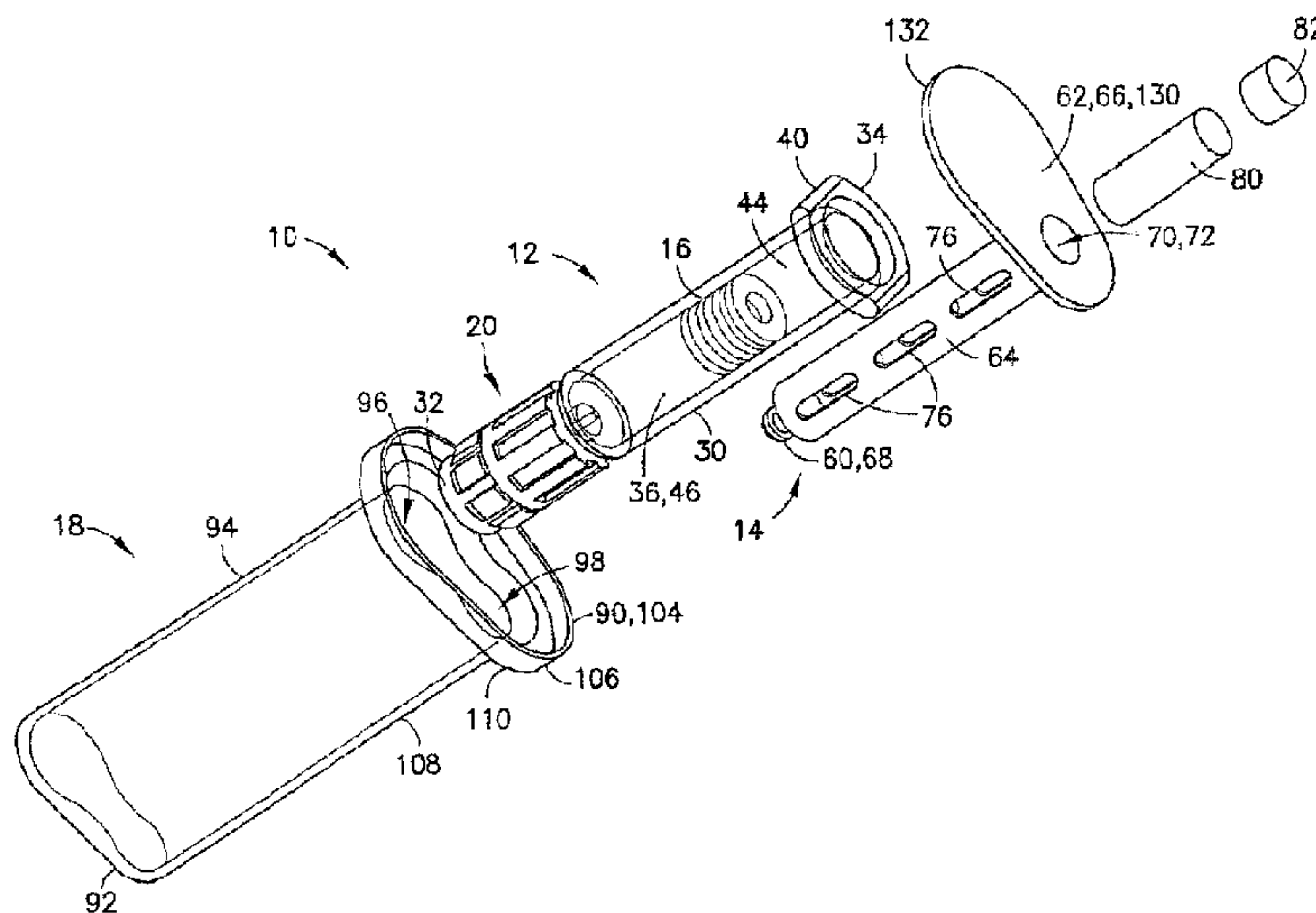




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(57) **Abrégé/Abstract:**

A syringe assembly, comprising a syringe barrel having a first end, a second end, and a sidewall extending therebetween and defining a chamber having an interior; a stopper slidably disposed within the interior and defining an aperture therein, the stopper comprising a deformable restraining member adjacent the aperture, the deformable restraining member transitionable between a deformed position to an undeformed position; and a plunger rod having a first end, a second end, and a plunger rod head disposed adjacent the first end of the plunger rod, wherein as the plunger rod head is moved axially within the aperture of the stopper, the plunger rod head deforms the restraining member of the stopper, and once the plunger rod head is advanced beyond the restraining member of the stopper, the restraining member returns to its undeformed position to secure the plunger rod head within the aperture.

ABSTRACT

A syringe assembly, comprising a syringe barrel having a first end, a second end, and a sidewall extending therebetween and defining a chamber having an interior; a stopper slidably disposed within the interior and defining an aperture therein, the stopper comprising a deformable restraining member adjacent the aperture, the deformable restraining member transitionable between a deformed position to an undeformed position; and a plunger rod having a first end, a second end, and a plunger rod head disposed adjacent the first end of the plunger rod, wherein as the plunger rod head is moved axially within the aperture of the stopper, the plunger rod head deforms the restraining member of the stopper, and once the plunger rod head is advanced beyond the restraining member of the stopper, the restraining member returns to its undeformed position to secure the plunger rod head within the aperture.

ATTACHABLE PLUNGER ROD AND ASSOCIATED PACKAGING**BACKGROUND OF THE INVENTION**

1. Field of the Disclosure

[0001] The present disclosure relates generally to a syringe assembly adapted for delivery of a fluid and/or collection of a fluid. More particularly, the present disclosure relates to a syringe assembly in which the plunger rod and the syringe barrel may be placed in a packaging member in a manner that allows for reduced storage space of the syringe assembly.

2. Description of the Related Art

[0002] Syringe assemblies, and in particular hypodermic syringes, are well known in the medical field for dispensing fluids, such as medications. A conventional syringe typically includes a syringe barrel with an opening at one end and a plunger mechanism disposed through the opposite end. The plunger mechanism typically includes a plunger rod extending through the barrel, with a plunger head or stopper disposed at the end of the plunger rod within the syringe barrel, and with a finger flange at the other end of the plunger rod extending out of the syringe barrel. In use, the plunger rod is retracted through the syringe barrel to aspirate or fill the syringe barrel with a fluid, such as a medication, with the plunger rod extending out from the rear end of the syringe barrel. For delivery of the medication to a patient, the opening of the syringe barrel is adapted for fluid communication with a patient, such as through a hypodermic needle fitted at the front end of the syringe barrel or through a luer-type fitting extending from the syringe barrel for attachment with a fluid line of a patient. Upon the user applying a force to depress the plunger rod and stopper through the syringe barrel towards the front end of the syringe barrel, the contents of the syringe are thereby forced out of the syringe barrel through the opening at the front end for delivery to the patient. Such an operation is well known in the medical field, and medical practitioners have become well accustomed to the use of such common fluid delivery procedures through standard syringes.

[0003] Conventional syringes are well known in the medical field to be used in connection with a vial of a medication, where the user collects or draws the fluid into the syringe immediately prior to injection and delivery of the fluid to the patient. Commonly, hypodermic syringes may be packaged as “pre-filled” devices, wherein the syringe is pre-filled with medication prior to being packaged and delivered to the patient. In this manner,

the need for the user to fill the device prior to injection is eliminated, thereby saving time and maintaining consistent volumes for delivery.

[0004] However, packaging of such pre-filled syringes tends to be bulky and difficult to ship and store. A pre-filled syringe is typically packaged with the opening at the front end of the barrel including a cap thereover and with the plunger rod retracted out of the back end of the syringe barrel, with the fluid pre-filled within the syringe barrel. Such packaging creates an elongated package that can be awkward for shipping and storage.

[0005] Pre-filled syringes and pre-filled metered dose syringes are often filled with fluids, such as a medication, at a production facility, packaged, and then shipped to a medical facility. Once at the facility, these syringes are often placed in controlled storage and/or locked cabinets to reduce theft of the syringes themselves and/or of the contents of these syringes. The space within these controlled storage locations is often limited, thus there is a need for a syringe assembly that has a smaller packaging footprint to reduce the amount of storage space required for containing the syringe.

SUMMARY OF THE INVENTION

[0006] In accordance with an embodiment of the present invention, a syringe assembly is provided which, in one embodiment, includes a plunger rod separate and detached from a syringe barrel and a packaging member, the plunger rod having a sealing member and the packaging member having a first compartment and a second compartment. With the syringe barrel received within the first compartment and the plunger rod received within the second compartment, the sealing member of the plunger rod seals the syringe barrel and the plunger rod within the packaging member. The syringe assembly of the present disclosure is placed in the packaging member in a manner that allows for reduced storage space of the syringe assembly. In one embodiment, the syringe assembly of the present disclosure includes a securement feature or engagement portion connected to the plunger rod and a stopper slidably disposed within the interior of the syringe barrel, the engagement portion operable to secure the plunger rod to the stopper. In this manner, upon removal of the plunger rod and the syringe barrel from the packaging member, the plunger rod can quickly and easily be secured to the syringe barrel via the stopper for collecting a fluid and/or delivering a fluid.

[0007] The present disclosure, in one embodiment thereof, includes a syringe packaging system including a syringe barrel having a first end, a second end, and a sidewall extending therebetween and defining a chamber having an interior, and a stopper slidably disposed within the interior of the syringe barrel. The syringe packaging system of this embodiment

includes a plunger rod having a first end engageable with a portion of the stopper, a second end, and a sealing member disposed adjacent the second end. The syringe packaging system further includes a packaging member having a first end, a second end, and a sidewall defining a first compartment and a second compartment each extending between the first end and the second end of the packaging member, the first compartment sized and adapted to receive the syringe barrel therein, and the second compartment sized and adapted to receive the plunger rod therein, wherein with the syringe barrel received within the first compartment of the packaging member and the plunger rod received within the second compartment of the packaging member, the sealing member of the plunger rod seals the syringe barrel and the plunger rod within the packaging member. Optionally, the packaging member is substantially rigid.

[0008] The present disclosure, in another embodiment thereof, includes a syringe assembly including a syringe barrel having a first end, a second end, and a sidewall extending therebetween and defining a chamber having an interior, and a stopper slidably disposed within the interior of the syringe barrel and defining an aperture therein, the stopper comprising a deformable restraining member adjacent the aperture, the deformable restraining member transitionable between a deformed position to an undeformed position. The syringe assembly of this embodiment includes a plunger rod having a first end, a second end, and a plunger rod head disposed adjacent the first end of the plunger rod, wherein as the plunger rod head is moved axially within the aperture of the stopper, the plunger rod head deforms the restraining member of the stopper, and once the plunger rod head is advanced beyond the restraining member of the stopper, the restraining member returns to its undeformed position to secure the plunger rod head within the aperture.

[0009] The present disclosure, in a further embodiment thereof, includes a syringe assembly including a syringe barrel having a first end, a second end, and a sidewall extending therebetween and defining a chamber having an interior, and a stopper slidably disposed within the interior of the chamber of the syringe barrel and defining an aperture therein, the stopper comprising a protruding member adjacent the aperture. The syringe assembly of this embodiment includes a plunger rod having a first end, a second end, and a plunger rod head disposed adjacent the first end of the plunger rod, the plunger rod head comprising a deformable restraining member transitionable between a deformed position to an undeformed position, wherein as the plunger rod head is moved axially within the aperture of the stopper, the protruding member of the stopper deforms the restraining member of the plunger rod head, and once the plunger rod head is advanced beyond the protruding member of the

stopper, the restraining member returns to its undeformed position to secure the plunger rod head within the aperture.

[0010] The present disclosure, in another embodiment thereof, includes a syringe packaging system including a syringe barrel having a first end, a second end, and a sidewall extending therebetween and defining a chamber having an interior, and a stopper slidably disposed within the interior of the syringe barrel. The syringe packaging system of this embodiment includes a plunger rod having a first end engageable with a portion of the stopper and a second end, and an oxygen absorber contained within the plunger rod. The syringe packaging system further includes a packaging member having a first end, a second end, and a sidewall defining a first compartment and a second compartment each extending between the first end and the second end of the packaging member, the first compartment sized and adapted to receive the syringe barrel therein and the second compartment sized and adapted to receive the plunger rod therein. Optionally, the packaging member is substantially rigid.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is an exploded, perspective view of a syringe assembly in accordance with an embodiment of the present invention.

[0012] **FIG. 2A** is a perspective view of a syringe assembly in accordance with an embodiment of the present invention.

[0013] **FIG. 2B** is a perspective view of the syringe assembly of **FIG. 2A** in accordance with an embodiment of the present invention.

[0014] **FIG. 3A** is a perspective view of the syringe assembly of **FIG. 1**, with a syringe barrel and a plunger rod placed in a packaging member, and a sealing member of the plunger rod sealing the syringe barrel and the plunger rod within the packaging member in accordance with an embodiment of the present invention.

[0015] **FIG. 3B** is a side elevation view of the syringe assembly of **FIG. 3A**, with a syringe barrel and a plunger rod placed in a packaging member, and a sealing member of the plunger rod sealing the syringe barrel and the plunger rod within the packaging member in accordance with an embodiment of the present invention.

[0016] **FIG. 3C** is a cross-sectional view taken along line 3C-3C of **FIG. 3B** in accordance with an embodiment of the present invention.

[0017] **FIG. 4** is an exploded, perspective view of the syringe barrel and the plunger rod of **FIG. 1** in accordance with an embodiment of the present invention.

[0018] **FIG. 5A** is a fragmentary, cross-sectional view of a securement feature of the syringe barrel and the plunger rod of **FIG. 4** in a disengaged position in accordance with an embodiment of the present invention.

[0019] **FIG. 5B** is a fragmentary, cross-sectional view of a securement feature of the syringe barrel and the plunger rod of **FIG. 4** in an engaged position in accordance with an embodiment of the present invention.

[0020] **FIG. 6A** is an assembled, perspective view of the syringe barrel and the plunger rod of **FIG. 4**, illustrating an alternative embodiment of a flange of the plunger rod and the syringe barrel in accordance with an embodiment of the present invention.

[0021] **FIG. 6B** is a cross-sectional view taken along line **6B-6B** of **FIG. 6A** in accordance with an embodiment of the present invention.

[0022] **FIG. 7** is an exploded, perspective view of a syringe assembly in accordance with an embodiment of the present invention.

[0023] **FIG. 8A** is a perspective view of a packaging member in accordance with an embodiment of the present invention.

[0024] **FIG. 8B** is a plan view of the packaging member of **FIG. 8A** in accordance with an embodiment of the present invention.

[0025] **FIG. 9A** is a perspective view of the plunger rod of **FIG. 7** in accordance with an embodiment of the present invention.

[0026] **FIG. 9B** is a perspective view of the plunger rod of **FIG. 9A** in accordance with an embodiment of the present invention.

[0027] **FIG. 10** is a perspective view of the syringe assembly of **FIG. 7** in accordance with an embodiment of the present invention.

[0028] **FIG. 11** is a partial elevation view of a top portion of the plunger rod of **FIG. 9A** and a top portion of the syringe assembly of **FIG. 10** in accordance with an embodiment of the present invention.

[0029] **FIG. 12A** is a perspective view of the syringe assembly of **FIG. 7**, with the syringe barrel of **FIG. 10** and the plunger rod of **FIG. 9A** placed in the packaging member of **FIG. 8A**, and an additional sealing cover disposed over the syringe barrel and the plunger rod within the packaging member in accordance with an embodiment of the present invention.

[0030] **FIG. 12B** is a side elevation view of the syringe assembly of **FIG. 12A** in accordance with an embodiment of the present invention.

[0031] **FIG. 12C** is a perspective view of the syringe assembly of **Fig. 12A** in accordance with an embodiment of the present invention.

[0032] FIG. 12D is a perspective view of the syringe assembly of FIG. 12A, with the additional sealing cover removed in accordance with an embodiment of the present invention.

[0033] FIG. 13 is a plan view of the syringe assembly of FIG. 12D in accordance with an embodiment of the present invention.

[0034] FIG. 14 is a perspective view of a syringe assembly with a tethering member connecting the plunger rod and the syringe barrel in accordance with an embodiment of the present invention.

[0035] FIG. 15A is a fragmentary, cross-sectional view of a securement feature of the syringe barrel and the plunger rod in a disengaged position in accordance with an embodiment of the present invention.

[0036] FIG. 15B is a fragmentary, cross-sectional view of the securement feature of FIG. 15A in an engaged position in accordance with an embodiment of the present invention.

[0037] FIG. 16A is a perspective view of a packaging member in accordance with an embodiment of the present invention.

[0038] FIG. 16B is a perspective view of the packaging member of FIG. 16A in accordance with an embodiment of the present invention.

[0039] FIG. 16C is a side elevation view of the packaging member of FIG. 16A in accordance with an embodiment of the present invention.

[0040] FIG. 16D is a plan view of the packaging member of FIG. 16A in accordance with an embodiment of the present invention.

[0041] FIG. 17 is a perspective view of a conventional pre-filled syringe in a position to be packaged in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

[0042] For purposes of the description hereinafter, the terms “upper”, “lower”, “right”, “left”, “vertical”, “horizontal”, “top”, “bottom”, “lateral”, “longitudinal”, and derivatives thereof shall relate to the invention as it is oriented in the drawing figures. However, it is to be understood that the invention may assume various alternative variations, except where expressly specified to the contrary. It is also to be understood that the specific devices illustrated in the attached drawings, and described in the following specification, are simply exemplary embodiments of the invention. Hence, specific dimensions and other physical characteristics related to the embodiments disclosed herein are not to be considered as limiting.

[0043] In the following discussion, “distal” refers to a direction generally toward an end of a syringe assembly adapted for contact with a patient and/or engagement with a separate device such as a needle assembly or IV connection assembly, and “proximal” refers to the opposite direction of distal, i.e., away from the end of a syringe assembly adapted for engagement with the separate device. For purposes of this disclosure, the above-mentioned references are used in the description of the components of a syringe assembly in accordance with the present disclosure.

[0044] Referring to **FIGS. 1** and **6B**, a syringe assembly **10** includes a syringe barrel **12**, a separate or detached plunger rod **14**, a stopper **16**, and a packaging member **18**. Syringe assembly **10** may be adapted for dispensing and delivery of a fluid and/or collection of a fluid. For example, syringe assembly **10** may be used for injection or infusion of fluid such as a medication into a patient. Syringe assembly **10** is contemplated for use in connection with a needle, such as by connecting syringe assembly **10** to a separate needle assembly (not shown), or alternatively for connection with an intravenous (IV) connection assembly (not shown). It can be appreciated that the present disclosure can be used with any type of syringe assembly, particularly those which are placed in a controlled storage environment in which storage space is limited. These types of syringes include traditional pre-filled syringe assemblies, metered dose syringes, aspiration syringes for withdrawing fluid from a patient or medication from a container, and the like.

[0045] Referring to **FIGS. 1**, **3C**, **4**, and **6B**, syringe barrel **12** generally includes a barrel body or sidewall **30** extending between a first or distal end **32** and a second or proximal end **34**. Sidewall **30** defines an elongate aperture or interior chamber **36** of syringe barrel **12**. In one embodiment, interior chamber **36** may span the extent of syringe barrel **12** so that syringe barrel **12** is cannulated along its entire length. In one embodiment, syringe barrel **12** may be in the general form of an elongated cylindrical barrel as is known in the art in the general shape of a hypodermic syringe. In alternative embodiments, syringe barrel **12** may be in other forms for containing a fluid for delivery, such as in the general form of an elongated rectangular barrel, for example. Syringe barrel **12** may be formed of glass, or may be injection molded from thermoplastic material such as polypropylene and polyethylene according to techniques known to those of ordinary skill in the art, though it is to be appreciated that syringe barrel **12** may be made from other suitable materials and according to other applicable techniques. In certain configurations, syringe barrel **12** may include an outwardly extending flange **40** about at least a portion of proximal end **34**. Flange **40** may be configured for easy grasping by a medical practitioner, as will be discussed herein.

[0046] Distal end 32 of syringe barrel 12 includes an outlet opening 38 (FIGS. 3C and 6B) which is in fluid communication with chamber 36. Outlet opening 38 may be sized and adapted for engagement with a separate device, such as a needle assembly or IV connection assembly and, therefore, may include a mechanism for such engagement as is conventionally known. For example, distal end 32 may include a generally-tapered luer tip 42 (FIGS. 3C and 6B) for engagement with an optional separate tapered luer structure of such a separate device for attachment therewith (not shown). In one configuration, both the tapered luer tip 42 and the separate tapered luer structure may be provided with syringe assembly 10. In such a configuration, the separate tapered luer structure may be fitted with an attachment mechanism, such as a threaded engagement, for corresponding engagement with a separate device (not shown). In another configuration, tapered luer tip 42 may be provided for direct engagement with a separate device (not shown). In addition, a mechanism for locking engagement therebetween may also be provided with at least one of tapered luer tip 42 and/or the separate tapered luer structure, such as a luer collar or luer lock including interior threads. Such luer connections and luer locking mechanisms are well known in the art.

[0047] Proximal end 34 of syringe barrel 12 is generally open-ended, but is intended to be closed off to the external environment as discussed herein. Syringe barrel 12 may also include markings, such as graduations located on sidewall 30, for providing an indication as to the level or amount of fluid contained within interior chamber 36 of syringe barrel 12. Such markings may be provided on an external surface of sidewall 30, an internal surface of sidewall 30, or integrally formed or otherwise within sidewall 30 of syringe barrel 12. In other embodiments, alternatively, or in addition thereto, the markings may also provide a description of the contents of the syringe or other identifying information as may be known in the art, such as maximum and/or minimum fill lines.

[0048] Syringe assembly 10 may be useful as a pre-filled syringe, and, therefore, may be provided for end use with a fluid, such as a medication or drug, contained within interior chamber 36 of syringe barrel 12, pre-filled by the manufacturer. In this manner, syringe assembly 10 can be manufactured, pre-filled with a medication, sterilized, and packaged in appropriate packaging such as packaging member 18 for delivery, storage, and use by the end user, without the need for the end user to fill the syringe with medication from a separate vial prior to use. In such an embodiment, syringe assembly 10 may include sealing cap member 20 disposed at distal end 32 of syringe barrel 12 to seal a fluid, such as a medication, within interior chamber 36 of syringe barrel 12 as described above.

[0049] Referring to **FIGS. 1, 2A, 2B, 4, and 6B**, syringe assembly **10** includes stopper **16** which is moveably or slidably disposed within interior chamber **36**, and in sealing contact with the internal surface of sidewall **30** of syringe barrel **12**, thereby separating interior chamber **36** into a proximal chamber **44** adjacent proximal end **34**, and a distal chamber **46** adjacent distal end **32**. Stopper **16** is sized relative to syringe barrel **12** to provide sealing engagement with the interior surface of sidewall **30** of syringe barrel **12**. Additionally, stopper **16** may include one or more annular ribs **48** (**FIGS. 3C, 5A, 5B, and 6B**) extending around the periphery of stopper **16** to increase the sealing engagement between stopper **16** and the interior surface of sidewall **30** of syringe barrel **12**. In alternate embodiments, a singular O-ring or a plurality of O-rings may be circumferentially disposed about stopper **16** to increase the sealing engagement with the interior surface of sidewall **30**.

[0050] Referring to **FIGS. 5A, 5B, and 6B**, in one embodiment, stopper **16** also includes a first or distal end **47** and a second or proximal end **49** defining a plunger receiving aperture **50** formed therein and having a securement feature or engagement portion such as a deformable restraining member for securing plunger rod **14** to stopper **16**. In one embodiment, referring to **FIGS. 5A and 5B**, the engagement portion or deformable restraining member of stopper **16** may include elastic fingers **52** extending into aperture **50** for securing plunger rod **14** to stopper **16** as will be described in more detail below. The deformable restraining member is transitionable between a deformed position to an undeformed position as described in more detail below. In one embodiment, the deformable restraining member includes at least one deformable finger. Each elastic finger **52** of stopper **16** generally includes a tapered portion **54** and a locking end **56**. In other embodiments, the engagement portion of stopper **16** may include a threaded portion, snap fit mechanism, a ball detent, locking tabs, spring loaded locking mechanism, latch, adhesive, or other similar mechanism. In another alternative embodiment, referring to **FIGS. 15A and 15B**, the engagement portion of stopper **16** may include a protruding member **150** having a tapered portion **152**, a locking end **154**, and a protrusion **156** disposed between tapered portion **152** and locking end **154** as will be described in more detail below. In one embodiment, protruding member **150** is formed of a rigid, unyielding material.

[0051] Referring to **FIGS. 1, 2A, 2B, 4, 6A, and 6B**, syringe assembly **10** further includes plunger rod **14** which provides a mechanism for dispensing fluid contained within interior chamber **36** of syringe barrel **12** through outlet opening **38** upon connection of plunger rod **14** to syringe barrel **12** via stopper **16** as will be described in more detail below. Plunger rod **14** is adapted for advancing stopper **16**. In one embodiment, plunger rod **14** is sized for

movement within interior chamber 36 of syringe barrel 12 as will be discussed in more detail below, and generally includes a first or distal end 60, a second or proximal end 62, a plunger rod body 64 extending between first end 60 and second end 62, a sealing member or flange 66 disposed adjacent second end 62, and a securement feature or engagement portion for securing plunger rod 14 to stopper 16. In one embodiment, the engagement portion of plunger rod 14 may include a plunger rod head 68 disposed adjacent first end 60 for securing plunger rod 14 to stopper 16 as will be described in more detail below. In one embodiment, referring to **Figs. 5A and 5B**, plunger rod head 68 may include a stopper contacting portion 140 and a neck 142 extending between stopper contacting portion 140 and plunger rod head 68. Plunger rod head 68 has a cross-section that has a greater area than a cross-section disposed below plunger rod head 68, i.e., neck 142, such that a shoulder wall 144 is defined therebetween. Plunger rod head 68 also includes a sidewall 146 and a tapered portion 148. In one embodiment, plunger rod head 68 is formed of a rigid, unyielding material. In other embodiments, the engagement portion of plunger rod 14 may include a threaded portion, snap fit mechanism, a ball detent, locking tabs, spring loaded locking mechanism, latch, adhesive, or other similar mechanism. In another alternative embodiment, referring to **FIGS. 15A and 15B**, the engagement portion of plunger rod 14 may include a plunger rod head 160 having a deformable restraining member such as elastic fingers 162, a stopper contacting portion 164, and a neck 166 disposed between stopper contacting portion 164 and plunger rod head 160. Plunger rod head 160 also includes an annular groove 168 located between elastic fingers 162 and neck 166. Elastic fingers 162 each include a tapered portion 170 and a locking end 172. Plunger rod head 160 will be described in more detail below.

[0052] The walls of plunger rod body 64 define an elongate aperture or plunger rod cavity 70. Plunger rod cavity 70 spans the extent of plunger rod body 64 so that plunger rod body 64 is cannulated along its entire length. Plunger rod cavity 70 includes a cavity opening 72, as shown in **FIG. 1**, adjacent proximal end 62 and terminates at a bottom wall 74 (**FIGS. 5A and 5B**) adjacent distal end 60. Plunger rod body 64 also defines slots 76 extending between first end 60 and second end 62 of plunger rod 14.

[0053] Referring to **FIG. 1**, in one embodiment, an oxygen absorber 80 can be inserted through cavity opening 72 and into plunger rod cavity 70. Next, a plunger rod cap 82 can be inserted into cavity opening 72 to secure oxygen absorber 80 in plunger rod cavity 70. In one embodiment, plunger rod cap 82 is secured in plunger rod cavity 70 by an interference fit. Referring to **FIG. 1**, plunger rod cap 82 is sized and adapted to substantially correspond to the interior wall of plunger rod body 64. This interference fit between plunger rod cap 82 and

the interior wall of plunger rod body **64** is achieved by sizing and adapting the two mating parts, i.e., the exterior profile of plunger rod cap **82** and the interior profile of the interior wall of plunger rod body **64**, so that the exterior profile of plunger rod cap **82** only slightly deviates dimensionally from the interior profile of the interior wall of plunger rod body **64**. This ensures an interference fit which secures plunger rod cap **82** within plunger rod cavity **70** by a friction force after insertion of plunger rod cap **82** into plunger rod cavity **70**. In alternative embodiments, plunger rod cap **82** can be secured in plunger rod cavity **70** using a taper lock connection or similar connection mechanisms.

[0054] By securing oxygen absorber **80** in plunger rod cavity **70**, oxygen absorber **80** can reduce the oxygen levels within packaging member **18**. Any oxygen contained within packaging member **18** will flow through slots **76** of plunger rod body **64** and will be absorbed by oxygen absorber **80**. Typical oxygen absorbing materials that can be used to form oxygen absorber **80** include iron, low molecular weight organic compounds such as ascorbic acid and sodium ascorbate, and polymeric materials incorporating a resin and a catalyst. Reduction of oxygen levels within packaging member **18** is important because atmospheric gases such as oxygen contained in packaging member **18** can cause a medication or drug contained within syringe barrel **12**, such as in a pre-filled syringe as discussed above, to degrade. Sealing member **66** of plunger rod **14** provides an additional mechanism to reduce oxygen levels within packaging member **18** by sealing syringe barrel **12** and plunger rod **14** within packaging member **18** as will be described in more detail below.

[0055] Referring to **FIGS. 1, 2A, and 2B**, syringe assembly **10** further includes packaging member **18** which is sized to receive both syringe barrel **12** and plunger rod **14** therein. Packaging member **18** generally includes a first or top end **90**, a second or bottom end **92**, and a sidewall **94** extending between top end **90** and bottom end **92**. Sidewall **94** defines a first compartment **96** and a second compartment **98** of packaging member **18**. First compartment **96** is sized and adapted to receive syringe barrel **12** therein and second compartment **98** is sized and adapted to receive plunger rod **14** therein.

[0056] Referring to **FIG. 8B**, in one embodiment, first compartment **96** has diameter d_1 and second compartment **98** has diameter d_2 . Referring to **FIGS. 1 and 3C**, in one embodiment, syringe barrel **12** has a larger diameter than the diameter of plunger rod **14**. Accordingly, referring to **FIG. 8B**, diameter d_1 of first compartment **96** is greater than diameter d_2 of second compartment **98**. In this manner, first compartment **96** accommodates syringe barrel **12** and second compartment **98** accommodates plunger rod **14**. Referring to **FIG. 8B**, in one embodiment, the sidewall **94**, as shown in **FIG. 8A**, of packaging member

18 includes opposing protruding portions **100** which together define a connecting channel **102**. The distance between opposing protruding portions **100** is less than the diameters **d₁** and **d₂** of first compartment **96** and second compartment **98**, respectively, and connecting channel **102** is disposed between first compartment **96** and second compartment **98**. In this manner, first compartment **96** and second compartment **98** can be formed in a single step manufacturing process such as stamping, punching, or similar process. In some embodiments, first compartment **96** and second compartment **98** can be formed as a unitary embodiment.

[0057] Referring to **FIG. 1**, packaging member **18** includes a locking lip **104** at top end **90**. Disposed below locking lip **104** is an upper tray portion **106** having a cross-section that has a greater area than a cross-section disposed below upper tray portion **106**, i.e., a compartment portion **108**, such that a shoulder **110** is defined therebetween. Upper tray portion **106** receives and supports flange **40** of syringe barrel **12** and sealing member **66** of plunger rod **14** as will be described in more detail below. Referring to **FIG. 8A**, in one embodiment, upper tray portion **106** includes vent channels **112** around a periphery of second compartment **98**. Vent channels **112** channel and allow any oxygen contained within packaging member **18** to flow through vent channels **112** and slots **76** of plunger rod body **64** so that any oxygen contained within packaging member **18** will be absorbed by oxygen absorber **80** and prevent contamination of medication contained within syringe barrel **12** as discussed above. Referring to **FIG. 8A**, in one embodiment, upper tray portion **106** includes projection keys **114**. Projection keys **114** provide a further securement mechanism to secure plunger rod **14** within second compartment **98** of packaging member **18**. For example, referring to **FIG. 9B**, in one embodiment, the underside surface of flange **66** of plunger rod **14** includes key slots **78**. During insertion of plunger rod **14** into packaging member **18**, key slots **78** are positioned relative to projection keys **114** and as plunger rod **14** is inserted into second compartment **98**, projection keys **114** engage key slots **78**, i.e., projection keys **114** are located within key slots **78** of plunger rod **14** and secure plunger rod **14** within packaging member **18**. Packaging member **18** may include a number of different features to accommodate a variety of different syringe barrels and plunger rods. For example, referring to **FIGS. 8A, 16A, and 16B**, packaging member **18** may include elongated depressions **116** and a chamfered end **118** to accommodate syringe barrels and plunger rods having different geometries and/or configurations.

[0058] All of the components of syringe assembly **10** may be constructed of any known material, and are desirably constructed of medical-grade polymers.

[0059] Referring to **FIGS. 1-3C and 12A-12D**, packaging of syringe barrel **12** and plunger rod **14** within packaging member **18** will now be described. Initially, syringe barrel **12**, plunger rod **14**, and packaging member **18** are sterilized according to techniques known to those of ordinary skill in the art. In some embodiments, syringe barrel **12** may be pre-filled as described above. Next, syringe barrel **12** is inserted into first compartment **96** of packaging member **18** such that flange **40** of syringe barrel **12** abuts upper tray portion **106** as shown in **FIG. 2B**. With syringe barrel **12** properly inserted into first compartment **96** of packaging member **18**, plunger rod **14** is then inserted into second compartment **98** of packaging member **18**.

[0060] By having syringe assembly **10** including plunger rod **14** separate and detached from syringe barrel **12**, plunger rod **14** and syringe barrel **12** can be separately placed in packaging member **18** in a manner that allows for reduced storage space of syringe assembly **10**. For example, referring to **FIG. 3C**, the overall length of syringe assembly **10** in packaging member **18** in a disassembled state, i.e., with plunger rod **14** separate and detached from syringe barrel **12** as shown in **FIG. 3C**, is equal to the length of syringe barrel **12**, i.e., L_1 , and the thickness of sealing member **66** of plunger rod **14**, i.e., L_2 . As shown in **FIG. 3C**, in the disassembled state plunger rod **14** and syringe barrel **12** have a first effective distance D_1 relative to packaging member **18**, i.e., L_1 and L_2 . **FIG. 17** illustrates a conventional pre-filled syringe in a position to be packaged. Such a conventional pre-filled syringe, i.e., a syringe assembly **200**, is typically packaged with a plunger rod **202** retracted out of a back or proximal end **204** of a syringe barrel **206**, with the fluid pre-filled within syringe barrel **206**. Accordingly, packaging of such pre-filled syringes is bulky and awkward for shipping and storage. For example, the overall length of pre-filled syringe assembly **200** in the position to be packaged shown in **FIG. 17**, is equal to the length of syringe barrel **206**, i.e., L_3 , and the length that plunger rod **202** extends outwardly from syringe barrel **206**, i.e., L_4 . As shown in **FIG. 17**, plunger rod **202** and syringe barrel **206** have a second effective distance D_2 , i.e., L_3 and L_4 , which is greater than the first effective distance D_1 (**FIG. 3C**) of a syringe assembly in accordance with the present invention. Accordingly, a syringe assembly in accordance with the present invention allows plunger rod **14** and syringe barrel **12** to be packaged in a manner that allows for reduced storage space.

[0061] In an alternative embodiment, referring to **FIG. 14**, plunger rod **14** and syringe barrel **12** can be separate and detached, but also include a tethering element **195** fastened between plunger rod **14** and syringe barrel **12** to limit the range of movement between the two components.

[0062] Additionally, in accordance with a syringe assembly of the present invention, upon removal of plunger rod **14** and syringe barrel **12** from packaging member **18**, plunger rod **14** can quickly and easily be secured to syringe barrel **12** for collecting a fluid and/or delivering a fluid as will be described in more detail below.

[0063] As described above, referring to **FIGS. 3B** and **3C**, with syringe barrel **12** properly inserted into first compartment **96** of packaging member **18**, plunger rod **14** is inserted into second compartment **98** of packaging member **18** such that sealing member **66** of plunger rod **14** seals syringe barrel **12** and plunger rod **14** within packaging member **18**, i.e., sealing member **66** of plunger rod **14** provides a substantially impermeable enclosure with respect to packaging member **18**, provides a leak prevention and protection enclosure, protects the contents of syringe assembly **10** contained within packaging member **18**, and/or maintains a sealed, sterilized environment within packaging member **18**. Sealing member **66** of plunger rod **14** provides a sufficient seal at a range of temperatures, pressures, and humidity levels.

[0064] Referring to **FIGS. 2A, 2B, 3B, and 3C**, an embodiment of sealing member **66** of plunger rod **14** is illustrated. In such an embodiment, sealing member **66** comprises a cap member **120** generally including a sidewall **122** extending around its periphery and defining a recessed portion **124**, and a locking portion **126**. In this embodiment, with syringe barrel **12** properly inserted into first compartment **96** of packaging member **18**, plunger rod **14** is then inserted into second compartment **98** of packaging member **18** such that cap member **120** seals syringe barrel **12** and plunger rod **14** within packaging member **18**. This is achieved by engagement between sidewall **122** with locking lip **104** of packaging member **18**. In one embodiment, cap member **120** can snap over locking lip **104** of packaging member **18** such that locking lip **104** of packaging member **18** is received within recessed portion **124** of cap member **120**, and sidewall **122** of cap member **120** engages over locking lip **104** to seal cap member **120** to packaging member **18**. In some embodiments, the interior surface of sidewall **122** of cap member **120** can include an annular groove around its inner periphery so that as cap member **120** snaps over locking lip **104**, locking lip **104** can be received into the annular groove along the interior surface of sidewall **122** to further secure and seal cap member **120** to packaging member **18**. In another embodiment, sidewall **122** can include an interior threaded portion and locking lip **104** of packaging member **18** can include an exterior threaded portion, and cap member **120** can be threadingly connected to locking lip **104** of packaging member **18**. In some embodiments, locking portion **126** is formed of a resilient material and can be compressed as cap member **120** is secured to locking lip **104** of packaging member **18** such that once cap member **120** engages locking lip **104**, locking

portion **126** can spring back to its original form or position and engage an aperture disposed within a portion of locking lip **104** of packaging member **18** to further secure and seal cap member **120** to packaging member **18**. In other embodiments, cap member **120** and packaging member **18** can also include mating locking tabs, a ball detent mechanism, a spring loaded locking mechanism, latch, adhesive, or other similar mechanism to further secure and seal cap member **120** to packaging member **18**. In one embodiment, tamper evidence is also provided by use of a tear strip or other indicating means secured to a portion of cap member **120** and packaging member **18** to indicate tampering with the contents of packaging member **18**.

[0065] Referring to **FIGS. 1, 3A, 4, 6A, and 6B**, an embodiment of sealing member **66** of plunger rod **14** is illustrated. In such an embodiment, sealing member **66** comprises a sealing flange **130** generally including a sidewall **132** having a constant thickness. In this embodiment, locking lip **104** of packaging member **18** can include an annular groove on its interior surface for receiving a sealing mechanism such as an o-ring around sidewall **132** of sealing flange **130** to secure sealing flange **130** to packaging member **18**. Sealing flange **130** can be formed of a resilient material sized relative to the profile of locking lip **104** of packaging member **18** so that as sealing flange **130** is forced in locking lip **104**, locking lip **104** compresses sealing flange **130** until sealing flange **130** reaches the annular groove on the interior surface of locking lip **104**. At this position, sealing flange **130** returns to its original position and locks inside of the annular groove on the interior surface of locking lip **104**. In other embodiments, referring to **FIGS. 12A-12C**, an additional sealing cover **190** can be secured over sealing flange **130** and packaging member **18** to provide an additional seal mechanism. In one embodiment, tamper evidence is also provided by use of a tear strip or other indicating means secured to a portion of sealing flange **130** and packaging member **18** to indicate tampering with the contents of packaging member **18**.

[0066] Referring to **FIGS. 8A and 8B**, packaging member **18** can also include opposing flanges **185** located at top end **90**. In such an embodiment, sealing flange **130** of plunger rod **14** can have a shape that corresponds to the profile of top end **90** of packaging member **18** with opposing flanges **185**. In this manner, in one embodiment, sealing flange **130** can be secured to opposing flanges **185** of packaging member **18** by an adhesive connection between the exterior surface of opposing flanges **185** and the underside surface of sealing flange **130** of plunger rod **14**. In another embodiment, referring to **FIGS. 12A-12C**, additional sealing cover **190** can be secured to packaging member **18** in a similar way using such an adhesive connection.

[0067] Referring to **FIGS. 1, 3B, 3C, 4, and 6B**, removal of syringe barrel **12** and plunger rod **14** from packaging member **18** so that syringe barrel **12** and plunger rod **14** can be secured together to form a syringe assembly to expel a fluid, such as a medication, contained within distal chamber **46** of syringe barrel **12** will now be described. Initially, the user removes syringe assembly **10** from packaging member **18**. To remove syringe assembly **10** from packaging member **18**, in one embodiment, a user can first check to make sure a tear strip or other tamper evidence member has not been broken. Next, the user can remove the tamper evidence member and then break the above described seal between sealing member **66** of plunger rod **14** and packaging member **18**.

[0068] With the seal between sealing member **66** of plunger rod **14** and packaging member **18** broken, a user can grasp sealing member **66** and pull sealing member **66** longitudinally to remove plunger rod **14** from second compartment **98** of packaging member **18**. Next, a user can grasp flange **40** located in upper tray portion **106** of packaging member **18** and pull flange **40** longitudinally to remove syringe barrel **12** from first compartment **96** of packaging member **18**. With plunger rod **14** and syringe barrel **12** removed from packaging member **18**, plunger rod **14** and syringe barrel **12** can be secured together to form syringe assembly **10** adapted for dispensing and delivery of a fluid and/or collection of a fluid.

[0069] Referring to **FIGS. 4-6B**, an embodiment of a securement feature operable to secure plunger rod **14** to syringe barrel **12** via stopper **16** will now be described. With plunger rod head **68** of plunger rod **14** positioned adjacent plunger receiving aperture **50** of stopper **16**, plunger rod **14** is inserted or moved axially into plunger receiving aperture **50** in a direction generally along arrow **A** (**FIG. 5A**), such that tapered portion **148** of plunger rod head **68** is disposed within plunger receiving aperture **50** of stopper **16**. As additional force is exerted on plunger rod **14** to axially move plunger rod head **68** in the direction generally along arrow **A** within plunger receiving aperture **50**, tapered portion **148** of plunger rod head **68** cooperates with tapered portion **54** of a deformable restraining member, such as elastic fingers **52**, and deforms or compresses elastic fingers **52** of stopper **16** outward in a direction generally along arrow **C** (**FIG. 5A**) until plunger rod head **68** advances beyond, i.e., slides over and past, elastic fingers **52** and locks plunger rod **14** to stopper **16** as shown in **FIG. 5B**. Once plunger rod head **68** slides over and past elastic fingers **52**, elastic fingers **52** of stopper **16** return to their undeformed or original position as shown in **FIGS. 5A and 5B**. In this position, referring to **FIG. 5B**, locking end **56** of elastic fingers **52** abut, contact, or engage shoulder wall **144** of plunger rod head **68** and lock or secure plunger rod **14** to stopper **16**. This configuration ensures that with elastic fingers **52** mechanically locked over shoulder

wall **144** of plunger rod head **68**, plunger rod **14** is secured to stopper **16**, such that, significant relative movement between plunger rod **14** and stopper **16** is prevented. In this manner, plunger rod **14** is adapted for advancing stopper **16** within syringe barrel **12**. In a further configuration, the stopper **16** may include an insert adapted for engagement with the plunger rod **14**. The insert may be formed of a different material than the material used to form the stopper **16**. In this fashion, different material properties would be permitted for the portion of the stopper **16** that seals against the syringe barrel **30** as compared to the material properties of the portion of the stopper that engages the plunger rod **14**.

[0070] Referring to **FIGS. 15A** and **15B**, another exemplary embodiment of a securement feature operable to secure plunger rod **14** to stopper **16** will now be described. With plunger rod head **160** of plunger rod **14** positioned adjacent plunger receiving aperture **50** of stopper **16**, plunger rod **14** is inserted or moved axially into plunger receiving aperture **50** in a direction generally along arrow **B** (**FIG. 15A**), such that elastic fingers **162** of plunger rod head **160** is disposed within plunger receiving aperture **50** of stopper **16**. As additional force is exerted on plunger rod **14** to axially move plunger rod head **160** in the direction generally along arrow **B** within plunger receiving aperture **50**, tapered portion **170** of elastic fingers **162** cooperates with tapered portion **152** of protruding member **150** and protruding member **150** pushes or compresses elastic fingers **162** of plunger rod head **160** inward in a direction generally along arrow **D** (**FIG. 15A**) until elastic fingers **162** of plunger rod head **160** slide over and past tapered portion **152** of protruding member **150** and lock plunger rod **14** to stopper **16** as shown in **FIG. 15B**. Once elastic fingers **162** of plunger rod head **160** slide over and past tapered portion **152** of protruding member **150**, elastic fingers **162** return to their original position as shown in **FIGS. 15A** and **15B**. In this position, referring to **FIG. 15B**, locking end **154** of protruding member **150** abuts, contacts, or engages locking end **172** of elastic fingers **162** with protrusion **156** of protruding member **150** disposed adjacent annular groove **168** of plunger rod head **160** and locks or secures plunger rod **14** to stopper **16**. This configuration ensures that with elastic fingers **162** mechanically locked over protruding member **150**, plunger rod **14** is secured to stopper **16**, such that significant relative movement between plunger rod **14** and stopper **16** is prevented. In this manner, plunger rod **14** is adapted for advancing stopper **16** within syringe barrel **12**.

[0071] In an alternative embodiment, plunger rod **14** can be secured to syringe barrel **12** via stopper **16** by threadingly engaging a threaded portion of plunger rod **14** to a threaded portion of stopper **16**. In other embodiments, plunger rod **14** can be secured to stopper **16** using a ball detent, locking tabs, spring loaded locking mechanism, latch, adhesive, or other

similar mechanism. In all embodiments, plunger rod **14** is locked, secured, or engaged to stopper **16**, i.e., significant relative movement between plunger rod **14** and stopper **16** is prevented and movement of plunger rod **14** can be transferred to stopper **16** to slide stopper **16** between positions within syringe barrel **12**. In other alternate embodiments, plunger rod **14** and stopper **16** may be integrally formed and both form a plunger assembly positioned within second compartment **98** of packaging member **18** and separate syringe barrel **12** positioned within first compartment **96** of packaging member **18**.

[0072] In other embodiments, plunger rod **14** and stopper **16** may be co-formed such as by co-extrusion. In alternate embodiments, plunger rod **14** and stopper **16** may be integrally formed as a plunger assembly that is securable to syringe barrel **12**. In an alternative embodiment, stopper **16** may include a stopper adapter co-formed therewith and plunger rod **14** engageable with the stopper adapter.

[0073] Next, referring to **FIG. 6B**, with plunger rod **14** and syringe barrel **12** secured together to form syringe assembly **10**, a user can remove sealing cap member **20** from distal end **32** of syringe barrel **12**. A user can then attach tip **42** of syringe barrel **12** to a separate needle assembly or IV connection assembly and lockingly engage the needle assembly or IV connection assembly to tip **42** of syringe barrel **12** in a known manner. Prior to dispensing any medication, any air trapped within distal chamber **46** of syringe barrel **12** can be expelled in a known manner.

[0074] Referring to **FIG. 6B**, the use of syringe assembly **10** to expel a fluid, such as a medication, contained within distal chamber **46** of syringe barrel **12** will now be described. Movement of flange **66** of plunger rod **14** provides actuation means for moving or sliding stopper **16** between positions within syringe barrel **12**. For example, flange **66** may have any shape that allows a user to grip and actuate flange **66** in a back and forth direction.

[0075] When it is desired to expel or deliver the medication contained within syringe barrel **12**, syringe assembly **10** is grasped with the user's thumb on flange **66** of plunger rod **14** and with the user's fingers grasping and extending around flange **40** of syringe barrel **12**. In this manner, syringe assembly **10** is grasped by a user in a well known and well recognized manner similar to the operation of a conventional hypodermic syringe. Next, the user effects a squeezing movement between the thumb on flange **66** of plunger rod **14** and four fingers grasping flange **40** of syringe barrel **12**, thereby causing flange **66** of plunger rod **14** to move in a direction generally along arrow **E** (**FIG. 6B**) toward proximal end **34** of syringe barrel **12**. In this manner, movement of stopper **16** in the direction generally along arrow **E** forces the fluid contained within distal chamber **46** of syringe barrel **12** to be forced out outlet

opening 38, i.e., movement of stopper 16 towards distal end 32 of syringe barrel 12 reduces the volume of distal chamber 46 and forces the fluid from syringe barrel 12. The fluid can be expelled from syringe barrel 12 through outlet opening 38 for contact with a patient and/or into a separate needle assembly or IV assembly and into the patient.

[0076] Referring now to FIG. 6B, the use of syringe assembly 10 to fill syringe barrel 12 with medication from a separate vial prior to use will now be described. With syringe assembly in a position in which stopper 16 is located adjacent distal end 32 of syringe barrel 12 and with a needle assembly locked to distal end 32 of syringe barrel 12 and placed in a vial containing fluid, when it is desired to aspirate or pull the fluid, such as a medication, into distal chamber 46 of syringe barrel 12, a user moves flange 66 of plunger rod 14 in a direction generally along arrow F (FIG. 6B) and away from proximal end 34 of syringe barrel 12 until the desired amount of the fluid is pulled into distal chamber 46 of syringe barrel 12.

[0077] In this manner, movement of stopper 16 in the direction generally along arrow F creates a vacuum inside distal chamber 46 of syringe barrel 12. As the user moves stopper 16, via plunger rod 14 in the direction generally along arrow F, the user actively increases the volume within distal chamber 46 of syringe barrel 12. Because the stopper is sized relative to syringe barrel 12 to provide sealing engagement with the interior wall of syringe barrel 12, as describe above, and because the needle assembly locked to distal end 32 of syringe barrel 12 is placed in a vial containing fluid, no air can enter into distal chamber 46 of syringe barrel 12 and, thus, the same number of air molecules are located within distal chamber 46 as the user actively increases the volume within distal chamber 46. This decreases the pressure in distal chamber 46 of syringe barrel 12 relative to the air pressure outside of syringe barrel 12. Therefore, a vacuum, i.e., a space of lower air pressure, is created to pull the fluid, such as a medication, into distal chamber 46 of syringe barrel 12. Advantageously, syringe assembly 10 can be used to collect a fluid into distal chamber 46 of syringe barrel 12 or to expel a fluid out of distal chamber 46 of syringe barrel 12.

CLAIMS

1. A syringe assembly, comprising:
 - a syringe barrel having a first end, a second end, and a sidewall extending therebetween and defining a chamber having an interior;
 - a stopper slidably disposed within the interior of the chamber of the syringe barrel and defining an aperture therein, the stopper comprising a deformable restraining member adjacent the aperture, the deformable restraining member transitionable between a deformed position to an undeformed position; and
 - a plunger rod having a first end, a second end, and a plunger rod head disposed adjacent the first end of the plunger rod,wherein the plunger rod defines a cavity therein and an oxygen absorber is contained in the cavity within the plunger rod when the syringe assembly is in a pre-filled position.
2. The syringe assembly of claim 1, wherein the restraining member comprises at least one deformable finger adjacent the aperture.
3. The syringe assembly of claim 1, wherein the restraining member comprises a plurality of deformable fingers disposed about a perimeter of the aperture.
4. The syringe assembly of claim 3, wherein the plurality of deformable fingers extends at least partially into the aperture.
5. The syringe assembly of claim 4, wherein as the plunger rod head is moved axially within the aperture of the stopper, the plunger rod head compresses the deformable fingers of the restraining member of the stopper, and once the plunger rod head is moved over and past the deformable fingers of the restraining member of the stopper, the deformable fingers of the restraining member of the stopper return to their undeformed position such that the deformable fingers engage the plunger rod head thereby securing the plunger rod to the stopper.

6. The syringe assembly of claim 1, wherein the plunger rod head is substantially rigid.

7. The syringe assembly of claim 1, further comprising a medication or drug disposed within the chamber.

8. A syringe assembly, comprising:
a syringe barrel having a first end, a second end, and a sidewall extending therebetween and defining a chamber having an interior;
a stopper slidably disposed within the interior of the chamber of the syringe barrel and defining an aperture therein, the stopper comprising a protruding member adjacent the aperture; and
a plunger rod having a first end, a second end, and a plunger rod head disposed adjacent the first end of the plunger rod, the plunger rod head comprising a deformable restraining member transitionable between a deformed position to an undeformed position,
wherein the plunger rod defines a cavity therein and an oxygen absorber is contained in the cavity within the plunger rod when the syringe assembly is in a pre-filled position.

9. The syringe assembly of claim 8, wherein the restraining member comprises at least one deformable finger.

10. The syringe assembly of claim 8, wherein the restraining member comprises a plurality of deformable fingers disposed about a perimeter of the plunger rod head.

11. The syringe assembly of claim 10, wherein as the plunger rod head is moved axially within the aperture of the stopper, the protruding member of the stopper compresses the deformable fingers of the restraining member of the plunger rod head, and once the plunger rod head is moved over and past the protruding member of the stopper, the deformable fingers of the restraining member of the plunger rod head return to their undeformed

position such that the protruding member of the stopper engages the deformable fingers of the restraining member of the plunger rod head thereby securing the plunger rod to the stopper.

12. The syringe assembly of claim 8, wherein the protruding member is substantially rigid.

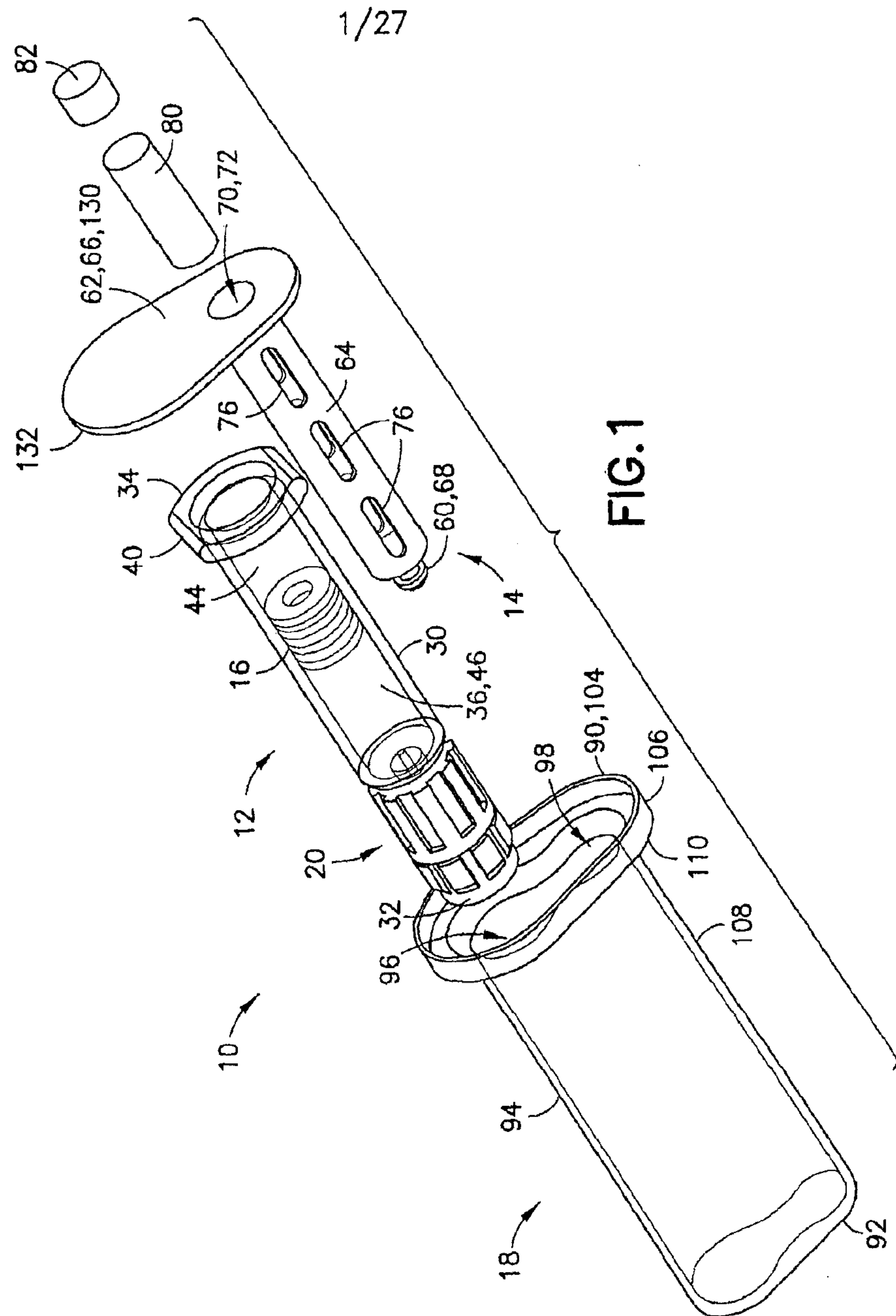
13. The syringe assembly of claim 8, further comprising a medication or drug disposed within the chamber.

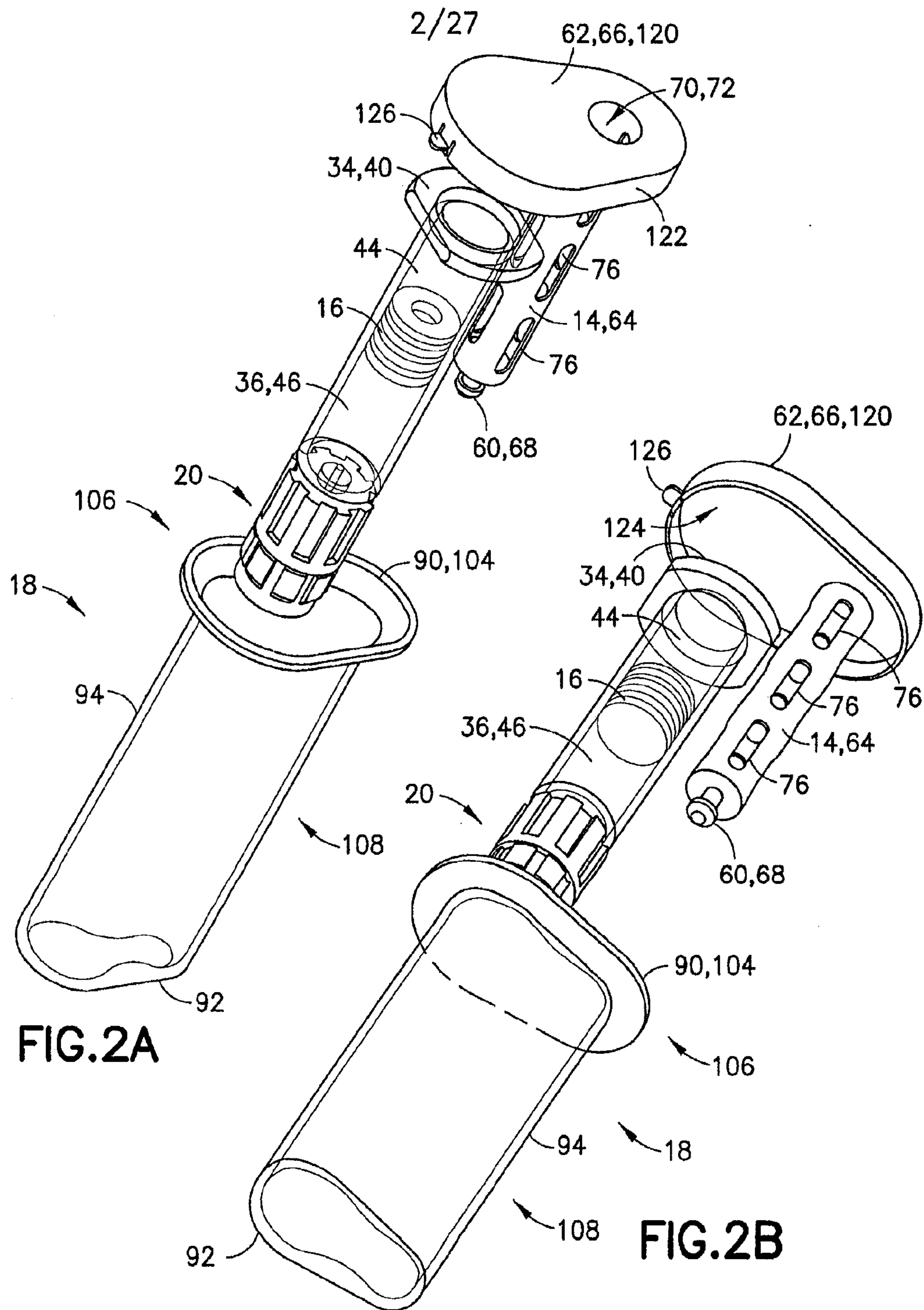
14. The syringe assembly of claim 1, wherein the plunger rod comprises a sealing member, which seals the syringe barrel and the plunger rod within a packaging member.

15. The syringe assembly of claim 8, wherein the plunger rod comprises a sealing member, which seals the syringe barrel and the plunger rod within a packaging member.

16. The syringe assembly of claim 1, further comprising a packaging member sized and adapted to receive the syringe barrel and the plunger rod.

17. The syringe assembly of claim 8, further comprising a packaging member sized and adapted to receive the syringe barrel and the plunger rod.





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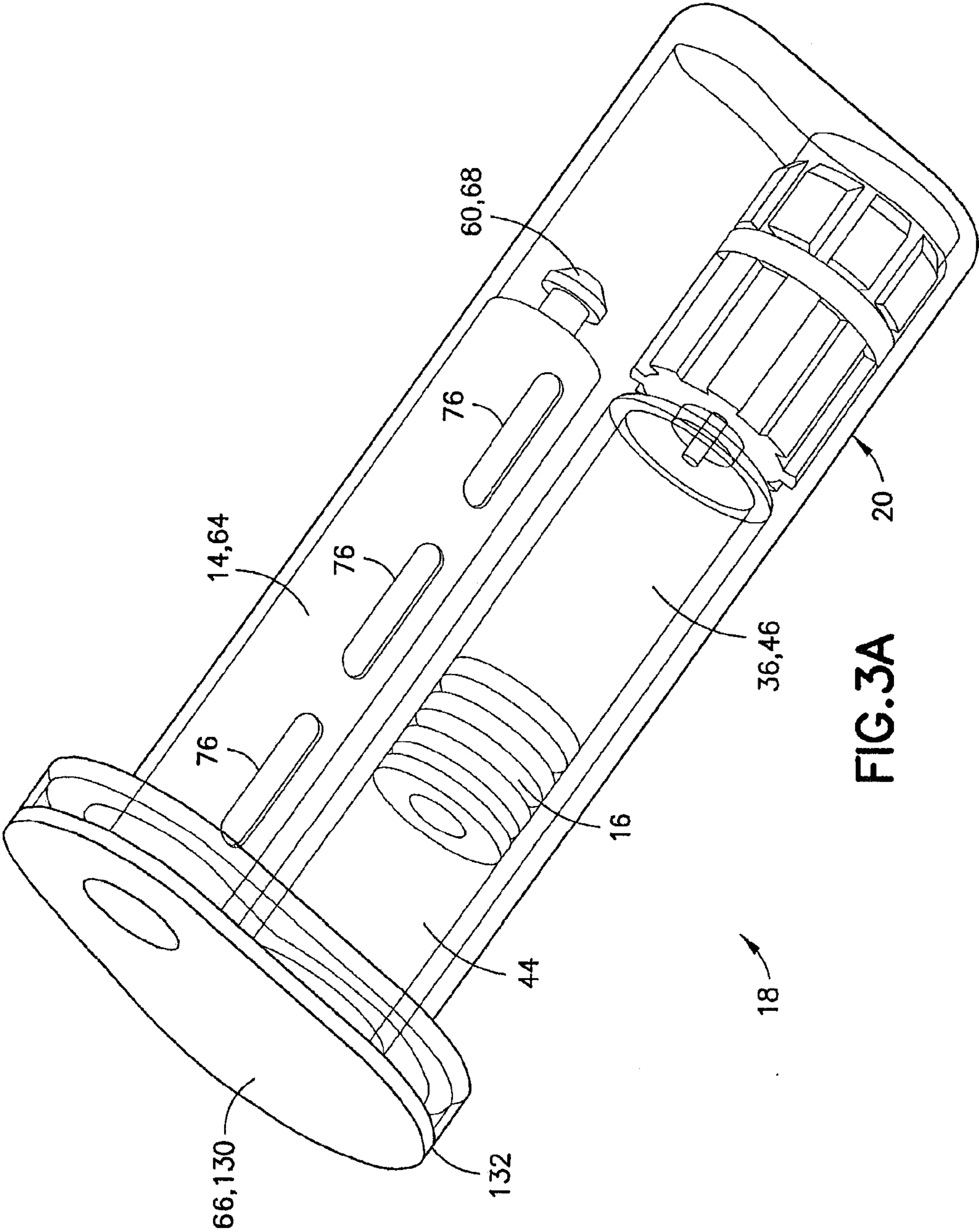
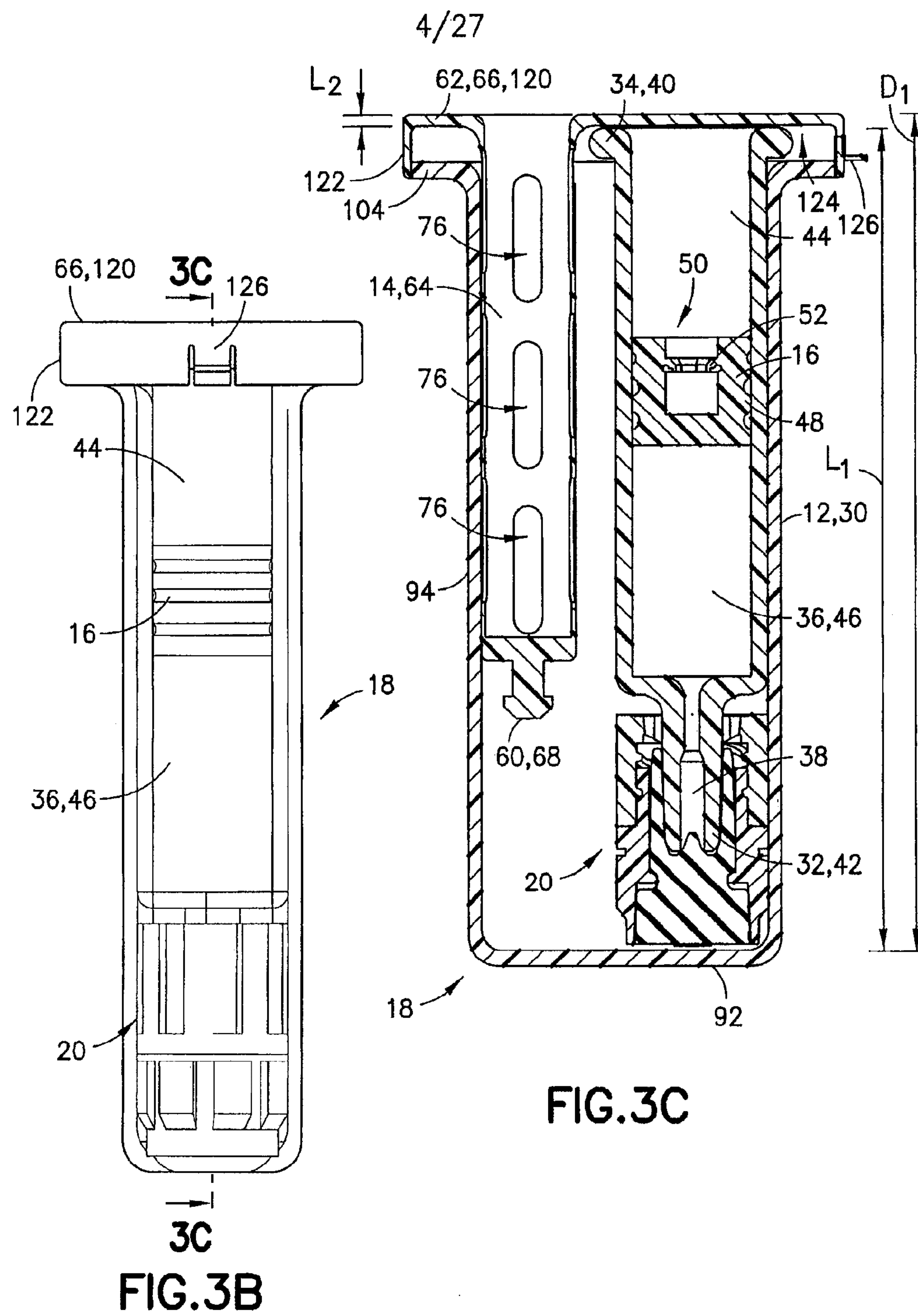
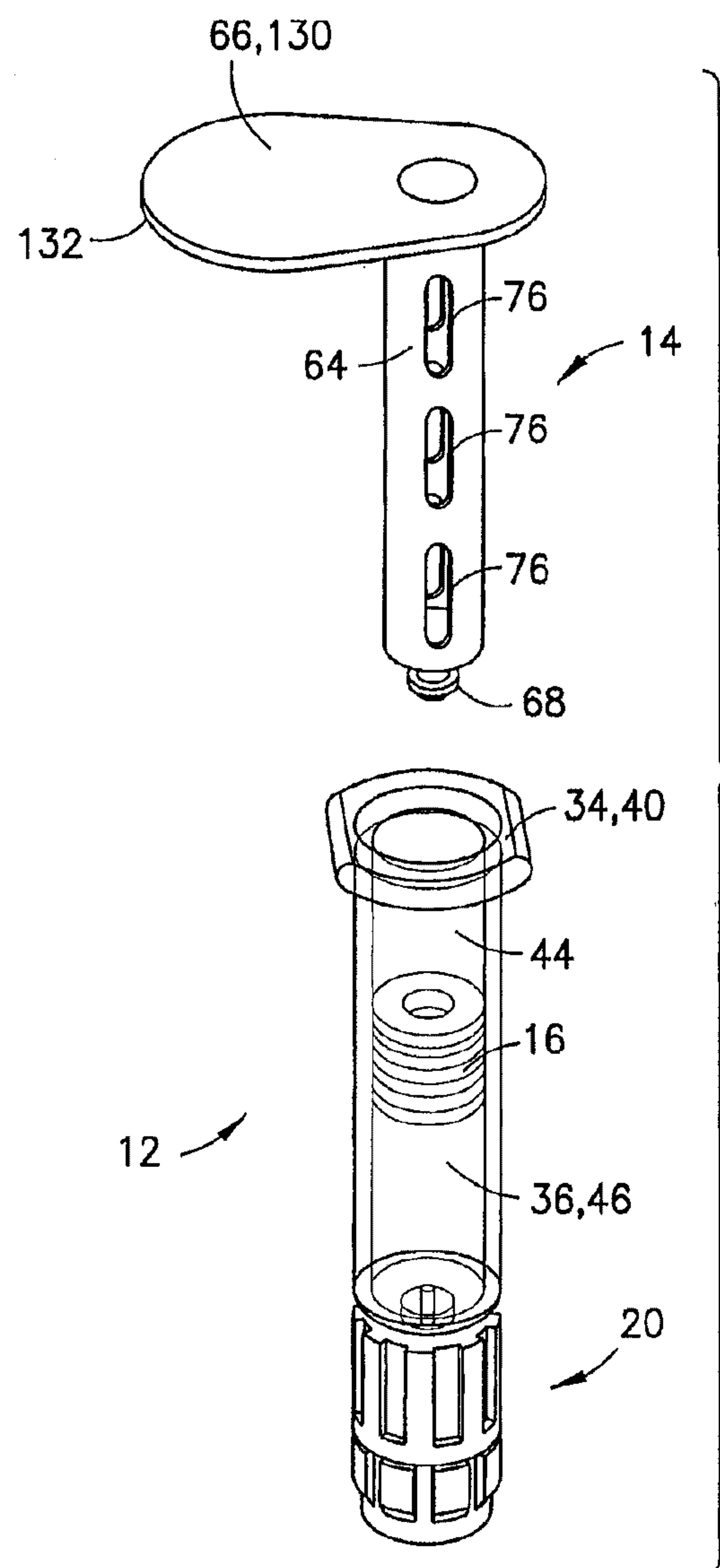


FIG. 3A



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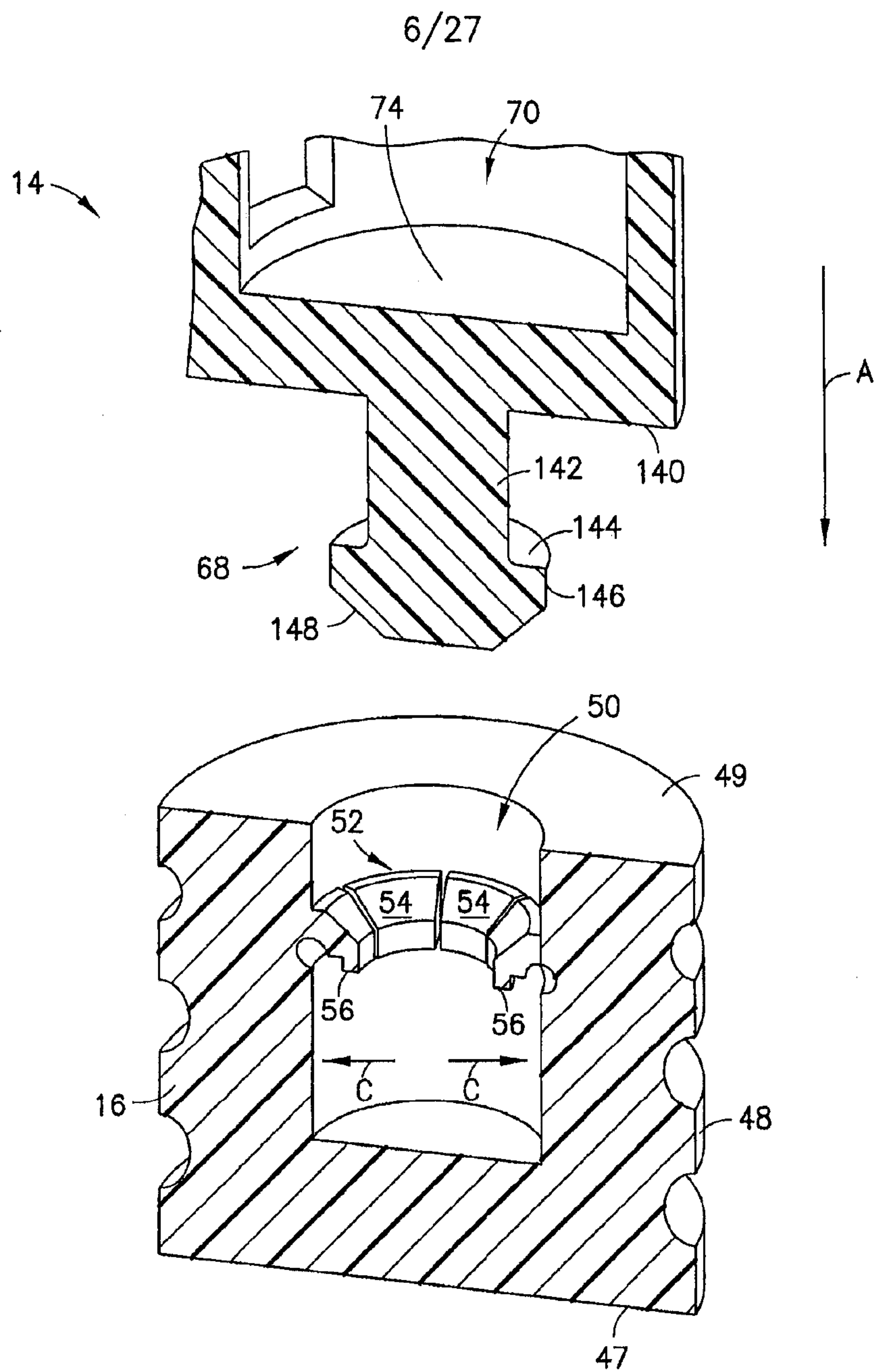


FIG.5A

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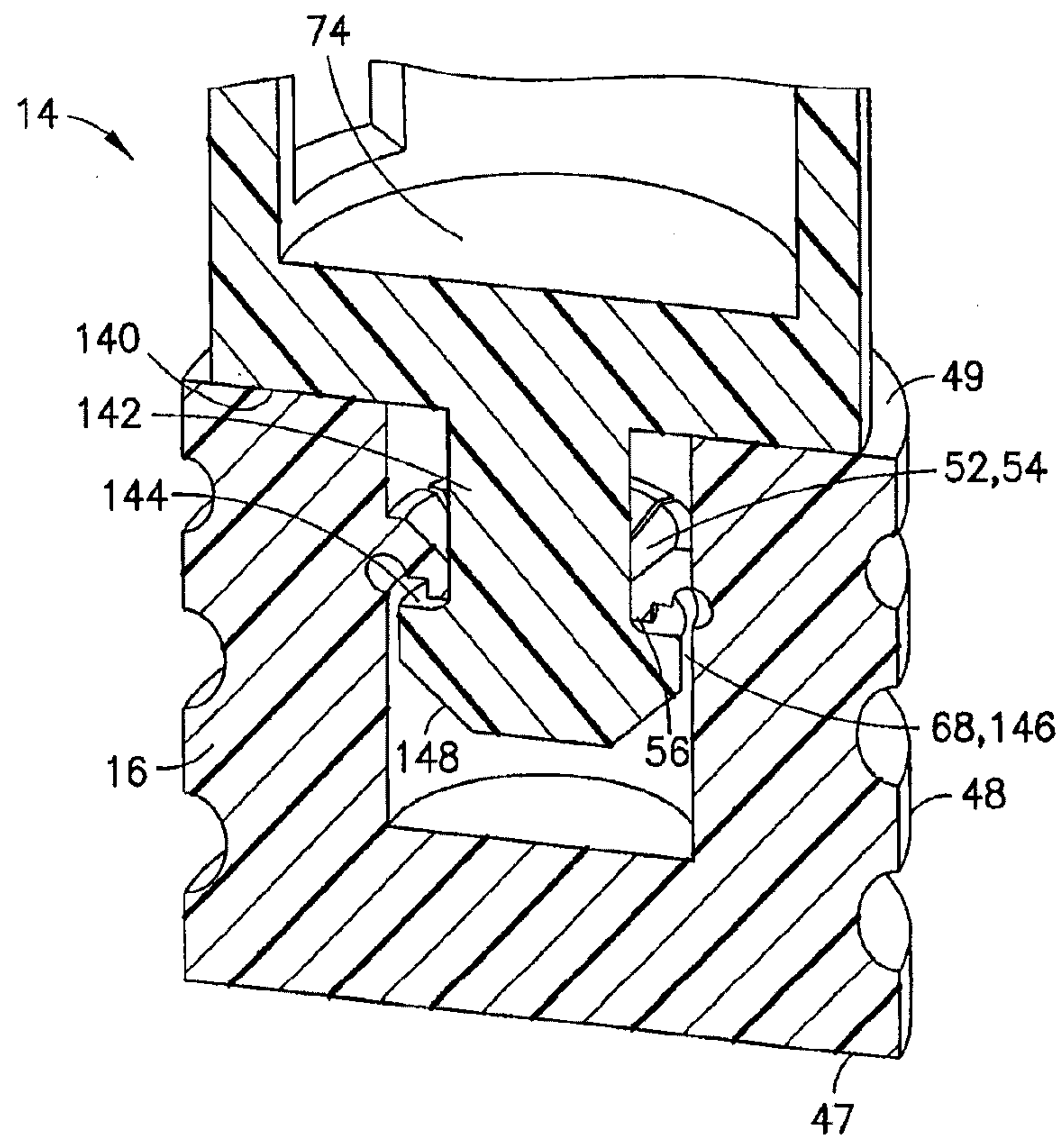


FIG.5B

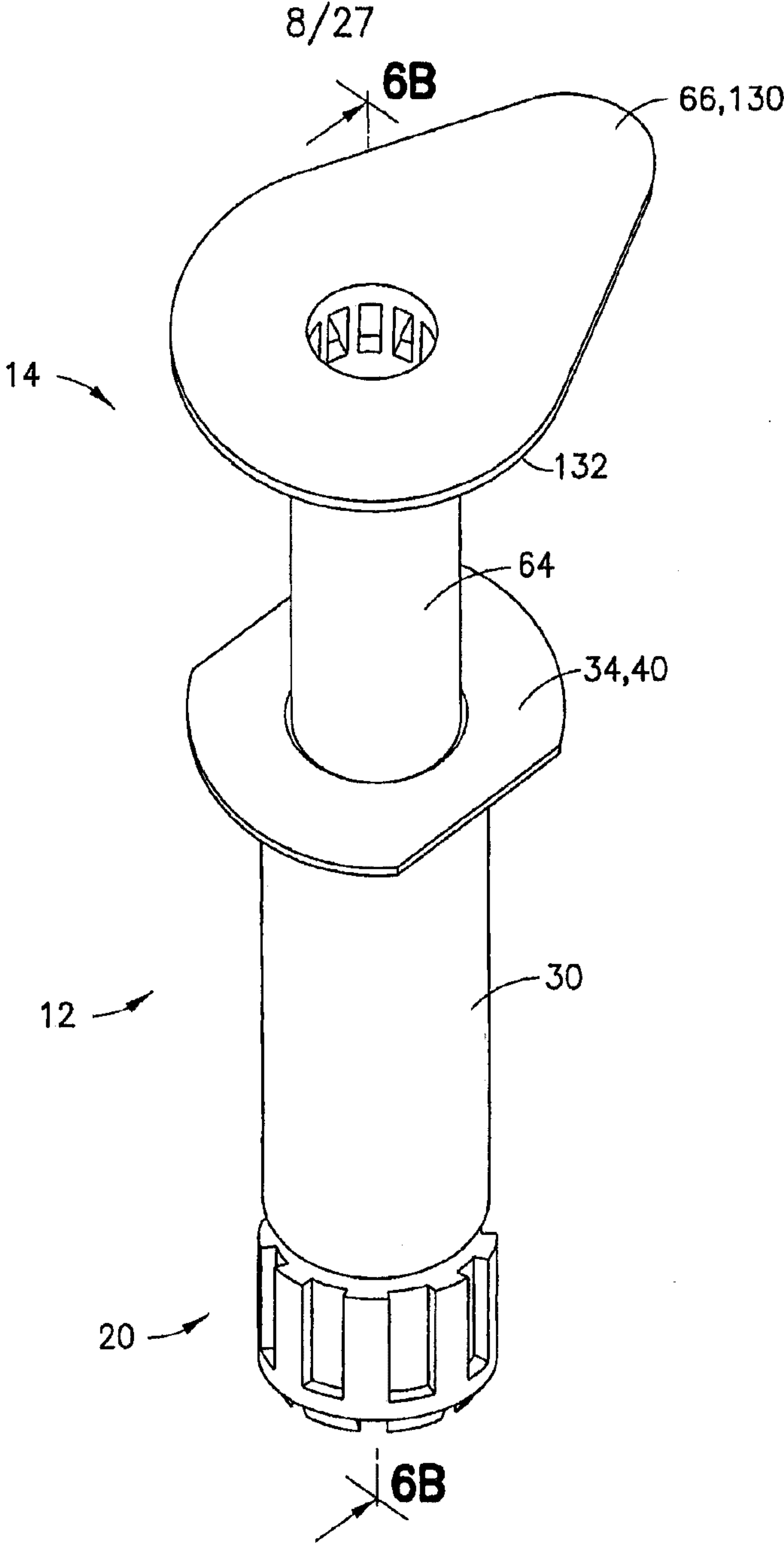
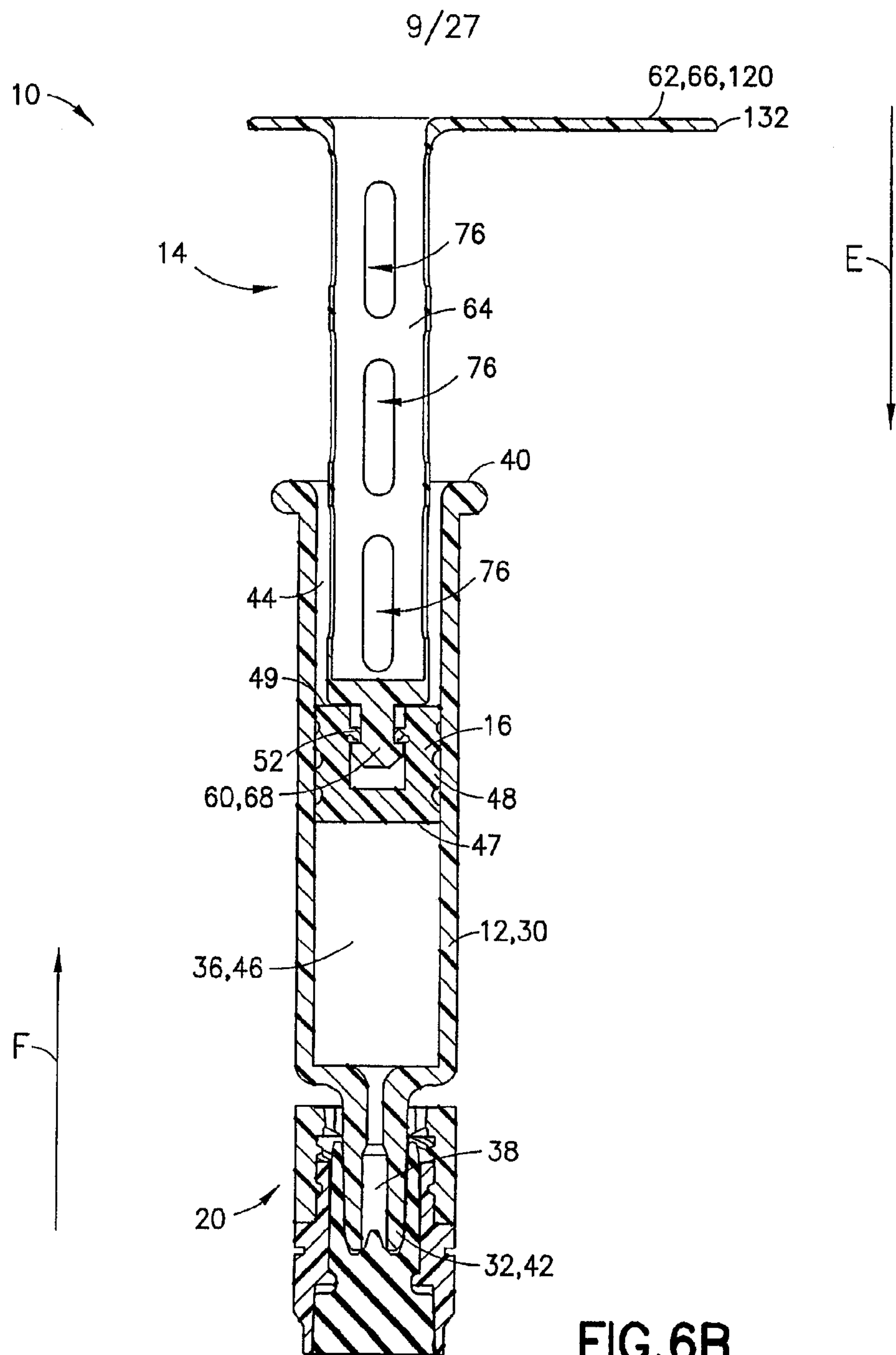
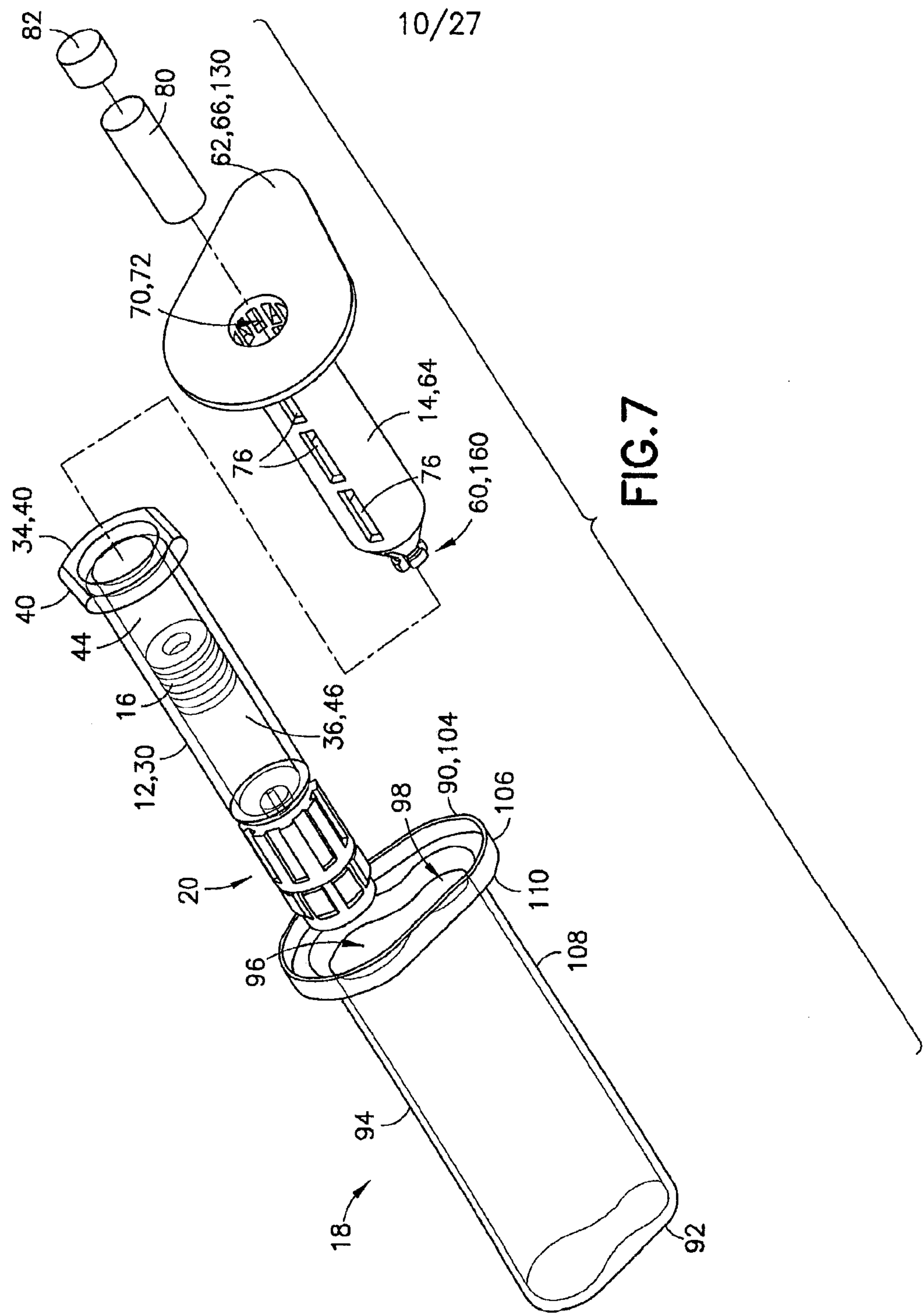


FIG. 6A





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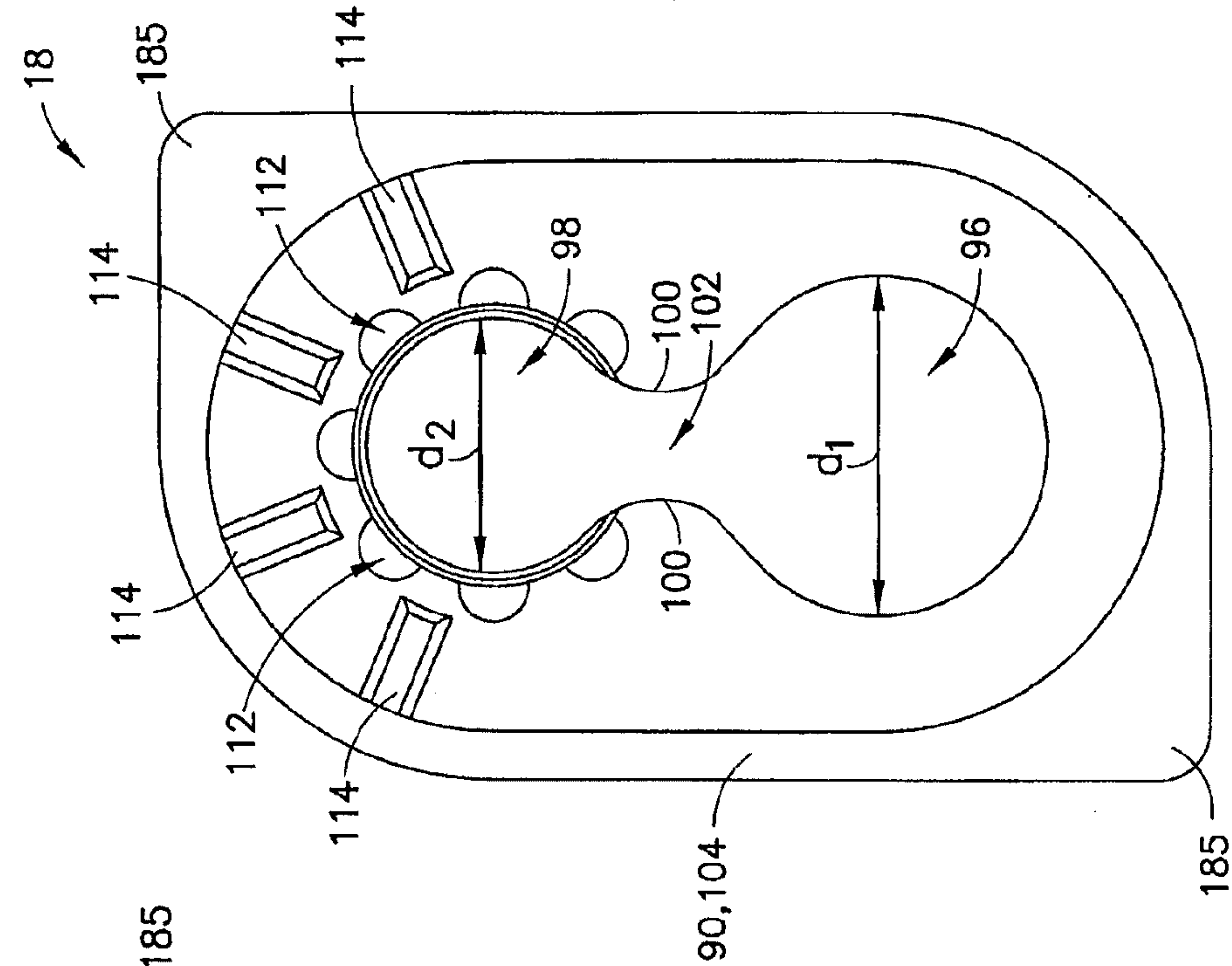


FIG. 8A

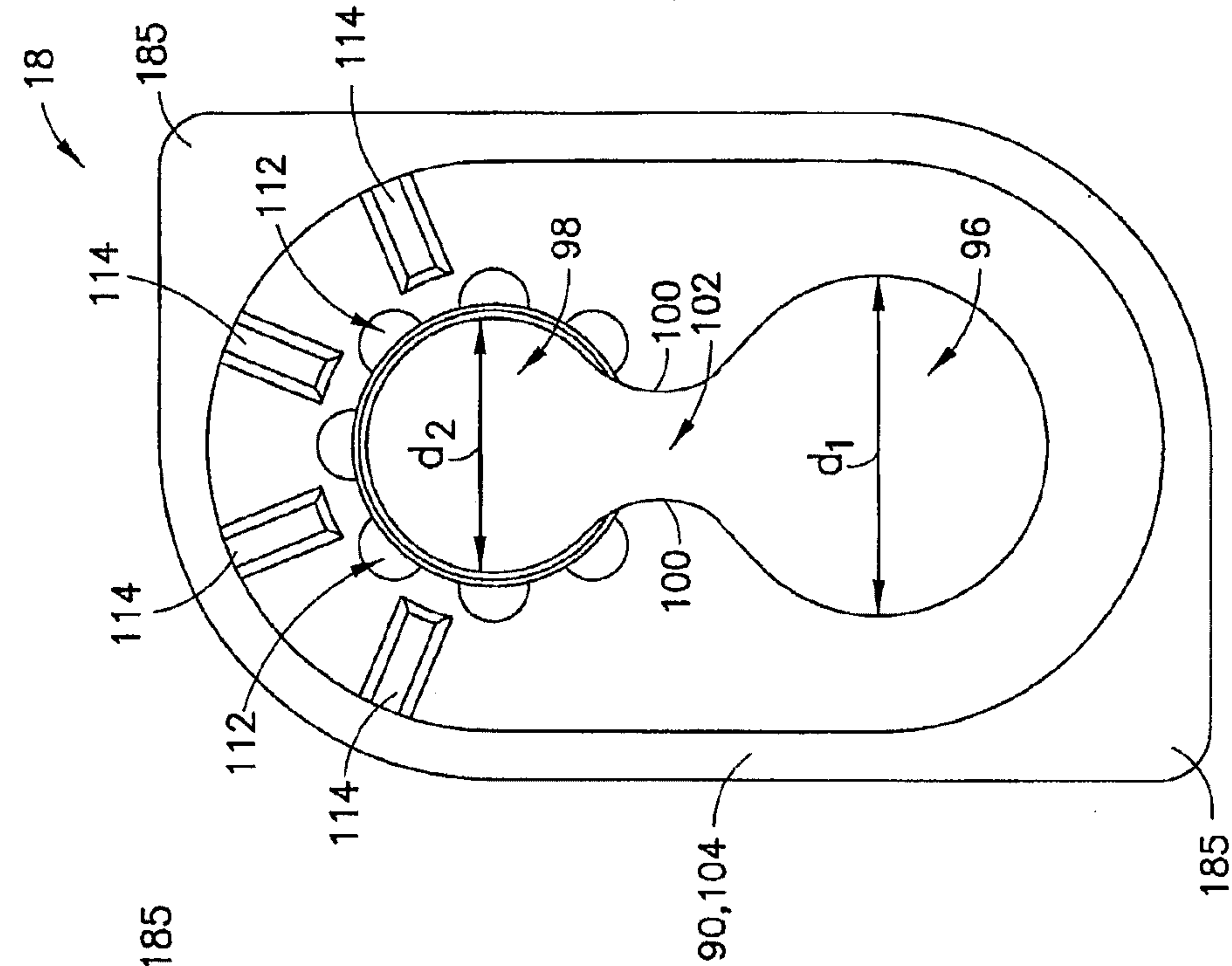
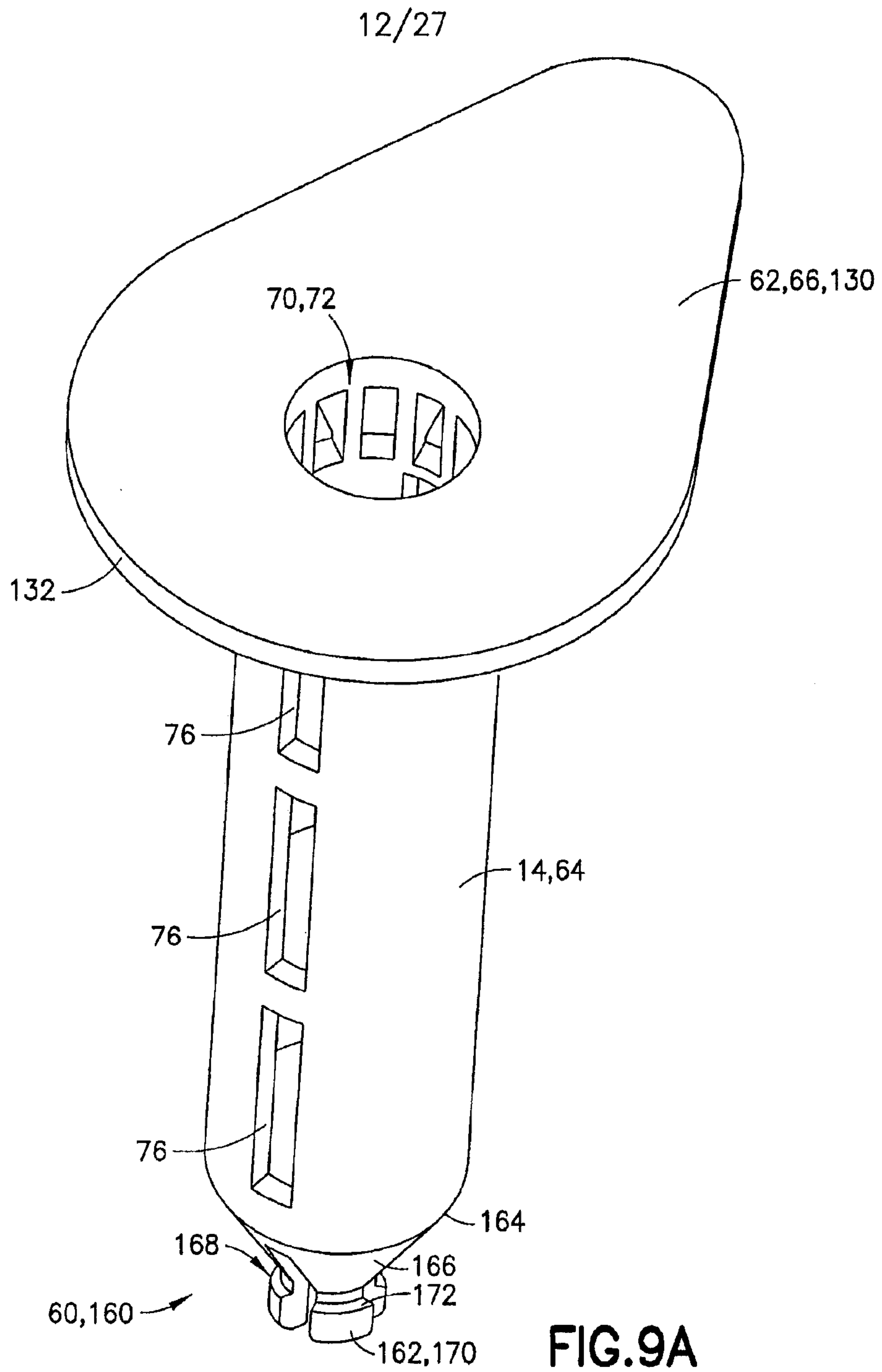
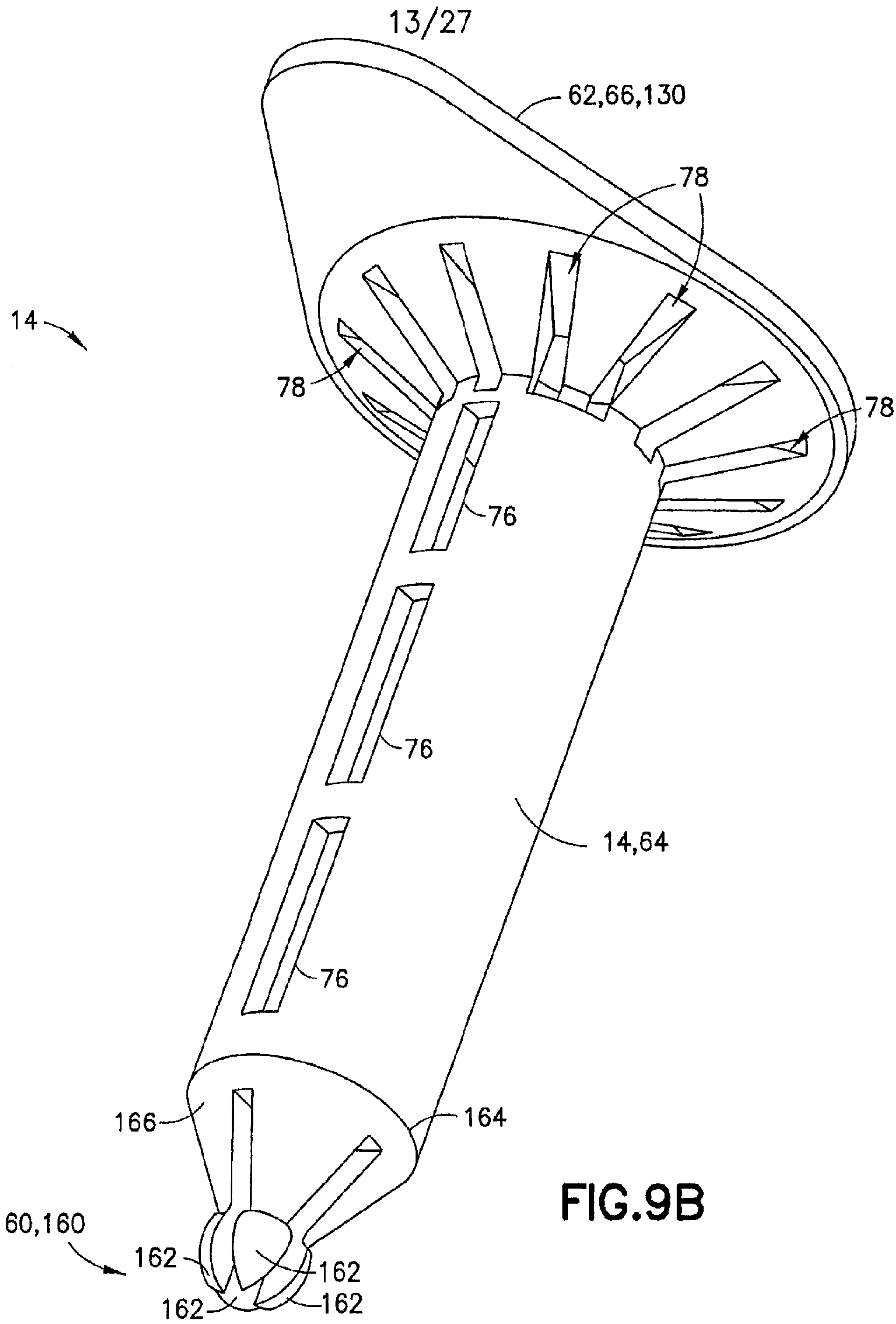


FIG. 8B





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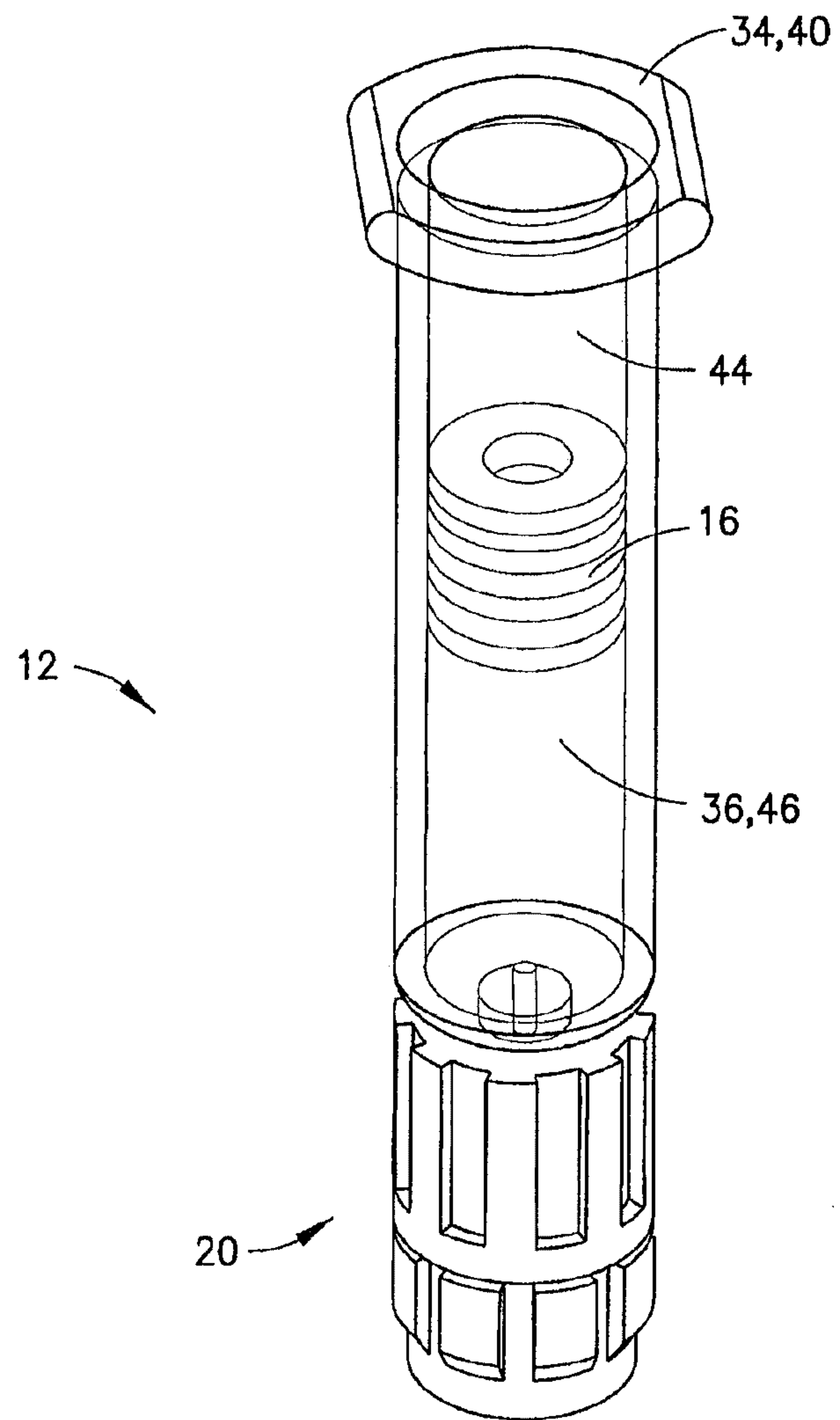
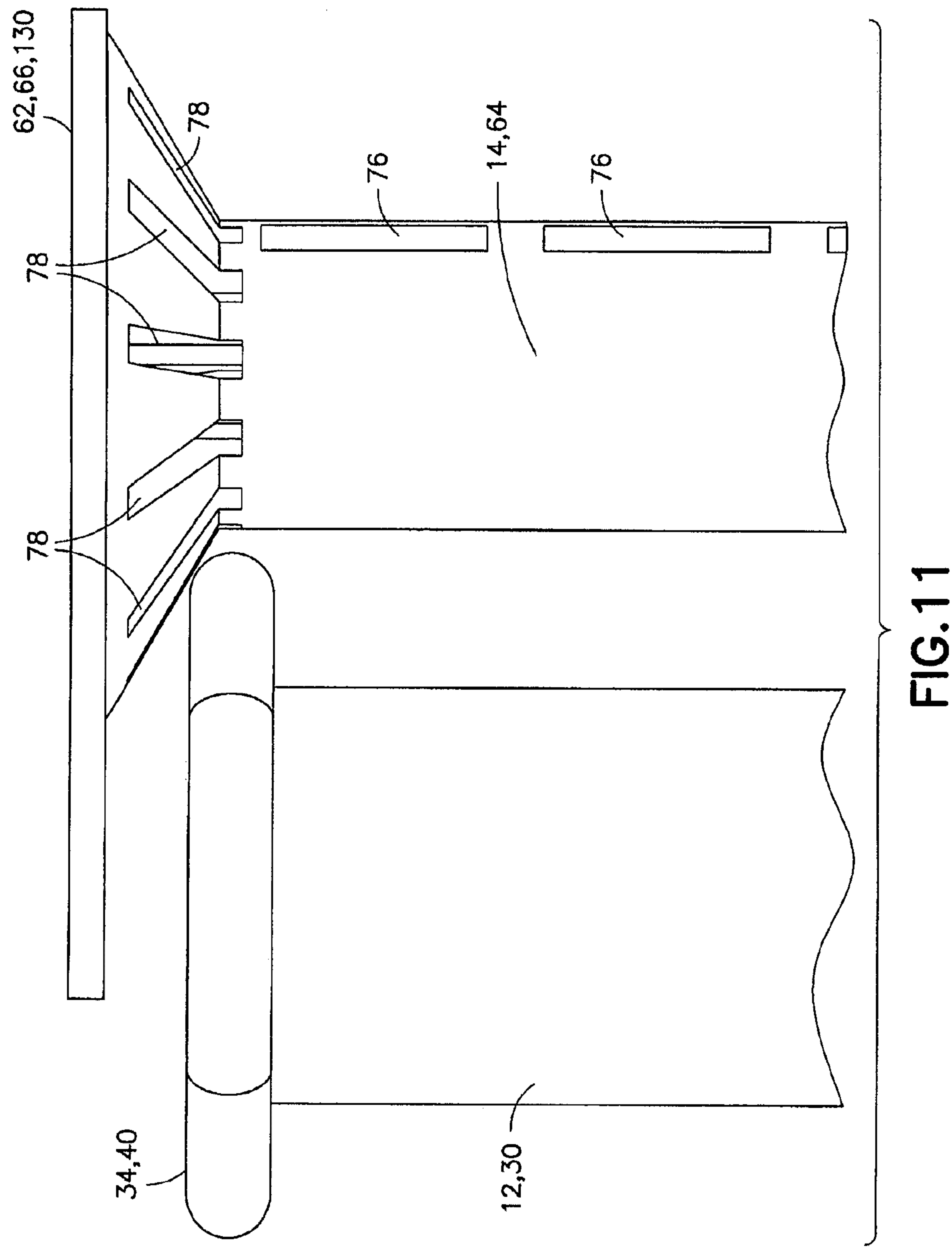


FIG. 10

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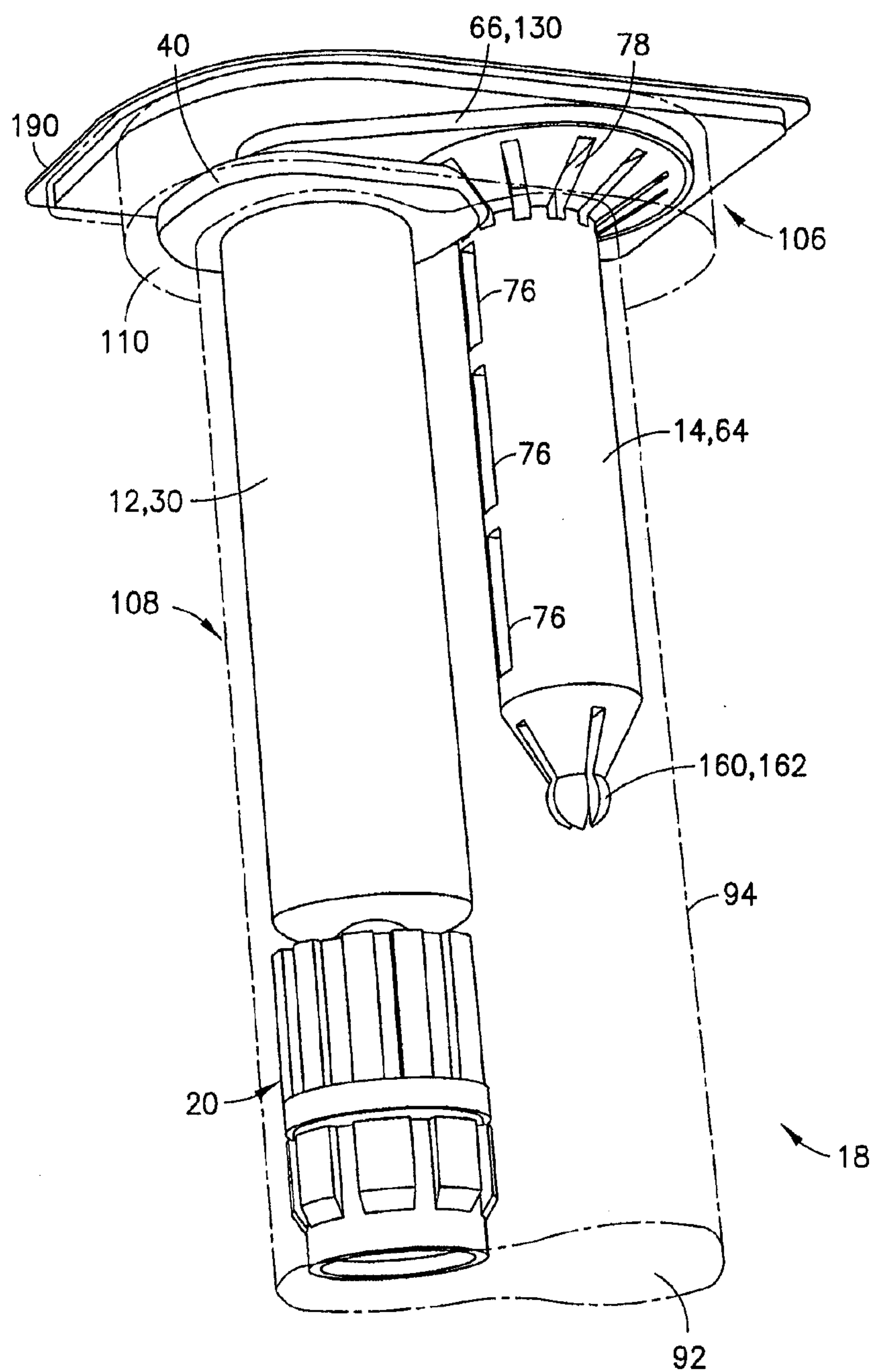
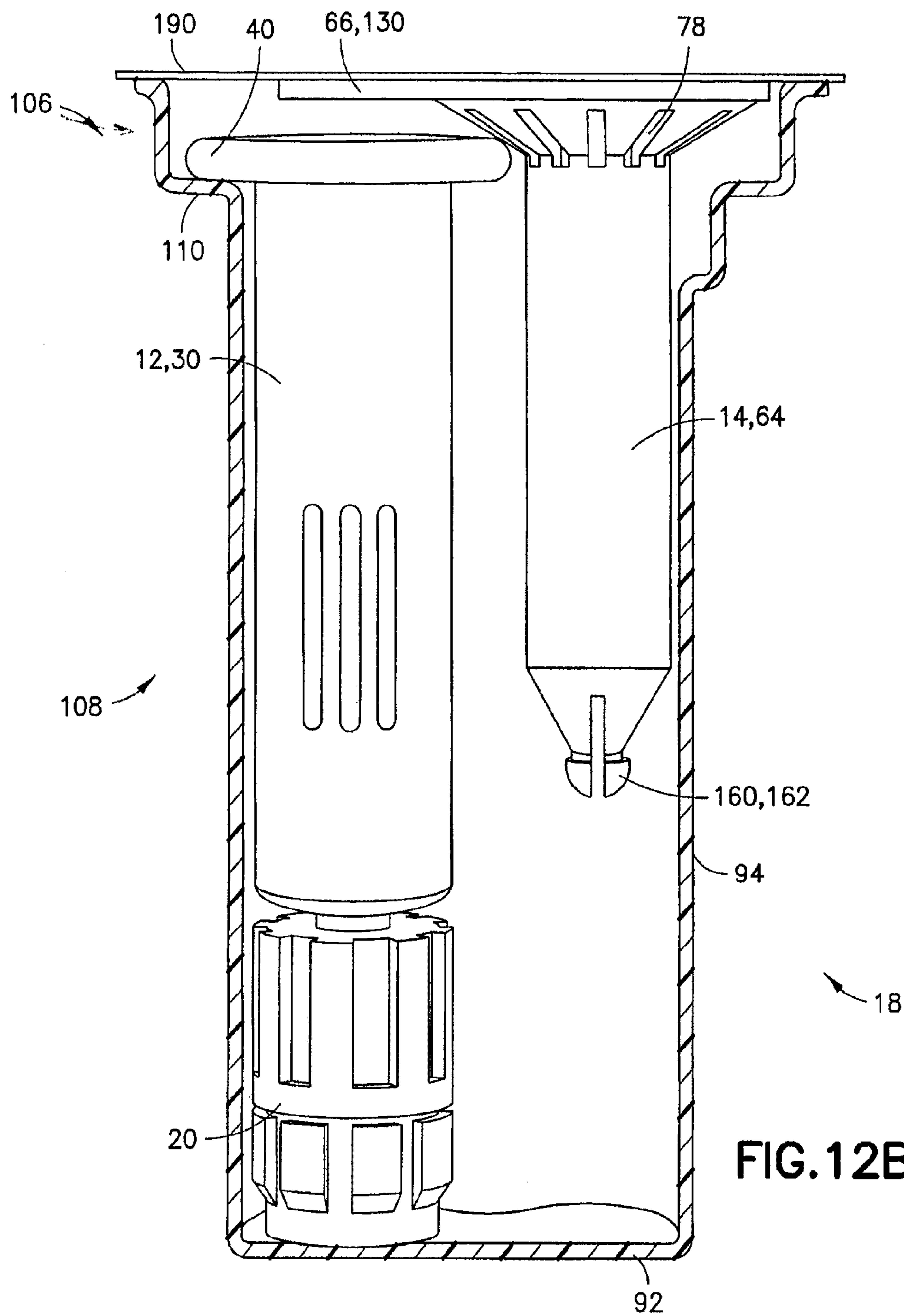
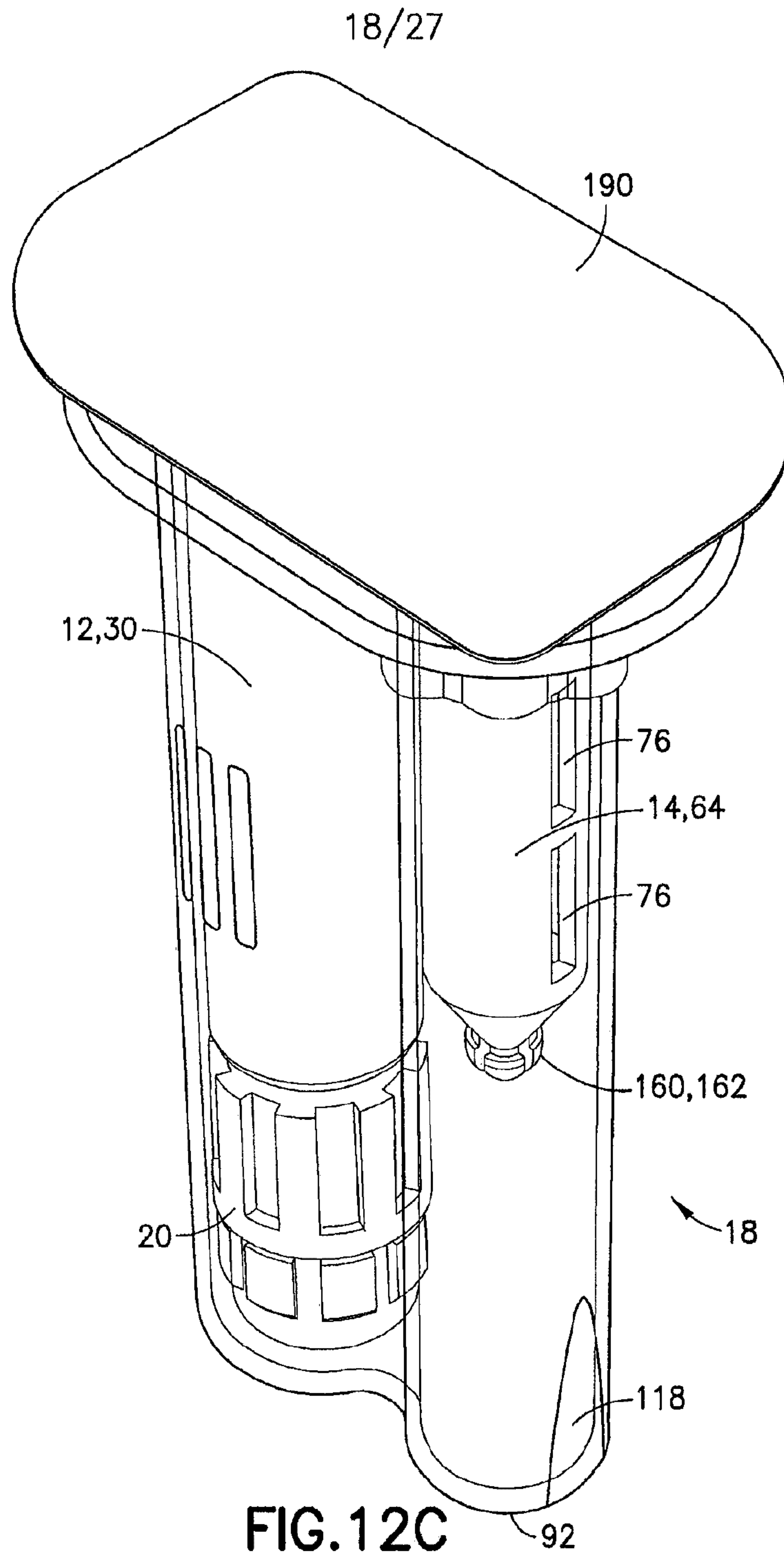
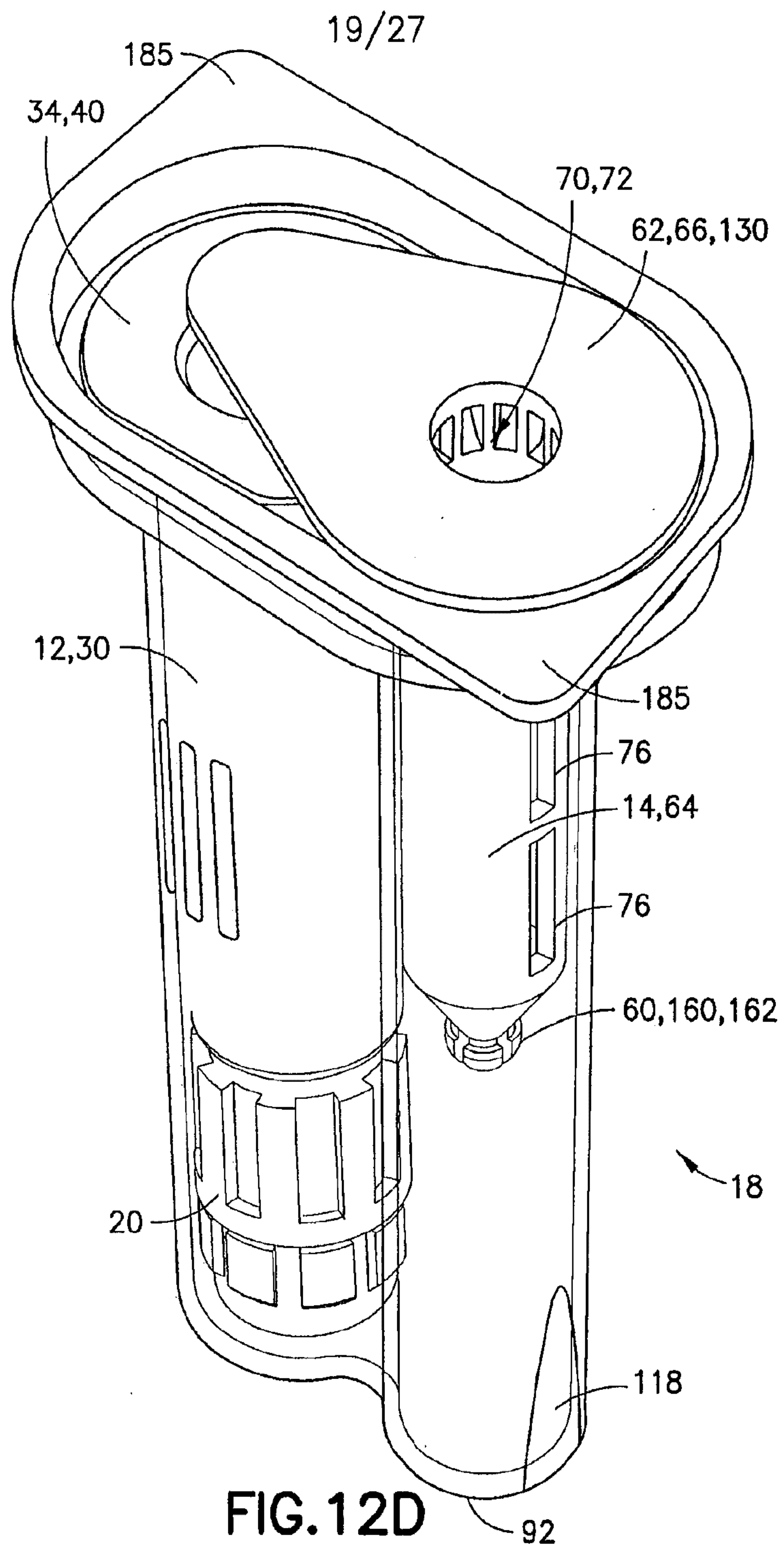


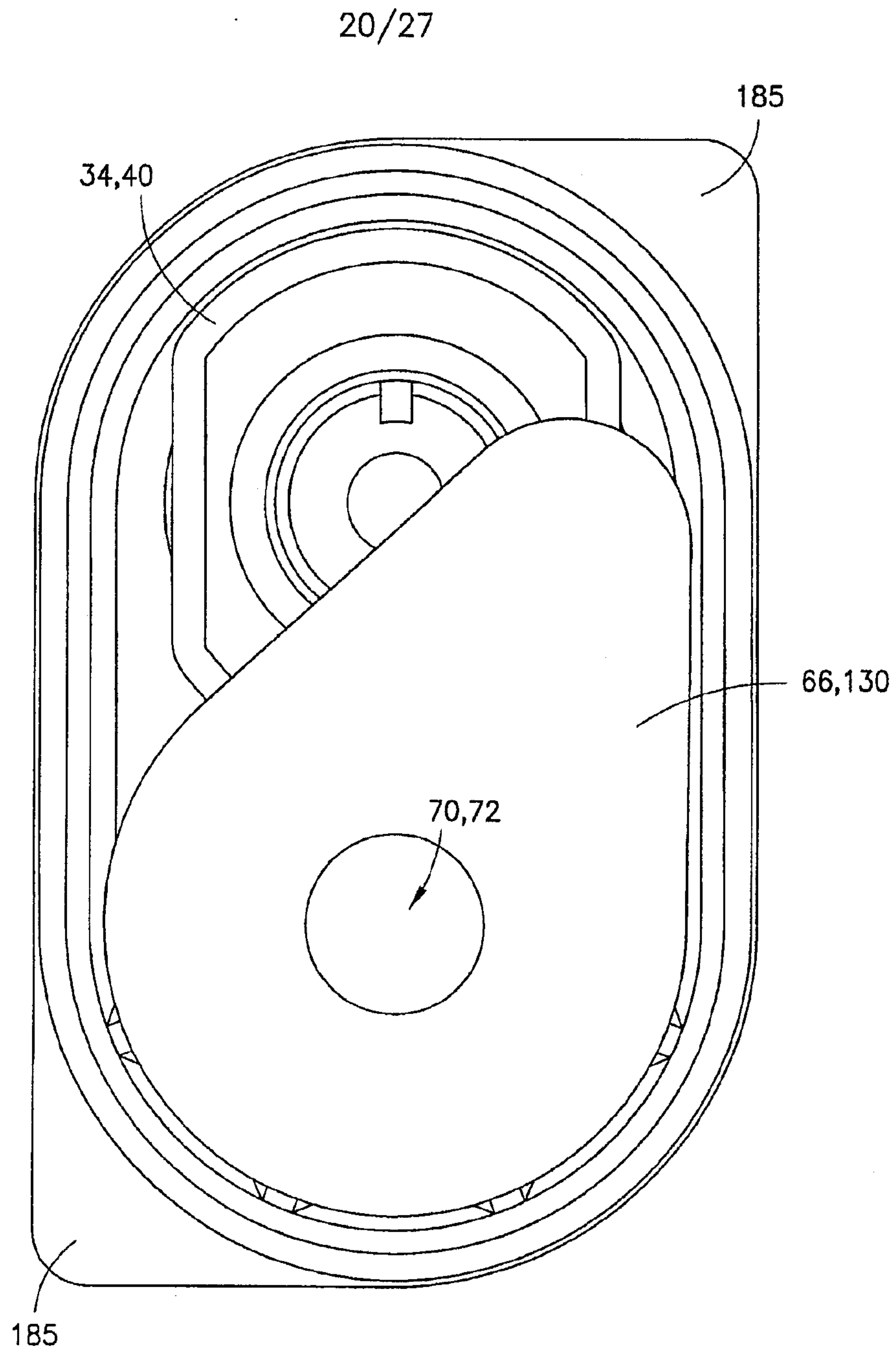
FIG. 12A

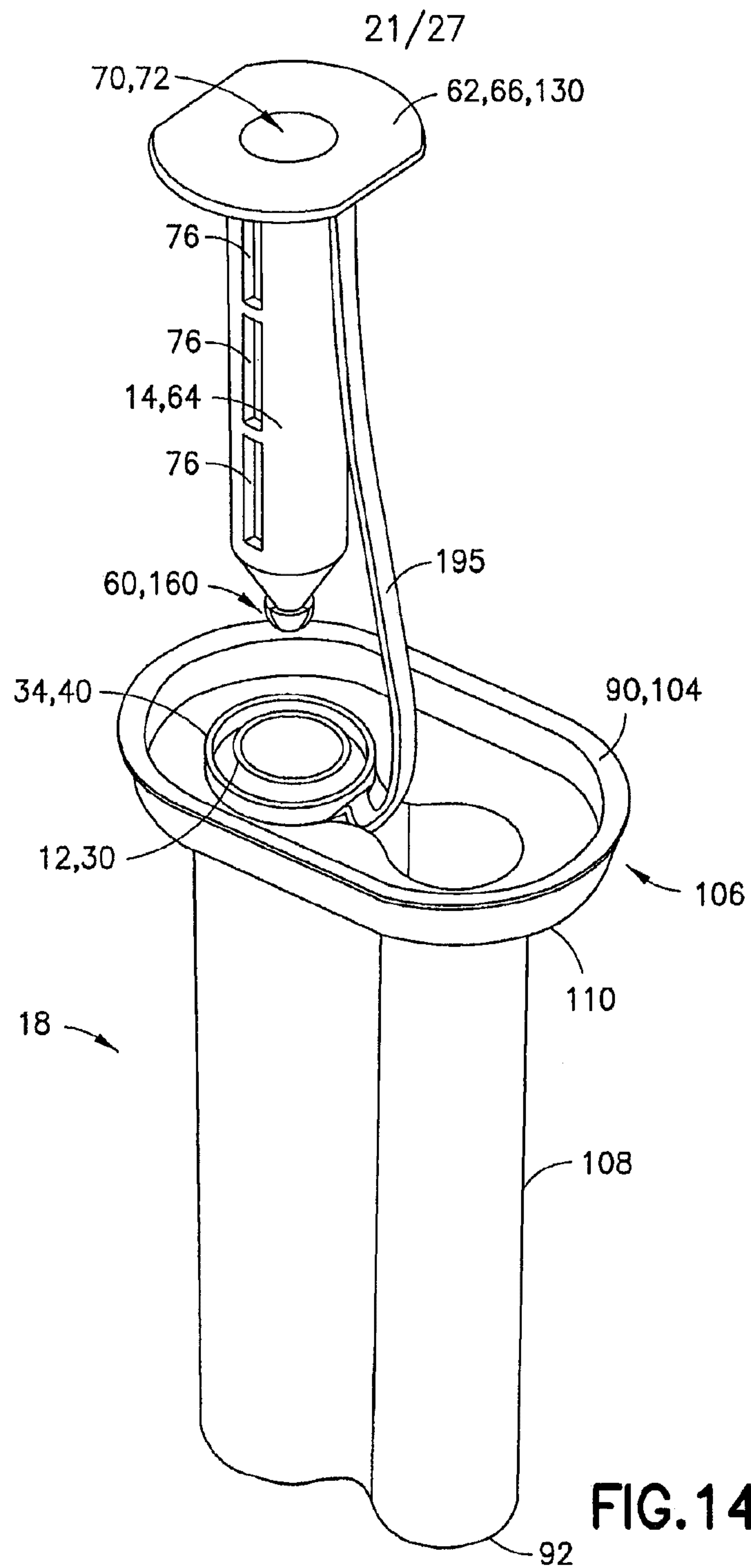
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**FIG.13**



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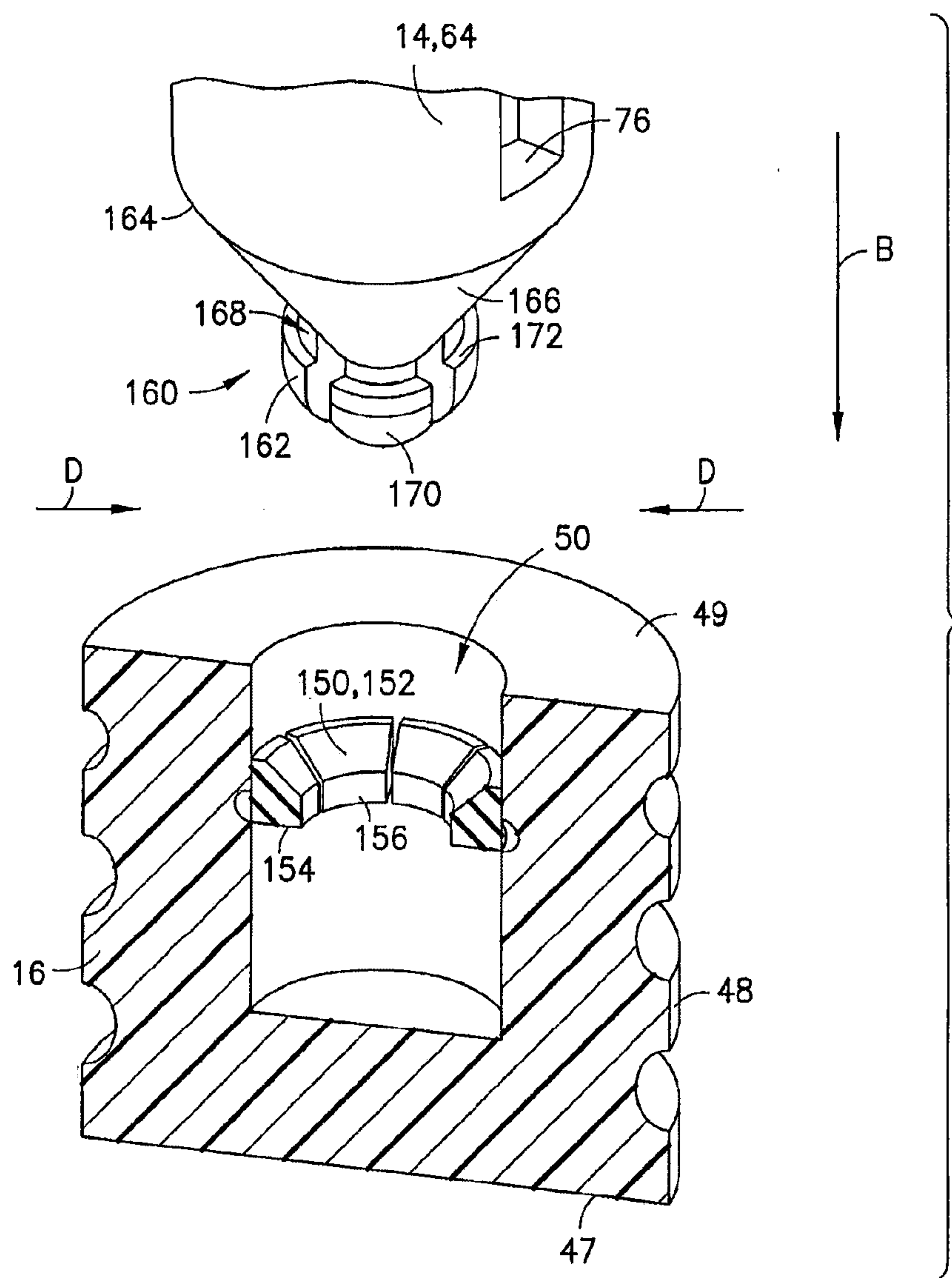


FIG. 15A

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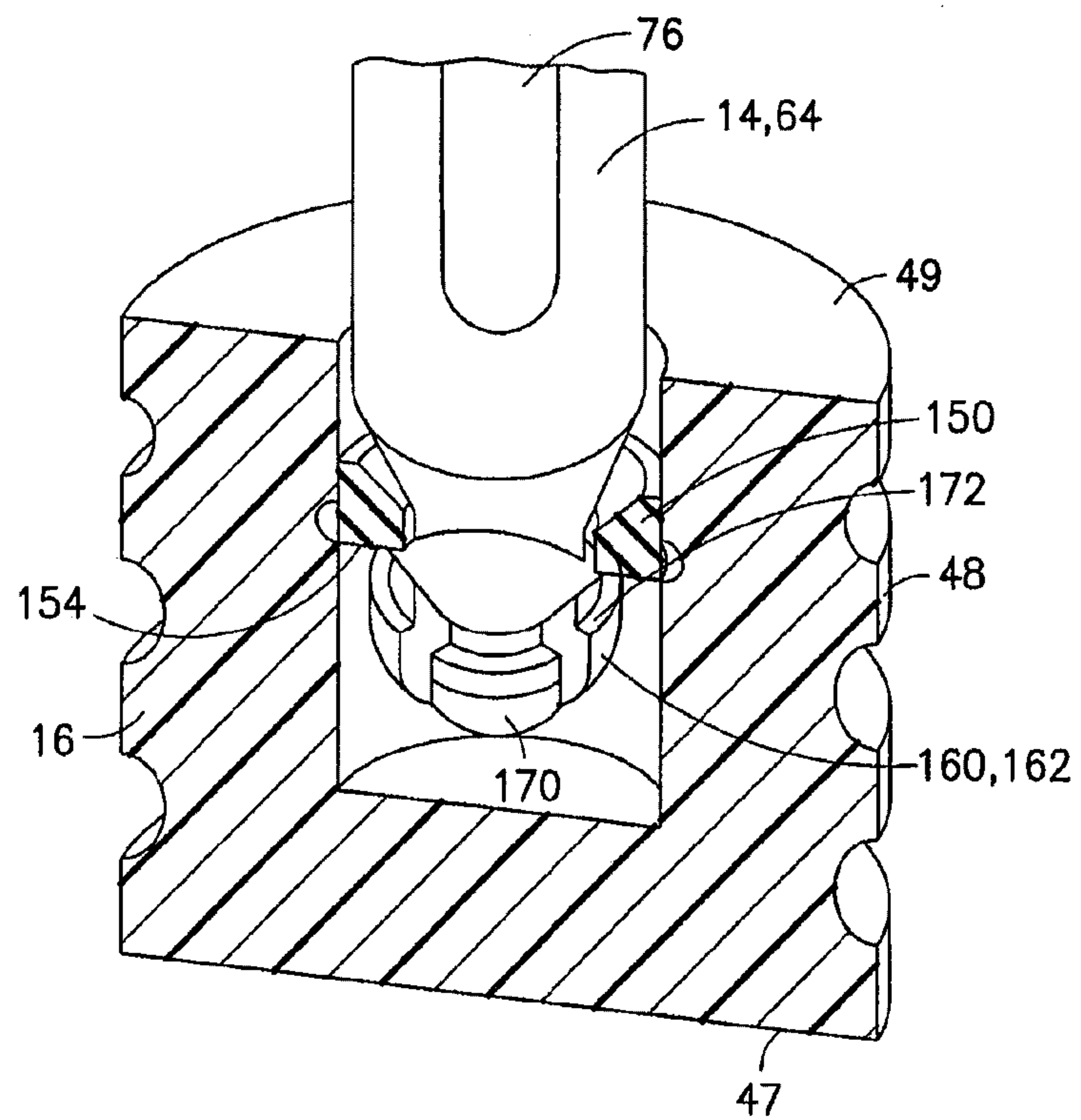
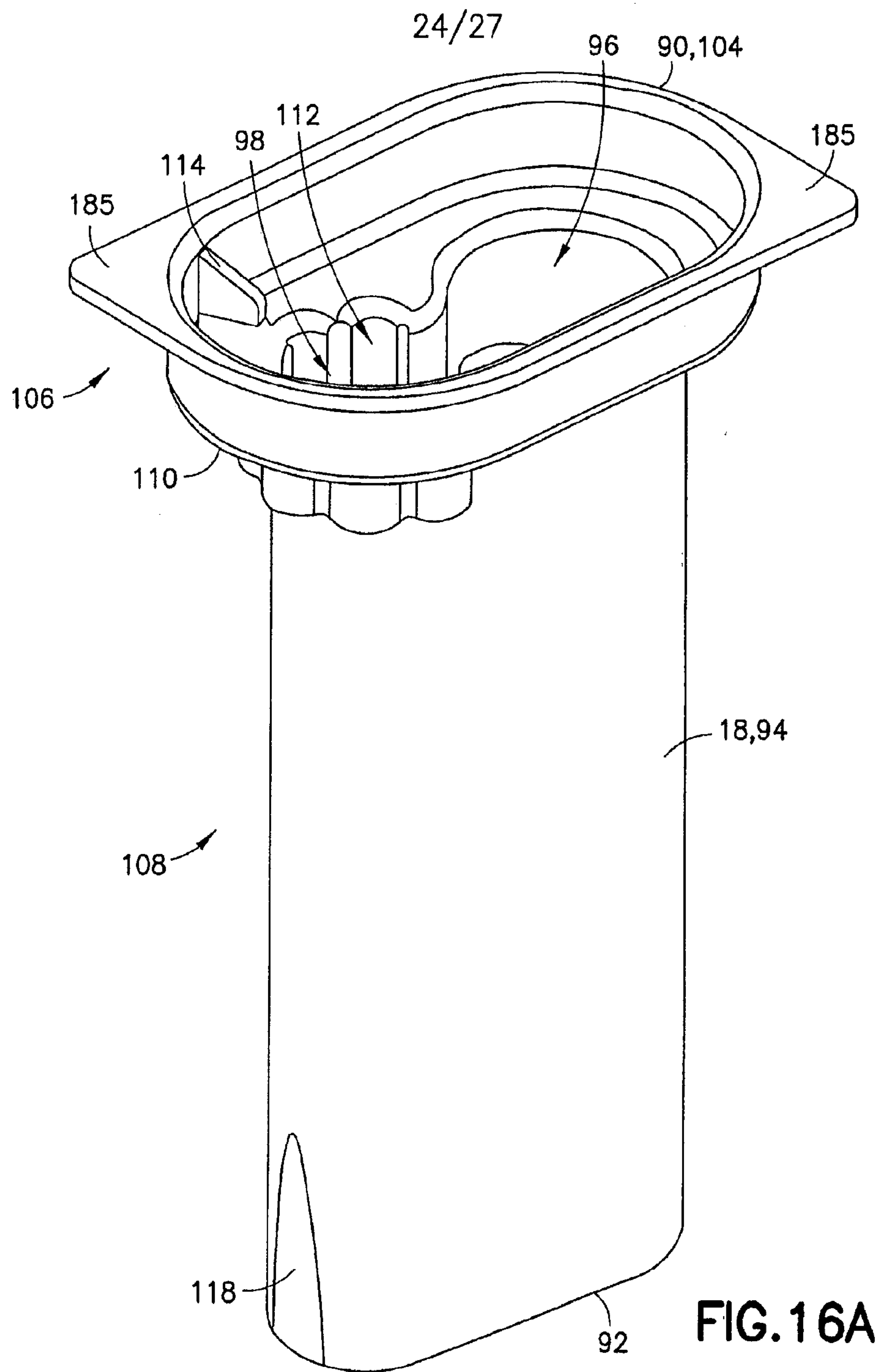


FIG. 15B



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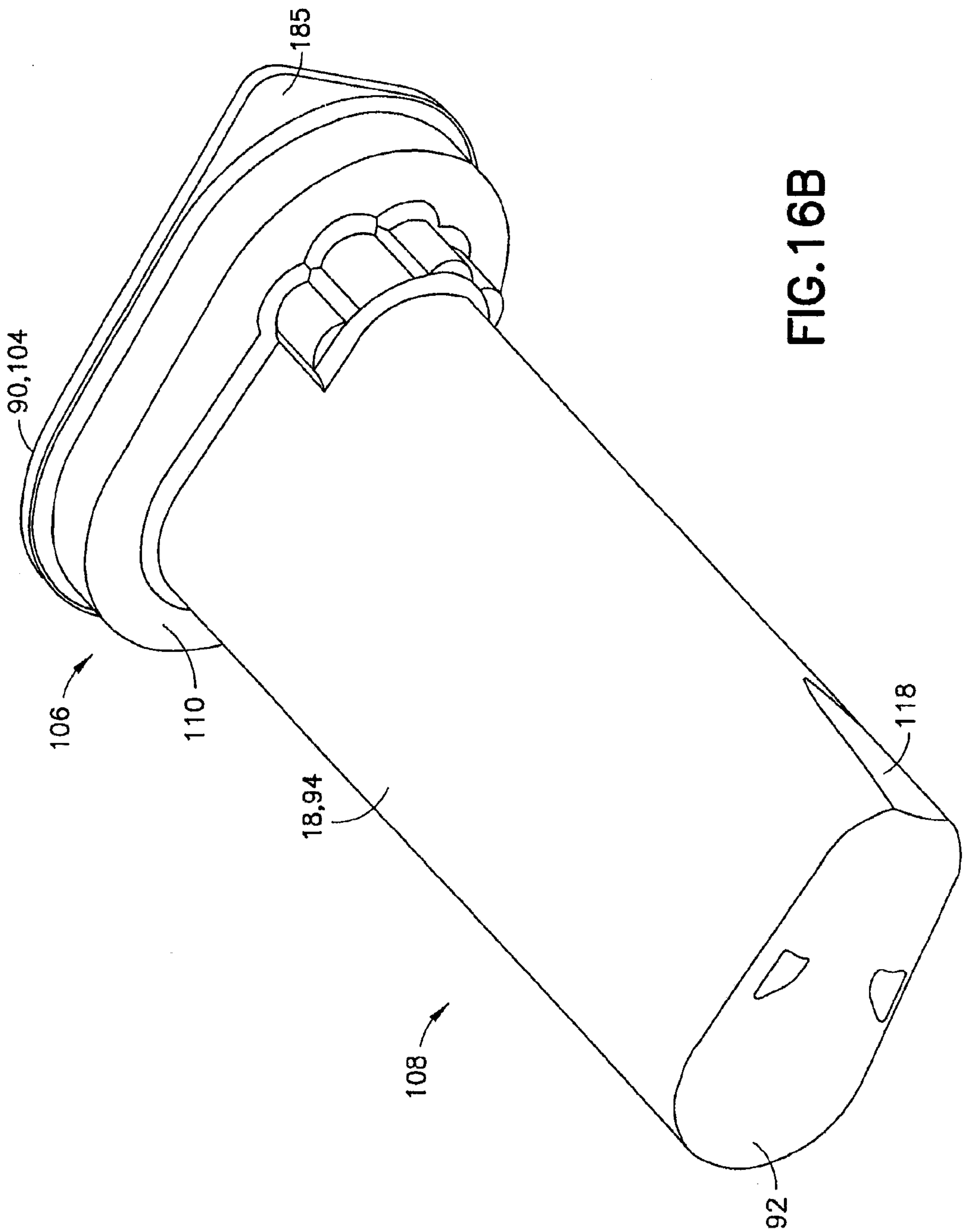
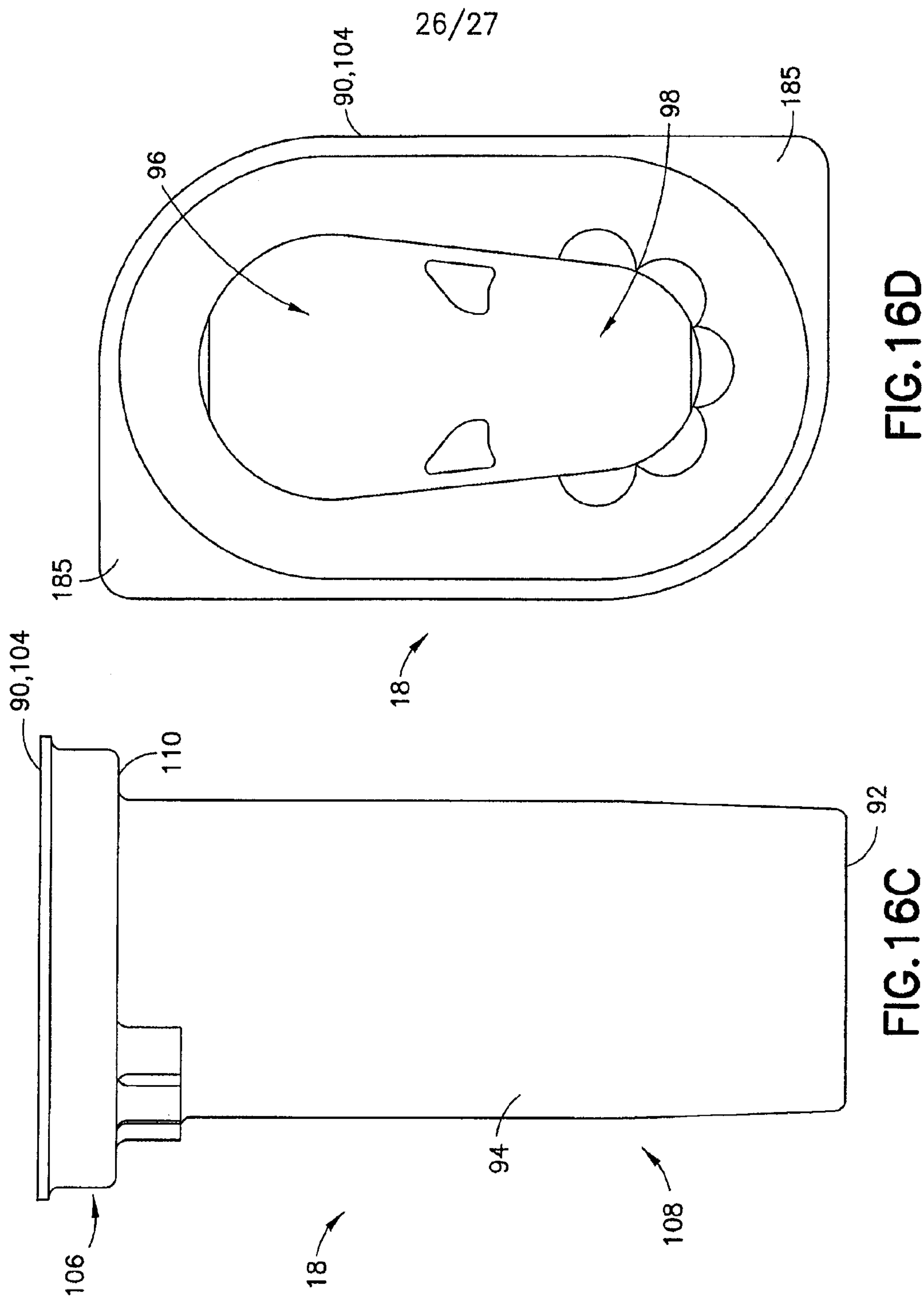


FIG. 16B



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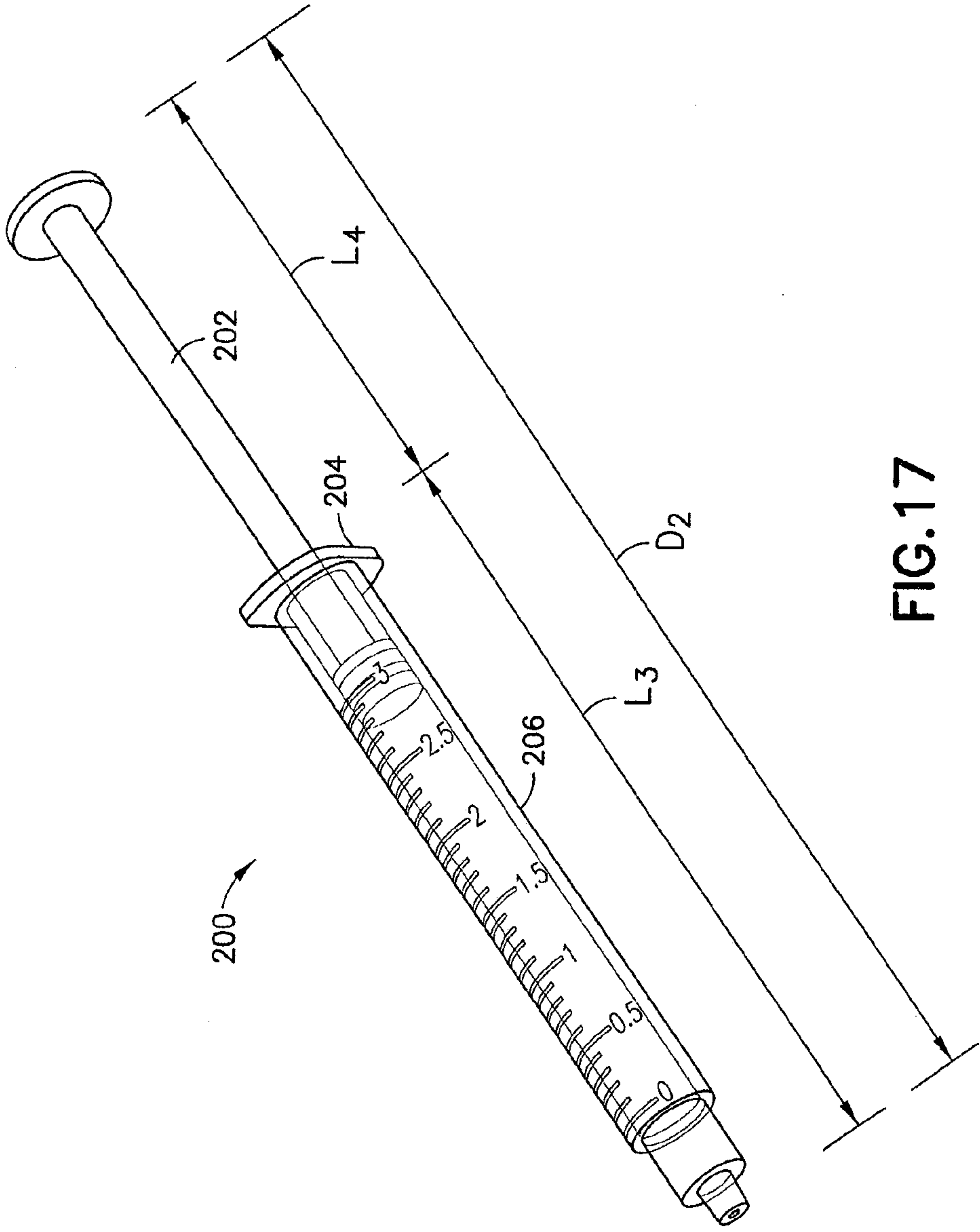


FIG. 17

