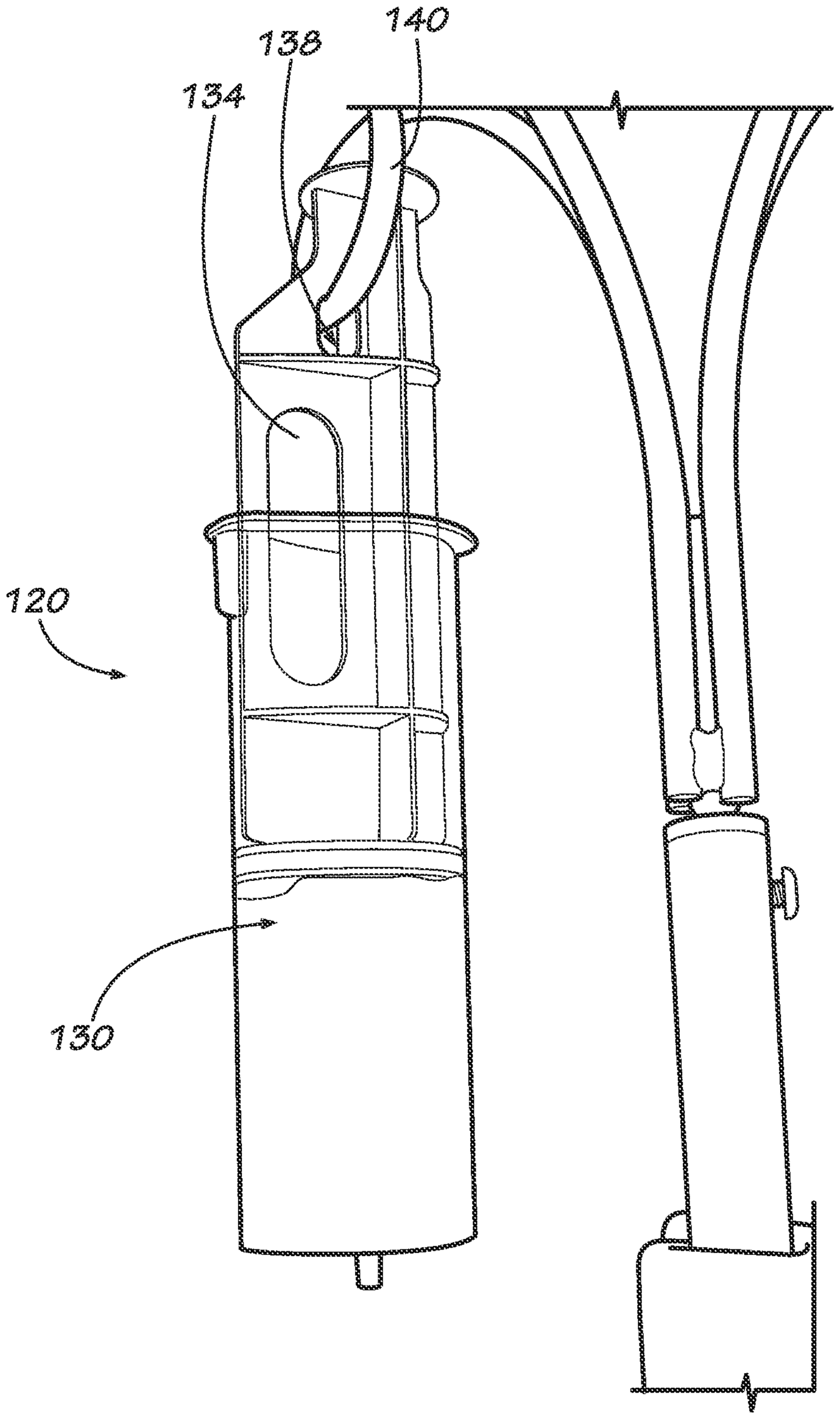
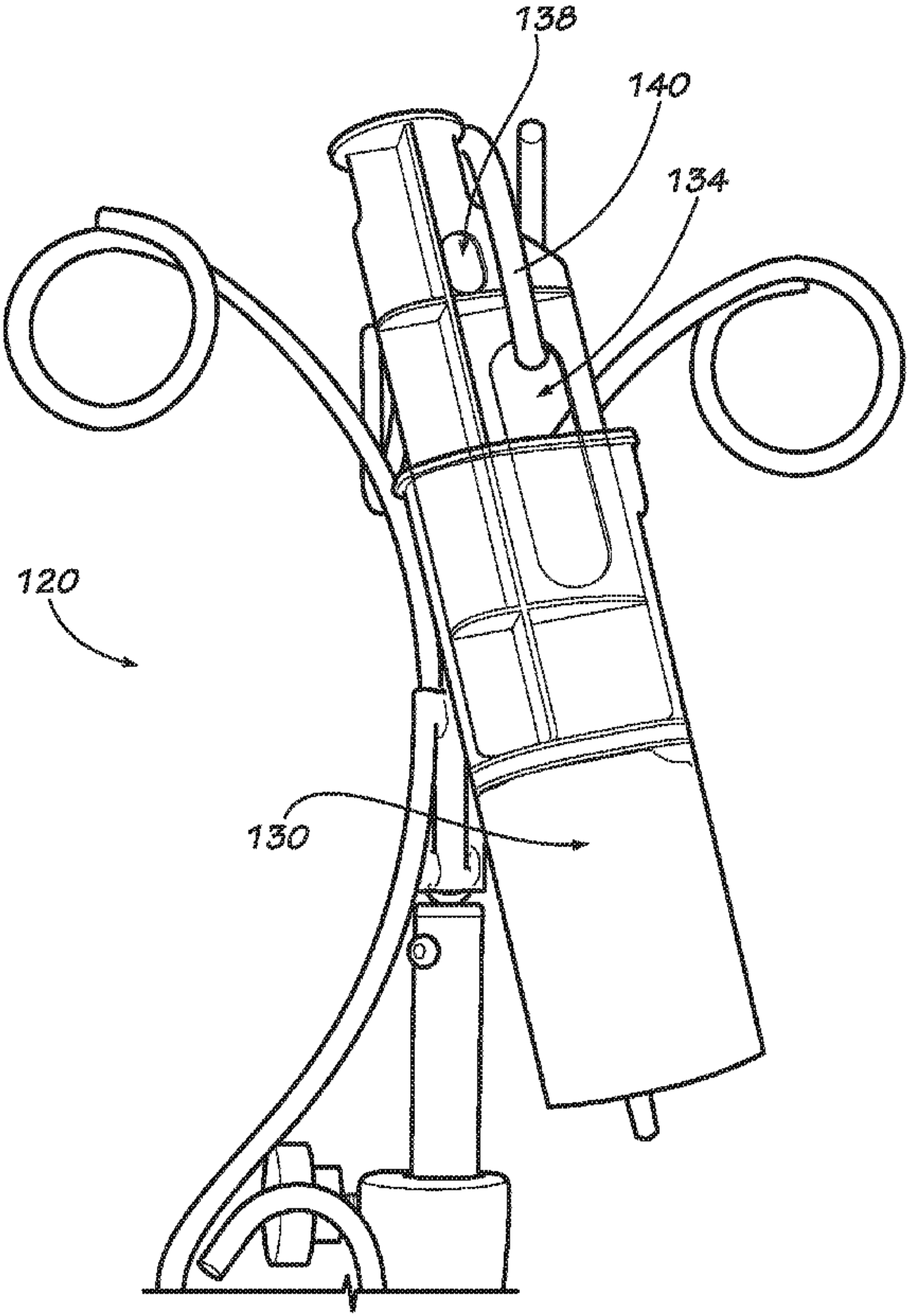


FIG. 23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