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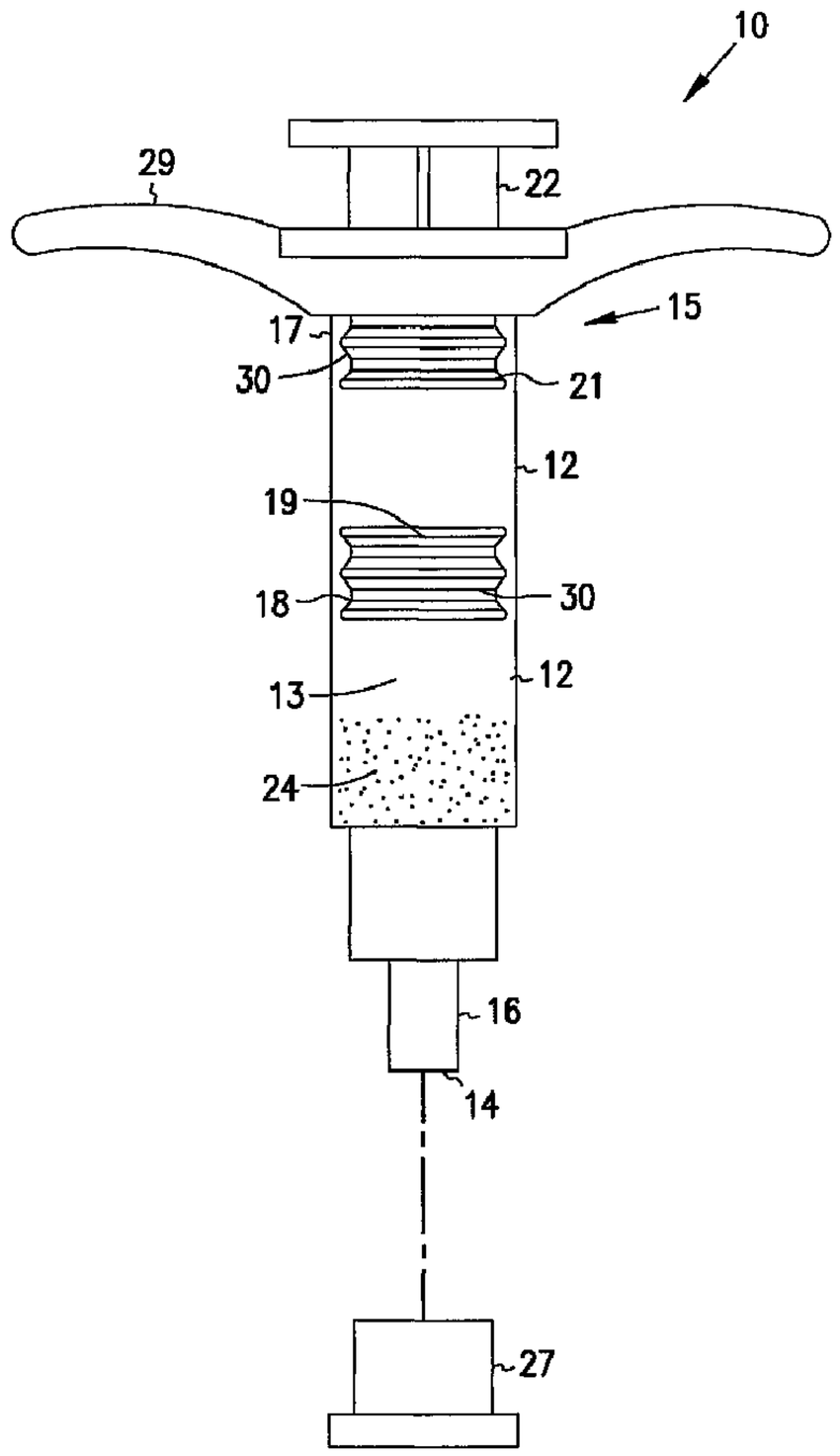

(57) Abrégé/Abstract:
A syringe assembly is provided which includes a hollow barrel that has an interior wall. The interior wall defines a chamber that retains medication. The hollow barrel also includes a distal end and a proximal end. The distal end of the hollow barrel has a

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(57) Abrégé(suite)/Abstract(continued):
passageway that is in contact with the chamber. The proximal end of the hollow barrel has an aperture. The syringe assembly also includes a primary plunger tip that is slidably positioned, in fluid tight engagement, with the interior wall. The primary plunger tip has a receptor to engage an engager of an elongated tip removal rod. The syringe assembly also includes a secondary plunger tip that is slidably positioned, in fluid tight engagement, with the interior wall. The secondary plunger tip also has a receptor to engage an engager of a tip removal rod. The secondary plunger tip is disposed between the primary plunger tip and the proximal end of the hollow barrel. The syringe assembly also includes a tip removal rod, which facilitates operation of the secondary plunger tip, engaged to the secondary plunger tip. The present invention also provides a process for providing a lyophilized medication (i.e., lyophilized) in a syringe assembly and also provides a process for reconstituting a medication in a syringe assembly.

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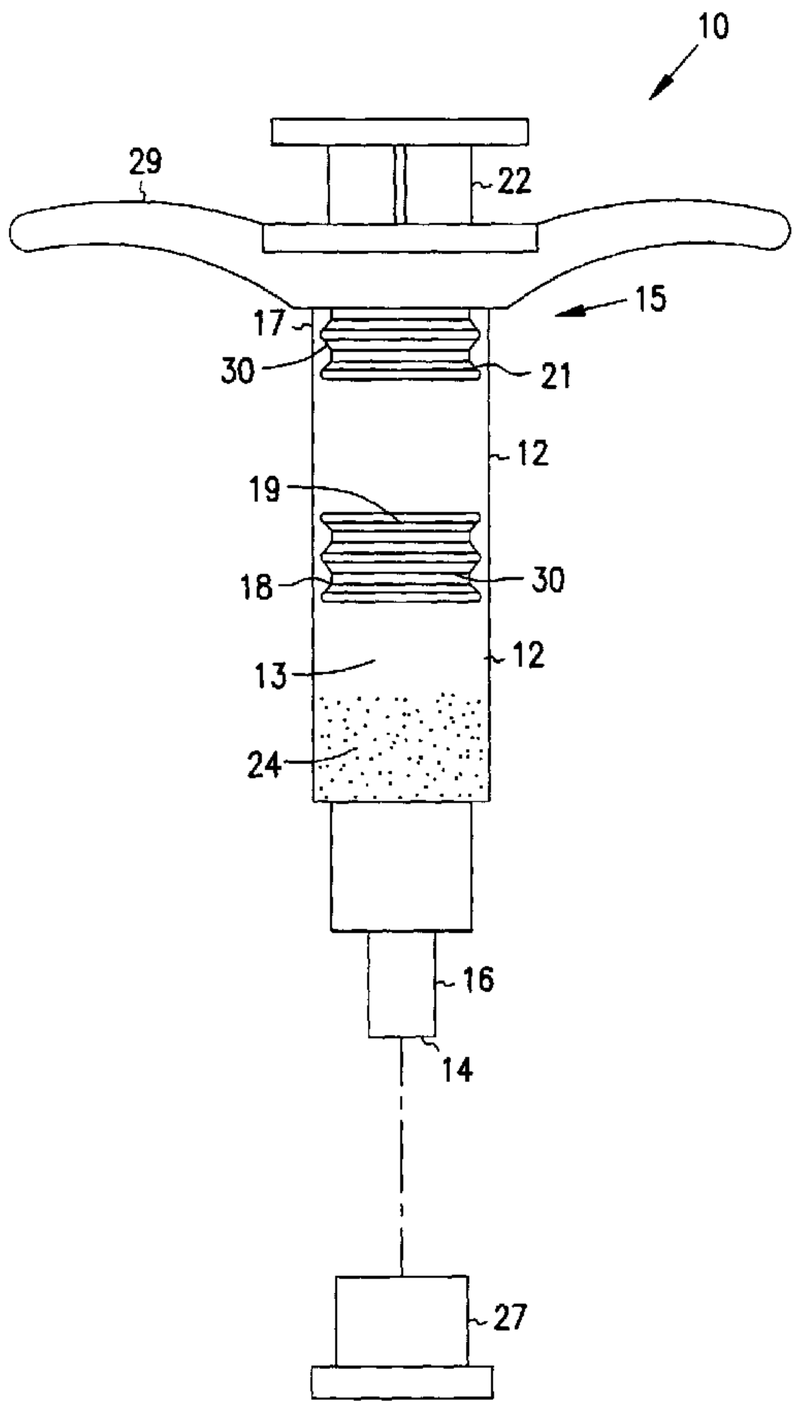
(54) Title: STOPPERING METHOD TO MAINTAIN STERILITY



(57) Abstract: A syringe assembly is provided which includes a hollow barrel that has an interior wall. The interior wall defines a chamber that retains medication. The hollow barrel also includes a distal end and a proximal end. The distal end of the hollow barrel has a passageway that is in contact with the chamber. The proximal end of the hollow barrel has an aperture. The syringe assembly also includes a primary plunger tip that is slidably positioned, in fluid tight engagement, with the interior wall. The primary plunger tip has a receptor to engage an engager of an elongated tip removal rod. The syringe assembly also includes a secondary plunger tip that is slidably positioned, in fluid tight engagement, with the interior wall. The secondary plunger tip also has a receptor to engage an engager of a tip removal rod. The secondary plunger tip is disposed between the primary plunger tip and the proximal end of the hollow barrel. The syringe assembly also includes a tip removal rod, which facilitates operation of the secondary plunger tip, engaged to the secondary plunger tip. The present invention also provides a process for providing a lyophilized medication (i.e., lyophilized) in a syringe assembly and also provides a process for reconstituting a medication in a syringe assembly.

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STOPPERING METHOD TO MAINTAIN STERILITY

Background of the Invention

Organic compounds, and more specifically pharmaceuticals, are generally more stable when they exist as a solid or powder than when they exist in solution. As such, the shelf-life of a pharmaceutical stored in solution is generally shorter than the shelf-life of the pharmaceutical stored as a solid or powder. Since many pharmaceuticals are stored for extended periods of time, it is advantageous to have these pharmaceuticals remain active over the extended period of time. It is therefore desirable to store pharmaceuticals, over an extended period of time, as a solid or powder. This includes those pharmaceuticals that are ultimately administered as a solution.

Lyophilization is routinely used in the preparation and storage of pharmaceuticals. In such applications, lyophilization is usually carried out by freezing a solution containing a solid or a powder, followed by sublimation to provide the solid or powder essentially free of solvent. Lyophilization directly in a vial or ampule requires transfer of the reconstituted pharmaceutical from the vial or ampule to a syringe. As such, a syringe is especially useful for the lyophilization of an injectable medication since the medication is ultimately administered from the syringe. Lyophilization can be performed wherein a solution containing the solid or powder is lyophilized directly in a syringe.

The lyophilized pharmaceutical (i.e., medication) can then be stored in the syringe wherein a diluent can be added to the syringe for reconstitution of the medication just prior to administration. The reconstituted medication can then be administered directly to the patient from the same hypodermic syringe in which the lyophilized medication had been stored.

Several problems exist in the packaging, shipment, and storage of a lyophilized pharmaceutical. Syringes are usually provided in an individual sterile package which is opened at the time of use. However, non-sterile matter (e.g., bacteria) from the environment may enter the syringe barrel through the proximal open end when the syringe is packaged. The

pharmaceutical is displaced between the distal end of the syringe barrel, which is sealed, and the plunger tip, which creates a seal. As such, the pharmaceutical is usually contained within a sterile portion of the syringe barrel. The portion of the syringe barrel between the plunger tip and the proximal end, however, is open to the environment. Even though the syringe may be packaged in a sterile packaging system, non-sterile matter (e.g., bacteria) can be introduced in that portion of the syringe barrel during packaging and can survive (i.e., remain dormant) in the syringe barrel over the lengthy storage time.

Reconstitution of the lyophilized pharmaceutical can be accompanied by the entrance of any non-sterile matter (e.g., bacteria) present in the non-sterile portion of the chamber of the syringe barrel. This occurs because the plunger rod and the stopper may be drawn back and forth along the portion of the syringe barrel where non sterile matter was introduced. Each cycling of the stopper along the barrel provides potential for contamination of the contents contained within the syringe. The introduction of non-sterile matter (e.g., bacteria) into the chamber of the syringe barrel results in the syringe, and the lyophilized pharmaceutical contained therein, being discarded or recycled, or infecting the patient.

Because of the extremely high requirements for sterility and quality control, lyophilization of pharmaceuticals is a very expensive process. The process requires a significant amount of energy to sustain the proper freezing and vacuum conditions in a lyophilization chamber. It is also costly and time consuming to discard or recycle those syringes, and the lyophilized pharmaceutical contained therein, because of contamination. Moreover, serious medical risks exist when a medication that is not sterile is parentally administered to a patient. As such, a syringe assembly is needed that will maintain the sterility of the lyophilized product during packaging, shipment and storage.

Summary of the Invention

The present invention is directed to a syringe assembly that maintains sterility, as well as to processes for their filling and use. The first syringe assembly includes a hollow barrel that has an interior wall. The interior wall defines a chamber that retains medication. The hollow barrel also includes a distal end and a proximal end. The distal end of the hollow barrel has a passageway that is in contact with the chamber. The proximal end of the hollow barrel has an aperture. The syringe assembly also includes a primary plunger tip that is slidably positioned, in fluid tight engagement, with the interior wall. The primary plunger tip has a receptor to engage an engager of an elongated tip removal rod. The syringe assembly also includes a secondary plunger tip that is slidably positioned, in fluid tight engagement, with the interior wall. The secondary plunger tip also has a receptor to engage an engager of a tip removal rod. The secondary plunger tip is disposed between the primary plunger tip and the proximal end of the hollow barrel. The syringe assembly also includes a tip removal rod, which facilitates operation of the secondary plunger tip, engaged to the secondary plunger tip.

The second syringe assembly is the first syringe assembly further including an elongated tip removal rod with an engager that is configured to engage the receptor of the primary plunger tip. The elongated tip removal rod facilitate the operation of the primary plunger tip. The third syringe assembly is the first syringe assembly further including a medication disposed between the primary plunger tip and the distal end of the hollow barrel.

The present invention also provides a process for providing a lyophilized medication (i.e., lyophilized) in a syringe assembly. The process includes providing a third syringe assembly and lyophilizing the solution in the chamber to provide a lyophilized. The process also includes inserting the primary plunger tip that is slidably positioned, in fluid tight engagement, with the interior wall. The primary plunger tip has a receptor to engage an engager of an elongated tip removal rod. The primary plunger tip is disposed between the lyophilized and the proximal end of the hollow barrel. The process also

includes inserting a secondary plunger tip that is slidably positioned, in fluid tight engagement, with the interior wall. The secondary plunger tip is engaged to a tip removal rod. The secondary plunger tip is disposed between the primary plunger tip and the proximal end of the hollow barrel.

The present invention also provides a process for reconstituting a medication in a syringe assembly. The process includes providing a second syringe assembly. The second syringe assembly also includes a medication that is disposed between the primary plunger tip and the distal end of the hollow barrel. The second syringe assembly also includes a discharge assembly or cannula (e.g., a needle) in fluid transport connection with the passageway. The secondary plunger tip is disposed between the primary plunger tip and the proximal end of the hollow barrel. The process also includes removing the secondary plunger tip from the hollow barrel and placing the discharge assembly in contact with a diluent. The process also includes urging the primary plunger tip proximally and away from the distal end of the hollow barrel. As the primary plunger is urged away from the distal end of the hollow barrel, the diluent is urged through the discharge assembly and through the distal end of the hollow barrel. As such, the diluent comes into contact with the medication thereby effectively reconstituting the medication.

Brief Description of the Drawings

Fig. 1 is an illustration of a syringe assembly.

Fig. 2 is an illustration of a hollow barrel.

Fig. 3 is an illustration of a primary plunger tip.

Fig. 4 is partial, cut-away side-view of a primary plunger tip.

Fig. 5 is an illustration of a an elongated tip removal rod.

Fig. 6 is an illustration of a primary plunger tip engaged to an elongated tip removal rod.

Fig. 7 is an illustration of a secondary plunger tip.

Fig. 8 is a partial, cut-away side-view of a secondary plunger tip.

Fig. 9 is an illustration of a tip removal rod.

Fig. 10 is an illustration of a secondary plunger tip engaged to a tip removal rod.

Fig. 11 is an illustration of a needle.

Fig. 12A is a top view of a flange extender.

Fig. 12B is a side view of a flange extender.

Fig. 13 is a partial view of a syringe assembly containing medication and a needle.

Fig. 14 is a partial view of a medication being reconstituted in a syringe assembly.

Detailed Description of the Invention

A syringe assembly in accordance with the subject invention is identified generally by the numeral **10** in Fig. 1. Syringe assembly **10** includes a hollow barrel **11** having an open proximal end **15**, a distal end **14**, and a substantially cylindrical interior wall **12** extending therebetween. The cylindrical interior wall **12** has a uniform circularity shaped cross section without any deformation in the side wall which will allow the primary plunger tip **18** and the secondary plunger tip **21** to maintain a fluid tight engagement with the cylindrical interior wall **12**. Interior wall **12** defines a substantially cylindrical fluid receiving chamber **13**. Distal end **14** of hollow barrel **11** includes a passageway **16** extending axially therethrough and communicating with chamber **13**. Distal end **14** of hollow barrel **11** is configured to engage a sealing cap **27**. In addition, distal end **14** of hollow barrel **11** is configured to engage a discharge assembly. The primary plunger tip **18** has a receptor **19** to engage an engager **28** of an elongated tip removal rod **20** (see Figs. 3-6). The secondary plunger tip **21** has a receptor **23** to engage an engager **31** of a tip removal rod **22** (see Figs. 7-10). The secondary plunger tip **21** is disposed between the primary plunger tip **18** and the proximal end **15** of the hollow barrel **11**. Tip removal rod **22** can be engaged to the secondary plunger tip **21** to facilitate operation of the secondary plunger tip **21**.

The syringe assembly **10** can further include a discharge assembly. Specifically, the discharge assembly can include a needle **25** or a flexible cannula (not shown). The needle **25** can include an engager **50**. The

engager **50** of the needle **25** is configured to engage the locking luer type collar **33** on the distal end **14** of the hollow barrel **11**. Needle **25** includes an elongate hollow tube **51** having a proximal end **52**, a distal end **53** and a lumen **54** extending therebetween. Proximal end **52** of elongated hollow tube **51** is securely and substantially permanently mounted to a mounting hub **55** which is configured for threaded engagement with locking luer type collar **33** and distal end **14** of hollow barrel **11**. The hollow barrel **11** can include a locking luer type collar **33** on the distal end **14**. The discharge assembly can engage the locking luer type collar **33** on the distal end **14** of the hollow barrel **11**.

The syringe assembly **10** can further include a sealing cap **27**. The sealing cap seals the hollow barrel from contamination. The sealing cap **27** can be inserted over tip **32** of hollow barrel **11** (see Fig. 2). The sealing cap **27** can engage the locking luer type collar **33** on the distal end **14** of the hollow barrel **11**.

The syringe assembly **10** can further include a flange **34** on the proximal end **15** of the hollow barrel **11**. In addition, a flange extender **29** can be mounted on the hollow barrel **11** such that the flange extender **29** is in continuous contact with the flange **34**. The flange extender **29** can project radially outward from the proximal end **15** of the hollow barrel **11** of the syringe assembly **10**. The flange extender **29** can be permanently mounted on the hollow barrel **11** or the flange extender **29** can be removably mounted on the hollow barrel **11**.

The hollow barrel **11** can be manufactured from any suitable material. Specifically, the hollow barrel **11** can be manufactured from glass, plastic (e.g., polypropylene, polyethylene, polycarbonate, polystyrene, and the like), rubber (natural rubber and synthetic rubber) and thermoplastic elastomers. The hollow barrel **11** can be sterilized. The hollow barrel **11** can be sterilized by any suitable means. More specifically, the hollow barrel **11** can be sterilized by gamma irradiation. The sterilization can occur before the medication **24** is introduced into the chamber **13** of the hollow barrel **11**. Alternatively, sterilization can occur before the medication **24** is introduced into the chamber **13** of the hollow barrel **11**. The size of the hollow barrel **11**

can be any suitable size. Suitable sizes include a hollow barrel **11** of about 0.01 to about 50 cc, about 0.1 cc to about 25 cc, about 0.1 cc to about 10 cc, or about 0.5 cc to about 5 cc. The hollow barrel **11** can be manufactured by any suitable process. The hollow barrel **11** can be manufactured by an injecting molding process where the entire hollow barrel **11** is made as one unit.

The primary plunger tip **18** includes opposed proximal and distal ends **47** and **48**. The primary plunger tip **18** is slidably positioned in fluid tight engagement with the cylindrical interior wall **12** (see Fig. 1). The primary plunger tip **18** can include a plurality of annular ribs **30** dimensioned for maintaining a fluid-tight engagement, while sliding, with the interior wall **12** (see Figs. 1, 3-4, and 6). Specifically, the primary plunger tip **18** can include 2, 3, 4, or 5 annular ribs **30**. More specifically, the primary plunger tip **18** can include 3 or 4 annular ribs **30**. Preferably the annular ribs are configured to provide fluid-tight engagement for movement of the primary plunger tip **18** in both directions, i.e., pushing tip **18** toward the distal end **14** and putting tip **18** away from distal end **14**.

The syringe assembly **10** can include an elongated tip removal rod **20** (see Figs. 5-6). The elongated tip removal rod **20** includes an engager **28**. Specifically, the engager **28** can be a threaded end **36**. The primary plunger tip **18** includes a receptor **19** to engage an engager **28** of an elongated tip removal rod **20** (see Figs. 1 and 3-6). Specifically, the engager **28** can be a threaded end **35** and the receptor **19** can be a threaded receiving end **36** (see Figs. 4-6). When the engager **28** is a threaded end **35** and when thereceptor **19** is a threaded receiving end **36**, the elongated tip removal rod **20** can be engaged to the primary plunger tip **18** by screwing the threaded end **35** into the threaded receiving end **36** (see Fig. 6).

The primary plunger tip **18** can have any suitable shape, provided the primary plunger tip **18** maintains fluid tight engagement with the interior wall **12** of the hollow barrel **11**. The distal end **47** of the primary plunger tip **18** can be shaped to facilitate the egress of the diluent **60** and medication **24** from chamber **13** of the hollow barrel **11**. Specifically, the cross-sectional shape of the distal end **47** of the primary plunger tip **18** can be

v-shaped. The primary plunger tip **18** can be manufactured from any suitable material. Suitable materials include plastic (e.g., polypropylene, polyethylene, polycarbonate, polystyrene, and the like), rubber (e.g., natural rubber or synthetic rubber), thermoplastic elastomers, or any combination thereof. The primary plunger tip **18** can be sterilized. The primary plunger tip **18** can be sterilized by any suitable means. More specifically, the primary plunger tip **18** can be sterilized by gamma irradiation. The sterilization can occur before the medication **24** is introduced into the chamber **13** of the hollow barrel **11**. Alternatively, sterilization can occur before the medication **24** is introduced into the chamber **13** of the hollow barrel **11**.

The elongated tip removal rod **20** includes a proximal end **40**, a distal end **41** and a body **45** extending therebetween. The proximal end **40** includes a flange **39**. The distal end **41** includes an engager **28**. The length of the elongated tip removal rod **20** (i.e., the body **45**) is sufficiently long as to enable the engager **28** of the elongated tip removal rod **20** to engage the receptor **19** of the primary plunger tip **18**, even when the primary plunger tip **18** is located at the distal end **14** of the chamber **13** of the hollow barrel **11**.

The elongated tip removal rod **20** can be manufactured from any suitable material. Specifically, the elongated tip removal rod **20** can be manufactured from glass, plastic (e.g., polypropylene, polyethylene, polycarbonate, polystyrene, and the like), rubber (natural rubber and synthetic rubber) and thermoplastic elastomers. The elongated tip removal rod **20** can be sterilized. The elongated tip removal rod **20** can be sterilized by any suitable means. More specifically, the elongated tip removal rod **20** can be sterilized by gamma irradiation. The sterilization can occur before the medication **24** is introduced into the chamber **13** of the hollow barrel **11**. Alternatively, sterilization can occur before the medication **24** is introduced into the chamber **13** of the hollow barrel **11**.

The secondary plunger tip **21** is slidably positioned in fluid tight engagement inside the interior wall **12** of the hollow barrel **11** (see Fig. 1). The secondary plunger tip **21** can include a plurality of annular ribs **30** dimensioned for maintaining fluid-tight engagement, while sliding, with the interior wall **12** of the hollow barrel **11** (see Figs. 1, 7-8, and 10).

Specifically, the secondary plunger tip **21** can include 2, 3, 4, or 5 annular ribs **30**. More specifically, the secondary plunger tip **21** can include 3 or 4 annular ribs **30**.

The secondary plunger tip **21** includes a receptor **23** to engage the engager **31** of the tip removal rod **22**. Specifically, the receptor **23** can be a threaded receiving end **37**. The tip removal rod **22** includes an engager **31**. Specifically, the engager **31** of the tip removal rod **22** can be a threaded end **38** (see Figs. 9-10). When the engager **31** is a threaded end **38** and when the receptor **23** is a threaded receiving end **37**, the tip removal rod **22** can be engaged to the secondary plunger tip **21** by screwing the threaded end **38** into the threaded receiving end **37** (see Fig. 10). In addition, the tip removal rod **22** can be permanently engaged (i.e., affixed) to the secondary plunger tip **21**.

The secondary plunger tip **21** can be manufactured from any suitable material. Suitable materials include plastic (e.g., polypropylene, polyethylene, polycarbonate, polystyrene, and the like), rubber (e.g., natural rubber or synthetic rubber), thermoplastic elastomers, or any combination thereof. The secondary plunger tip **21** can be sterilized. The secondary plunger tip **21** can be sterilized by any suitable means. More specifically, the secondary plunger tip **21** can be sterilized by gamma irradiation. The sterilization can occur before the medication **24** is introduced into the chamber **13** of the hollow barrel **11**. Alternatively, sterilization can occur before the medication **24** is introduced into the chamber **13** of the hollow barrel **11**.

The tip removal rod **22** includes a proximal end **42**, a distal end **43** and a body **46** extending therebetween. The proximal end **42** can include a flange **44**. The distal end **43** can include an engager **31**. The length of the tip removal rod **22** (i.e., the body **46**) can be sufficiently short such that when the receptor **23** of the secondary plunger tip **21** is engaged to the engager **31** of the tip removal rod **22**, the secondary plunger tip **21** is located at the proximal end **15** of the chamber **13** of the hollow barrel **11**. The location of the secondary plunger tip **21** at the proximal end **15** of the chamber **13** of the hollow barrel **11** will ensure that the portion of interior wall **12**, and the contents thereof, located between the secondary plunger tip

21 and the primary plunger tip 18 will remain sterile during the packaging, shipping and storage of the syringe assembly 10.

The tip removal rod 22 can be manufactured from any suitable material. Suitable materials include glass, plastic (e.g., polypropylene, polyethylene, polycarbonate, polystyrene, and the like), rubber (natural rubber and synthetic rubber), thermoplastic elastomers, or any combination thereof. The tip removal rod 22 can be sterilized. The tip removal rod 22 can be sterilized by any suitable means. More specifically, the tip removal rod 22 can be sterilized by gamma irradiation. The sterilization can occur before the medication 24 is introduced into the chamber 13 of the hollow barrel 11. Alternatively, sterilization can occur before the medication 24 is introduced into the chamber 13 of the hollow barrel 11.

The syringe assembly 10 can include a medication 24 (i.e., pharmaceutical or drug). The medication 24 can be sterilized. The medication 24 can be sterilized by any suitable means. More specifically, the medication 24 can be sterilized by filtration. The sterilization can occur prior to the introduction of the solution containing the medication 24 into the chamber 13 of the hollow barrel 11 (i.e., prior to lyophilization). The medication 24 can be located between the distal end 14 of the chamber 13 of the hollow barrel 11 and the primary plunger tip 18. Specifically, the medication 24 can be located toward the distal end 14 of the chamber 13 of the hollow barrel 11 such that the medication 24 is in contact with the passageway 16.

Any suitable medication or pharmaceutically acceptable salt thereof can be employed. Suitable classes of pharmaceuticals include antibiotics, peptides, hormones, analgesics, growth factors, vaccines and any agent described in U.S. Patent No. B14938763.

The drug can exist as a solid (e.g., crystal or powder), an oil, or as a clay-like material. The drug can also be a lyophilized medication (e.g., leuprolide acetate or doxycycline), a powdered medication, or a granular medication. In addition, the drug may exist in a microcapsule containing the drug or as a microparticle.

The present invention also provides a process for providing a lyophilized medication (i.e., lyophilized) in a syringe assembly **10**. The process includes providing a syringe assembly **10**. The distal end **14** of the hollow barrel **11** or the proximal end **15** of the hollow barrel **11** is sealed and a solution comprising the medication is placed in the chamber **13**. The solution is then lyophilized in the chamber **13** to provide a lyophilized. A primary plunger tip **18**, slidably positioned in fluid tight engagement with the interior wall **12**, is inserted inside the hollow barrel **11**. The primary plunger tip **18** is inserted inside the hollow barrel **11** such that the primary plunger tip **18** is disposed between the lyophilized and the proximal end **15** of the hollow barrel **11**. Specifically, the primary plunger tip **18** can be positioned toward the distal end **14** of the hollow barrel **11**. More specifically, the primary plunger tip **18** can be positioned toward the distal end **14** of the hollow barrel **11** such that the primary plunger tip **18** is in contact with the lyophilized medication (i.e., lyophilized). a secondary plunger tip **21**, slidably positioned in fluid tight engagement with the interior wall **12**, is inserted inside the hollow barrel **11**. The secondary plunger tip **21** can be engaged to a tip removal rod **22**. The secondary plunger tip **21** can be inserted inside the hollow barrel **11** such that the secondary plunger tip **21** is disposed between the primary plunger tip **18** and the proximal end **15** of the hollow barrel **11**. More specifically, the secondary plunger tip **21** can be positioned toward the proximal end **15** of the hollow barrel **11** such that the secondary plunger tip **21** is in contact with the proximal end **15** of the hollow barrel **11**.

As used herein, "lyophilization" is the removal of solvent from the frozen state by sublimation. Lyophilization is accomplished by freezing the solution below its melting point and manipulating the temperature and pressure conditions affecting the frozen solution to sublimation. Precise control of these conditions permits drying from the frozen state without product melt-back. In practical applications, the process is accelerated and more precisely controlled under reduced pressure conditions. McGraw-Hill Concise Encyclopedia of Science & Technology, Fourth Edition, Sybil P. Parker, 1997. The vacuum causes the water molecules to "sublimate", i.e., to become gaseous and leave the solid, without going through a liquid state. As

used herein, " lyophilized " is the solid, powder or granular material remaining after lyophilization. The solid, powder or granular material is essentially free of solvent.

The process for providing a lyophilized medication (i.e., lyophilized) in a syringe assembly **10** can further include the step of packaging the syringe assembly containing the lyophilized medication. The packaging of the syringe assembly **10** typically includes placing the syringe assembly **10** in a pouch and sealing the pouch. The syringe assembly **10** can be placed in a pouch and the pouch can be sealed under sterile conditions. The pouch can be manufactured from any suitable material. Suitable materials include plastic (e.g., polypropylene, polyethylene, polycarbonate, polystyrene, and the like) and thermoplastic elastomers.

The process for providing a lyophilized medication (i.e., lyophilized) in a syringe assembly **10** can further include the step of applying a label to the syringe assembly **10**. The label can be applied to the hollow barrel **11** of the syringe assembly **10**. The label can be clear or opaque. The label can include a description of the contents of the syringe assembly **10** (i.e., the medication **24**). In addition, the label can include directions for administering the contents of the syringe assembly **10** (i.e., the medication **24**).

The process for providing a lyophilized medication (i.e., lyophilized) in a syringe assembly **10** can further include the step of engaging a flange extender **29** to the proximal end **15** of the hollow barrel **11** of the syringe assembly **10**. The flange extender **29** can be engaged to the proximal end **15** of the hollow barrel **11** of the syringe assembly **10**. The distal end **14** of hollow barrel **11** can be inserted through the proximal end **58** of aperture **56** of the flange extender **29**. The hollow barrel **11** can be inserted through the aperture **56** until the flange extender **29** is in continuous contact with flange **34**.

The present invention also provides a process for reconstituting a medication **24** (i.e., lyophilized) in a syringe assembly **10**. The process includes providing a syringe assembly **10** that includes a

discharge assembly (e.g., needle **25)** engaged to the distal end **14** of the hollow barrel **11**. The hollow barrel **11** can contain a medication **24** disposed between the primary plunger tip **18** and the distal end **14** of the hollow barrel **11**. The secondary plunger tip **21** is removed from the hollow barrel **11**. The distal end **53** of the discharge assembly (e.g., needle **25)** is placed in communication with a diluent **60**. The primary plunger tip **18** is urged proximally and away from the distal end **14** of the chamber **13** of the hollow barrel **11**. The primary plunger tip **18** can be urged proximally and away from the distal end **14** of the chamber **13** of the hollow barrel **11** with the use of an elongated tip removal rod **20**. In such an embodiment, the elongated tip removal rod **20** is engaged to the primary plunger tip **18** as described above. As the elongated tip removal rod **20** is urged proximally and away from the distal end **14** of the chamber **13** of the hollow barrel **11**, the primary plunger tip **18** is urged proximally and away from the distal end **14** of the chamber **13** of the hollow barrel **11**. The diluent **60** is thereby urged through the lumen **54** of the needle, through the distal end **14** of the hollow barrel **11**, into the chamber **13** of the hallow barrel **11**, and into contact with the medication **24**, thereby effectively reconstituting the medication **24**. It is also possible and within the confines of the present invention to reconstitute the medication **24** by connecting the distal end **14** of the hollow barrel **11** directly to a liquid reservoir without the use of a discharge assembly (e.g., needle **25)**.

The diluent **60** can contain any suitable liquid carrier. Suitable liquid carriers include a collagen solution, an oil (e.g., vegetable oil), a sterile aqueous solution, a sterile saline solution, an alcoholic solution, or any suitable mixture thereof. In addition, the liquid carrier can be an emulsion formed from a mixture of an oil (e.g., vegetable oil) and a sterile aqueous solution or a sterile saline solution. Specifically, the liquid drug delivery system can be the Atrigel ® system.

What is claimed is:

1. A syringe assembly comprising:

a hollow barrel having an interior wall defining a chamber for retaining medication, wherein the hollow barrel comprises a distal end and a proximal end, wherein the distal end of the hollow barrel has a passageway therethrough communicating with the chamber and the proximal end of the hollow barrel has an aperture therethrough;

a primary plunger tip having a proximal end and a distal end slidably positioned in fluid tight engagement with the interior wall, wherein the proximal end of the primary plunger tip has a receptor to engage an engager on a distal end of an elongated tip removal rod;

a secondary plunger tip having a proximal end and a distal end slidably positioned in fluid tight engagement with the interior wall, wherein the proximal end of the secondary plunger tip has a receptor to engage the engager on the distal end of the tip removal rod, wherein the secondary plunger tip is disposed between the primary plunger tip and the proximal end of the hollow barrel such that the secondary plunger tip is spaced at an axial distance from, and not engaged with, the primary plunger tip; and

the tip removal rod having the engager located on the distal end, the engager being configured to engage the receptor of the secondary plunger tip to facilitate operation of the secondary plunger tip.

2. The syringe assembly of claim 1 wherein the distal end of the hollow barrel is configured to engage at least one of a discharge assembly and a sealing cap.

3. The syringe assembly of claim 2 wherein the discharge assembly includes a needle.

4. The syringe assembly of claim 1 further comprising a sealing cap positioned at the distal end of the hollow barrel, wherein the sealing cap seals the passageway from contamination.

5. The syringe assembly of claim 1 further comprising the elongated tip removal rod which comprises a length greater than a length of the tip removal rod and the engager located on the distal end, the engager being configured to engage the receptor of the primary plunger tip to facilitate operation of the primary plunger tip.

6. The syringe assembly of claim 1 further comprising a medication disposed between the primary plunger tip and the distal end of the hollow barrel.

7. The syringe assembly of claim 6 wherein the medication is selected from lyophilized medication, powdered medication, and granular medication.

8. The syringe assembly of claim 7 wherein the lyophilized medication is leuprolide acetate.

9. The syringe assembly of claim 1 further comprising a flange extender projecting radially outward from the proximal end of the hollow barrel.

10. The syringe assembly of claim 1 wherein at least one of the primary plunger tip and the secondary plunger tip comprises a plurality of annular ribs dimensioned for sliding fluid-tight engagement with the interior wall.

11. The syringe assembly of claim 1 wherein the hollow barrel is made from material selected from glass and plastic.

12. The syringe assembly of claim 1 wherein at least one of the primary plunger tip and the secondary plunger tip is made from material selected from natural rubber, synthetic rubber and thermoplastic elastomers.

13. A process for providing a lyophilized medication in a syringe assembly, the process comprising:

providing a hollow barrel having an interior wall defining a chamber for retaining a solution comprising a medication, wherein the hollow barrel comprises a distal end and a proximal end, wherein the distal end of the hollow barrel has a passageway therethrough communicating with the chamber and the proximal end of the hollow barrel has an aperture therethrough, wherein the distal end of the hollow barrel or the proximal end of the hollow barrel is sealed;

placing a solution comprising a medication in the chamber;

lyophilizing the solution in the chamber to provide a lyophilized medication;

inserting a primary plunger tip having a proximal end and a distal end that is slidably positioned in fluid tight engagement with the interior wall, wherein the primary plunger tip has a receptor on the proximal end to engage an engager on a distal end of an elongated tip removal rod, wherein the primary plunger tip is disposed between the lyophilized medication and the proximal end of the hollow barrel; and

inserting a secondary plunger tip having a proximal end and a distal end that is slidably positioned in fluid tight engagement with the interior wall, wherein the secondary plunger tip has a receptor on the proximal end that is engaged to an engager on a distal end of a tip removal rod, wherein the secondary plunger tip is disposed between the primary plunger tip and the proximal end of the hollow barrel such that the secondary plunger tip is spaced at an axial distance from, and not engaged with, the primary plunger tip, to provide the lyophilized medication in a syringe assembly.

14. The process of claim 13 wherein the distal end of the hollow barrel is configured to engage at least one of a discharge assembly and a sealing cap.

15. The process of claim 14 wherein the discharge assembly includes a needle.

16. The process of claim 13 wherein the medication is leuprolide acetate.

17. The process of claim 13 wherein at least one of the primary plunger tip and the secondary plunger tip comprises a plurality of annular ribs dimensioned for sliding fluid-tight engagement with the hollow barrel.

18. The process of claim 13 wherein the hollow barrel is made from material selected from glass and plastic.

19. The process of claim 13 wherein at least one of the primary plunger tip and the secondary plunger tip is made from material selected from natural rubber, synthetic rubber and thermoplastic elastomers.

20. The process of claim 13 wherein the medication is sterilized by filtration.

21. The process of claim 13 wherein at least one of the hollow barrel, primary plunger tip, and the secondary plunger tip is sterilized by gamma irradiation.

22. The process of claim 13 further including the step of packaging the syringe assembly containing the lyophilized medication.

23. The process of claim 22 wherein the packaging is under sterile conditions.

24. The process of claim 13 further including the step of labeling the syringe assembly containing the lyophilized medication.

25. The process of claim 13 further including the step of engaging a flange extender to the proximal end of the hollow barrel of the syringe assembly, wherein the flange extender projects radially outward from the proximal end of the hollow barrel of the syringe assembly.

26. A process for reconstituting a medication in a syringe, the process comprising:

providing a syringe assembly with a medication according to claim 6;

removing the secondary plunger tip from the hollow barrel;

placing the discharge assembly in communication with a diluent; and

urging the primary plunger tip proximally and away from the distal end of the hollow barrel, thereby urging the diluent through the discharge assembly and through the distal end of the hollow barrel, thereby contacting the medication and effectively reconstituting the medication.

27. The process of claim 26 wherein the distal end of the hollow barrel is configured to engage at least one of a discharge assembly and a sealing cap.

28. The process of claim 26 wherein the discharge assembly includes a needle.

29. The process of claim 26 wherein the medication is selected from lyophilized medication, powdered medication, and granular medication.

30. The process of claim 29 wherein the lyophilized medication is leuprolide acetate.

31. The process of claim 26 wherein the urging the primary plunger tip proximally and away from the distal end of the hollow barrel is accomplished by engaging the primary plunger tip with an elongated tip removal rod and urging the elongated tip removal rod proximally and away from the distal end of the hollow barrel, thereby urging the diluent through the distal end of the hollow barrel and into the chamber, thereby effectively reconstituting the medication.

32. The process of claim 26 wherein at least one of the primary plunger tip and the secondary plunger tip comprises a plurality of annular ribs dimensioned for sliding fluid-tight engagement with the hollow barrel.

33. The process of claim 26 wherein the hollow barrel is made from material selected from glass and plastic.

34. The process of claim 26 wherein at least one of the primary plunger tip and the secondary plunger tip is made from material selected from natural rubber, synthetic rubber and thermoplastic elastomers.

35. The process of claim 26 wherein the medication is sterilized by filtration.

36. The process of claim 26 wherein at least one of the hollow barrel, primary plunger tip, and the secondary plunger tip is sterilized by gamma irradiation.

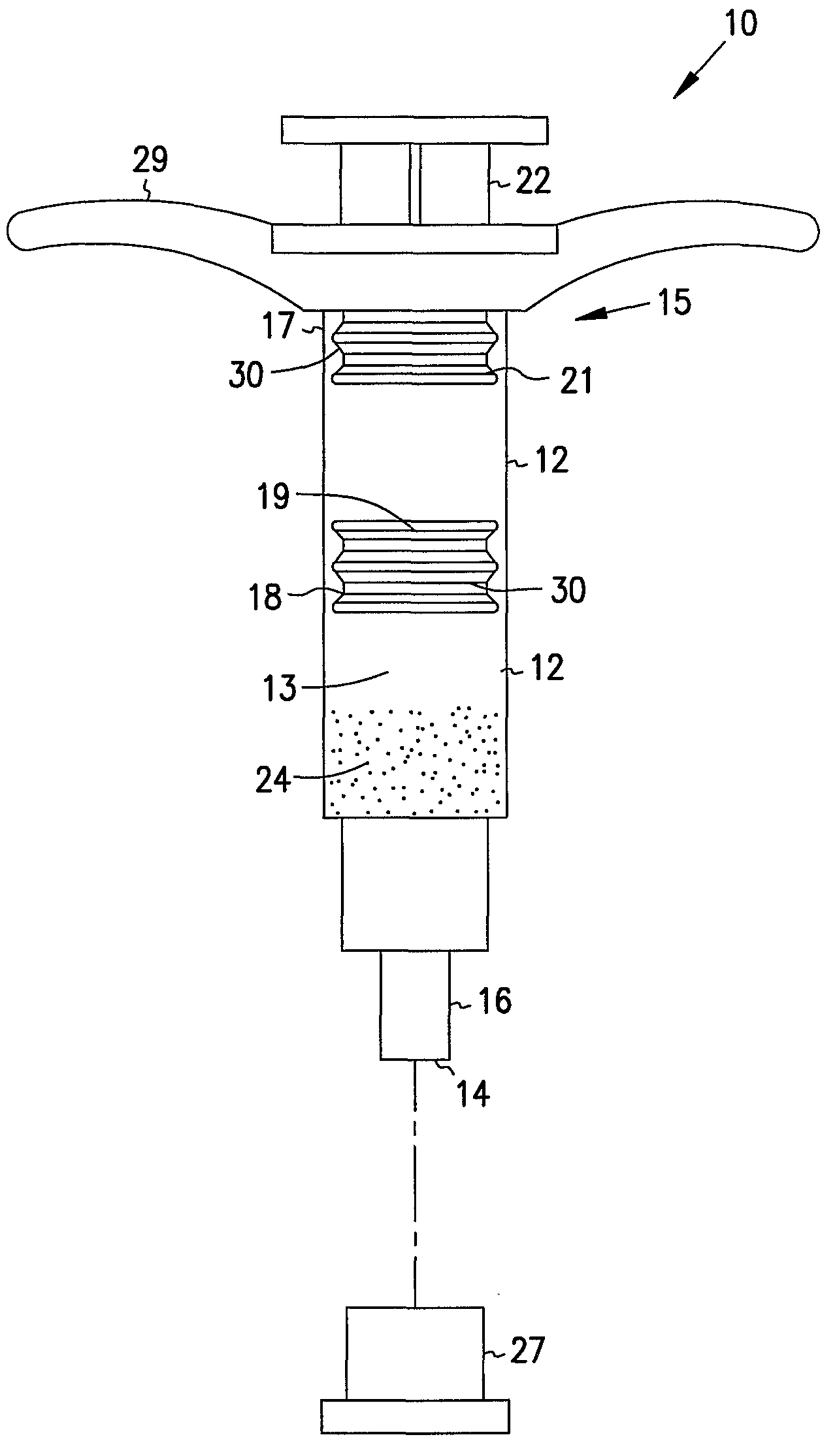


FIG. 1

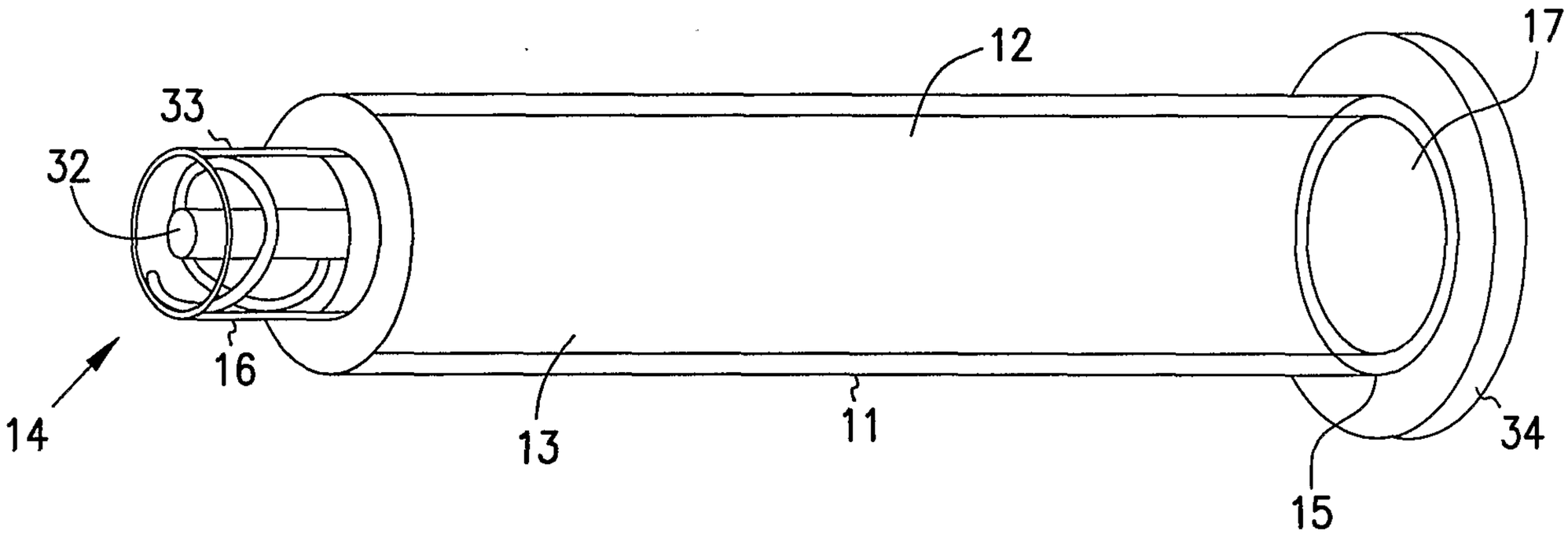


FIG. 2

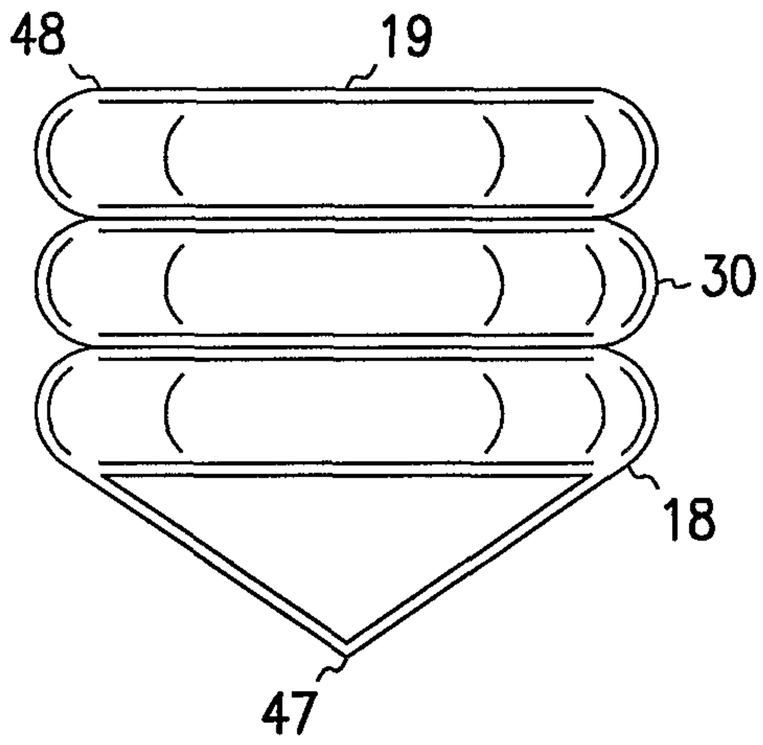
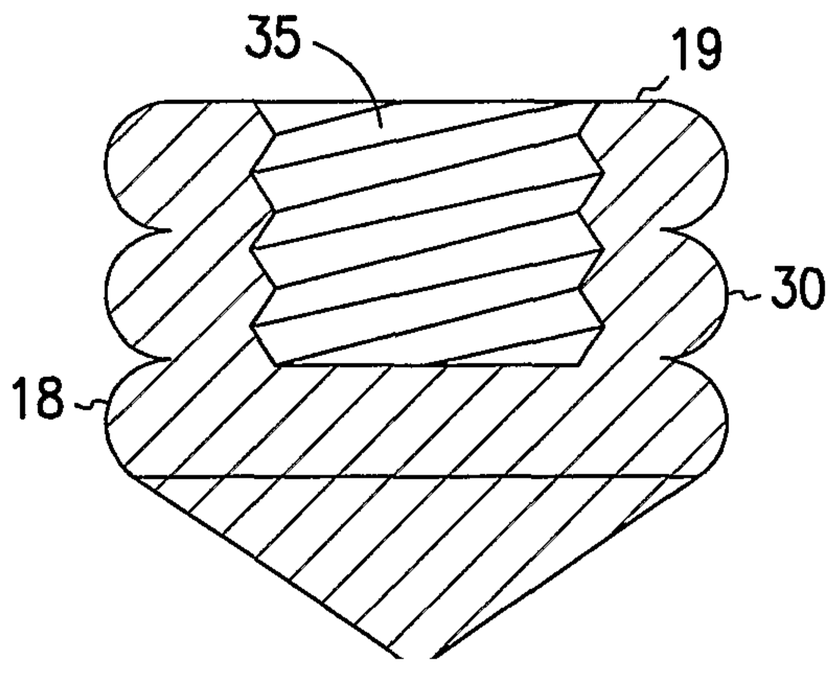


FIG. 3



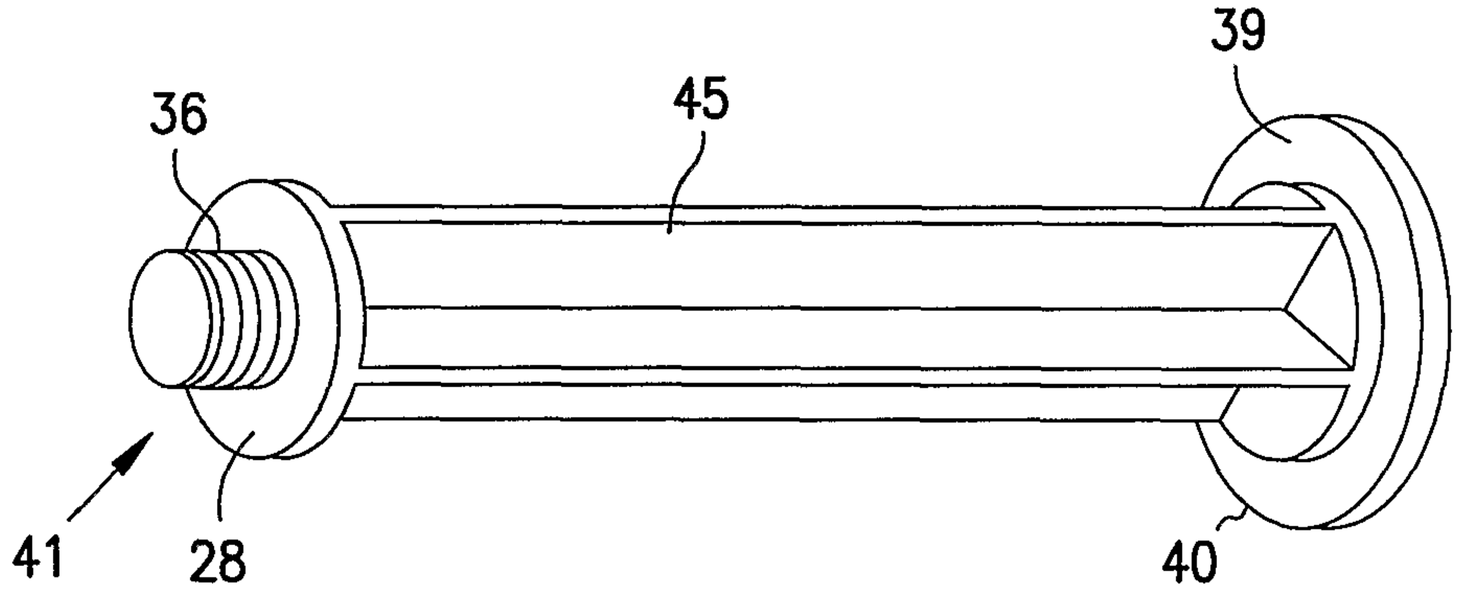


FIG. 5

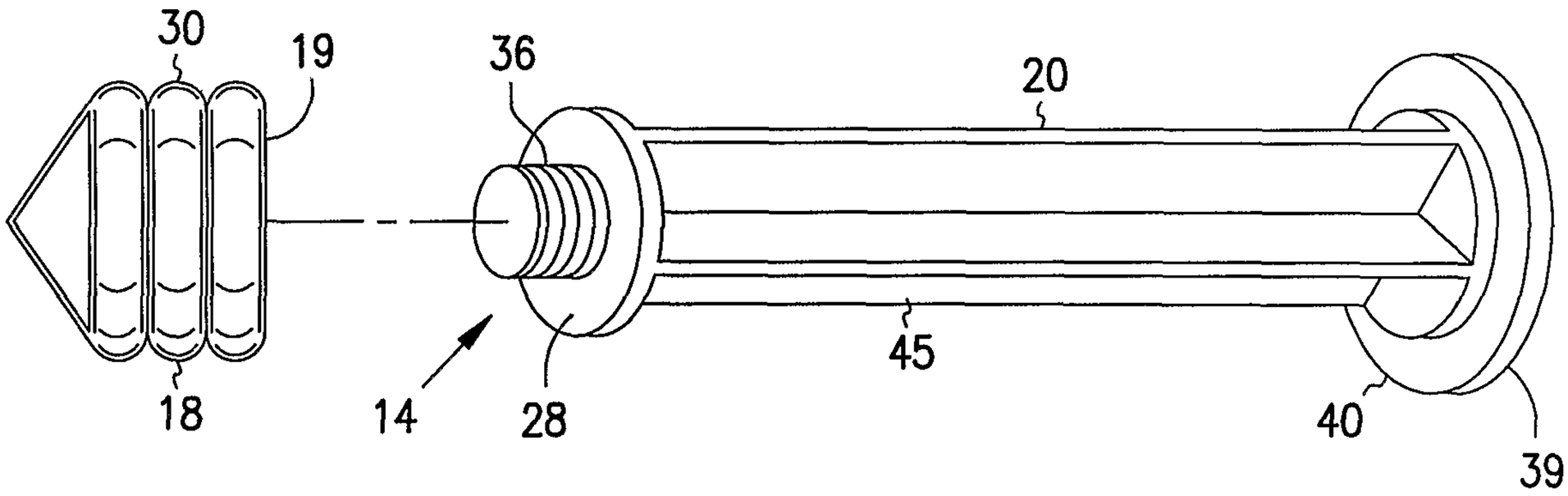


FIG. 6

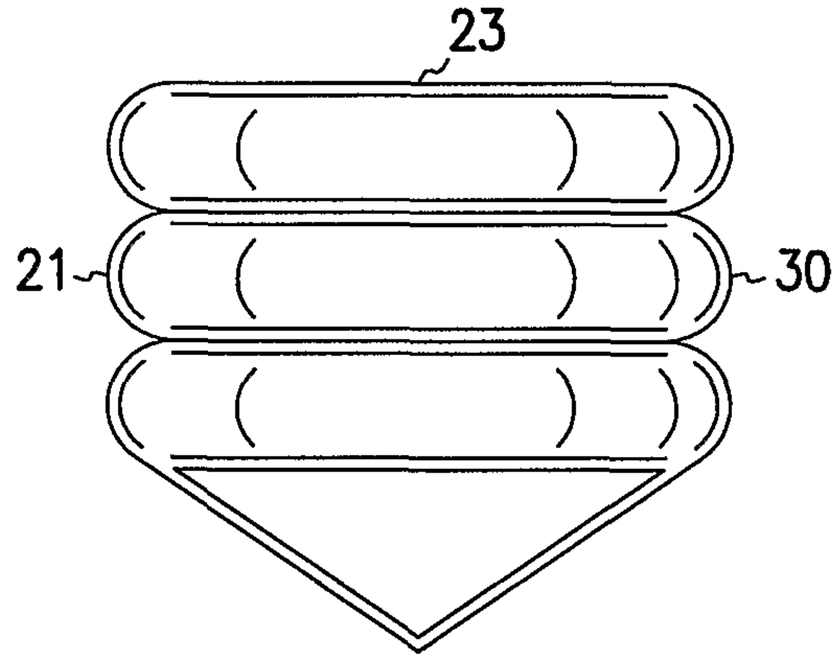


FIG. 7

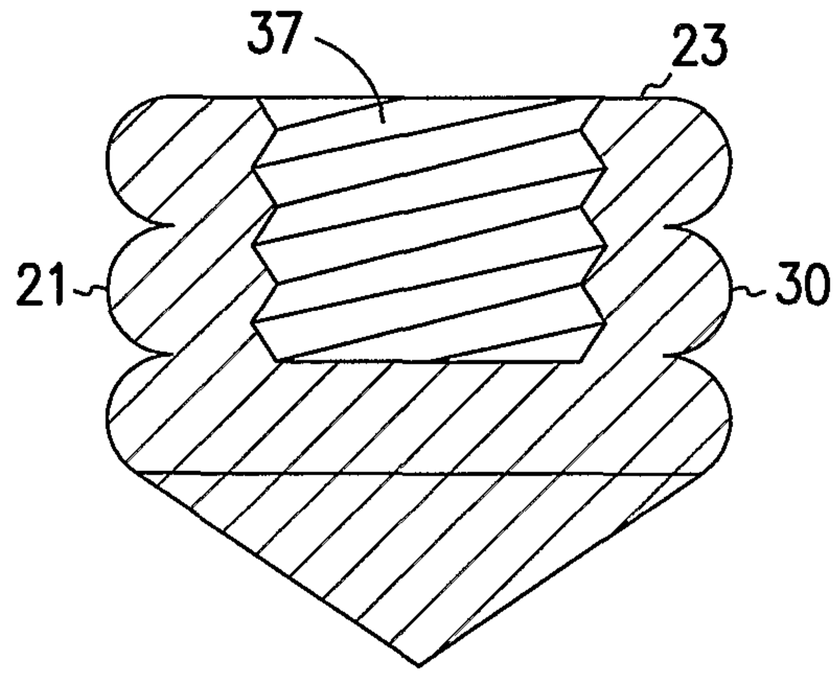


FIG. 8

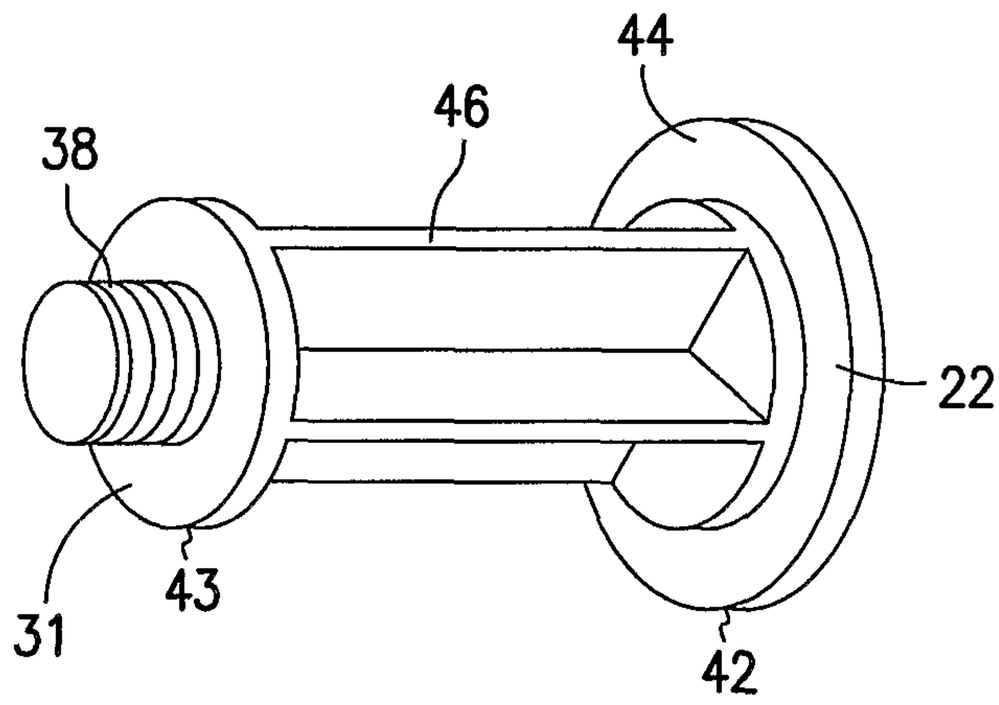


FIG. 9

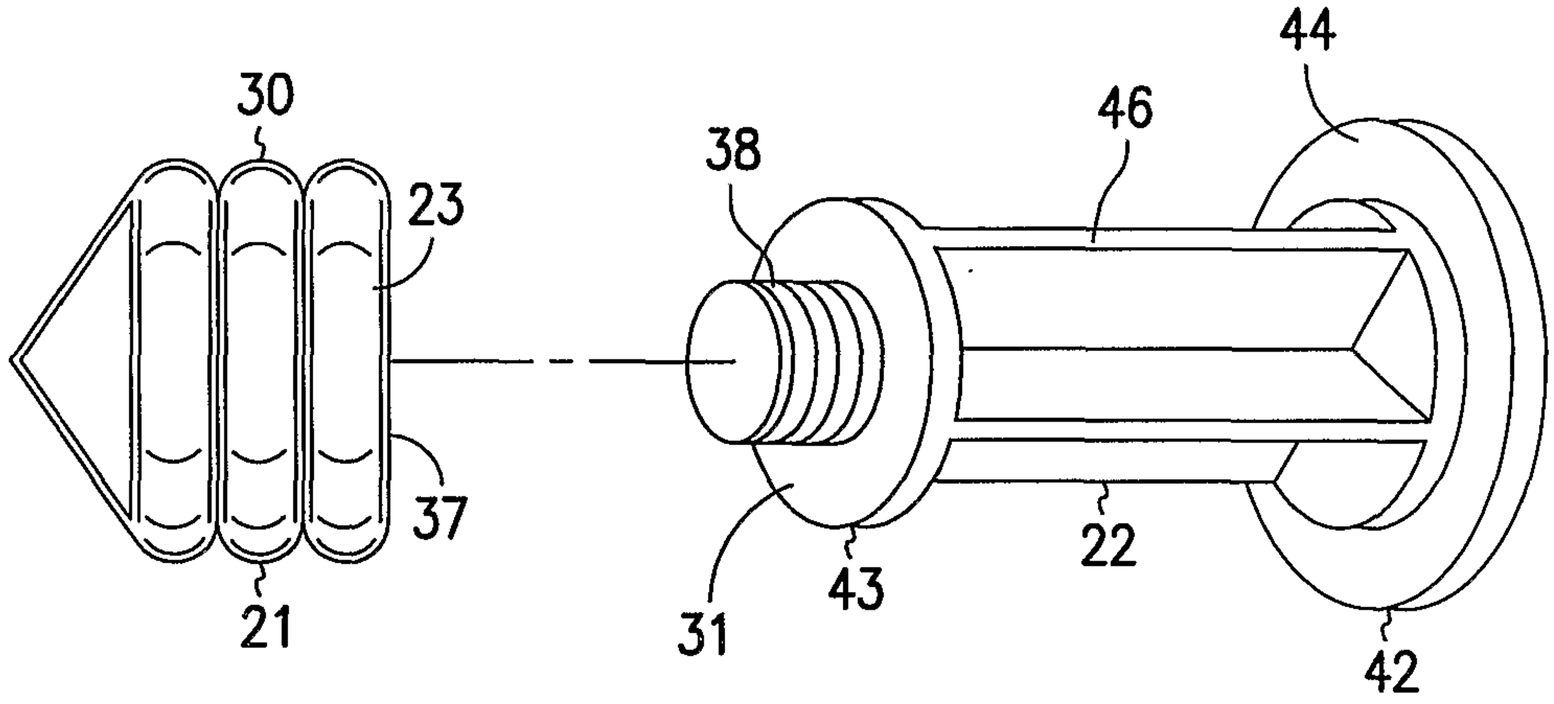
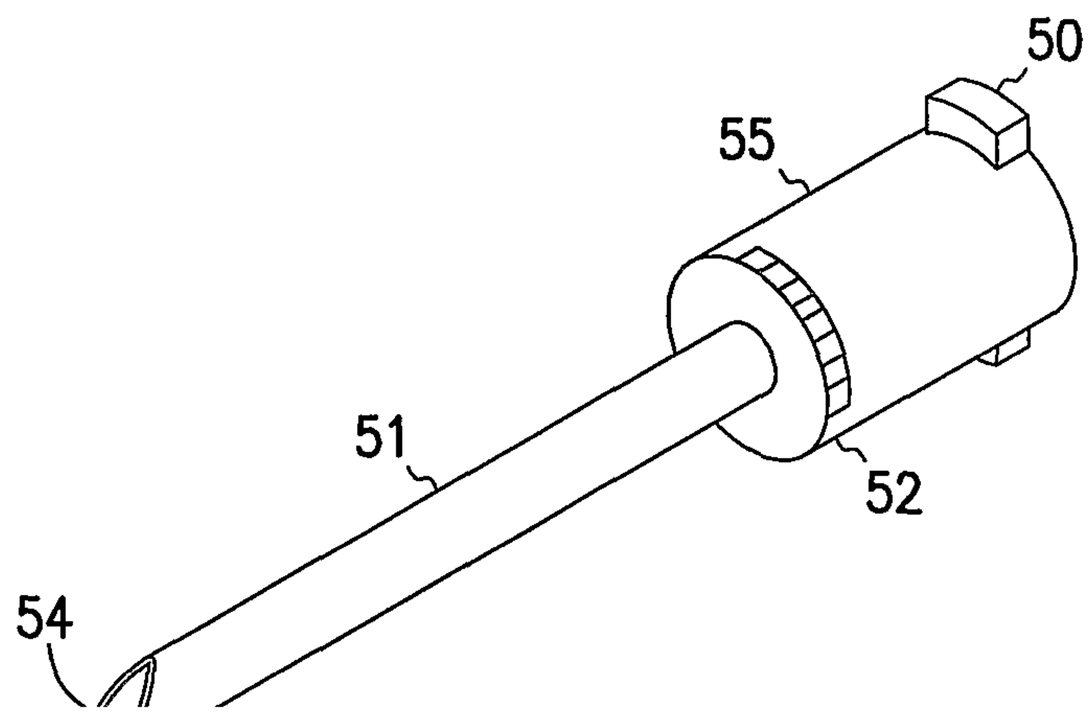


FIG. 10



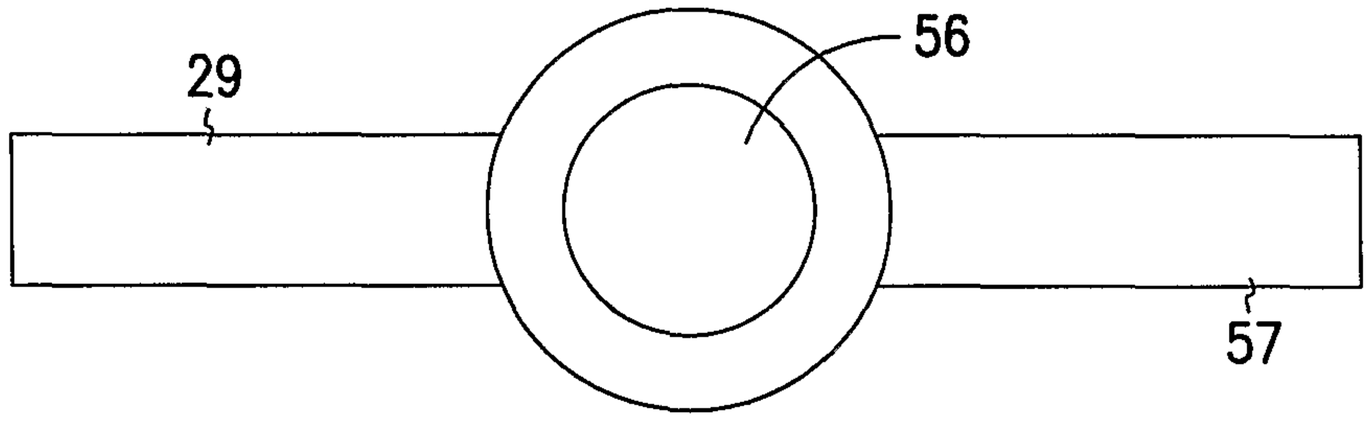


FIG. 12A

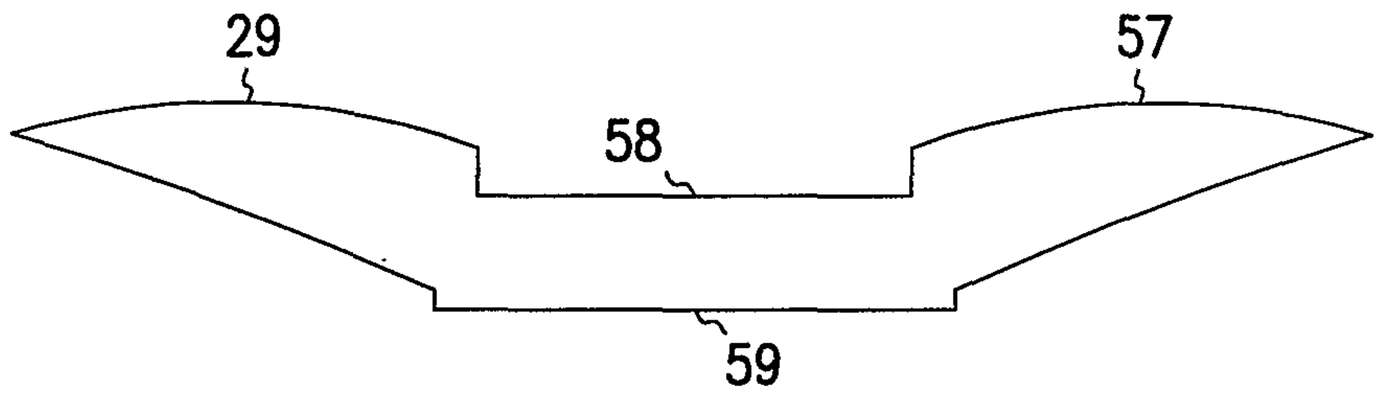


FIG. 12B

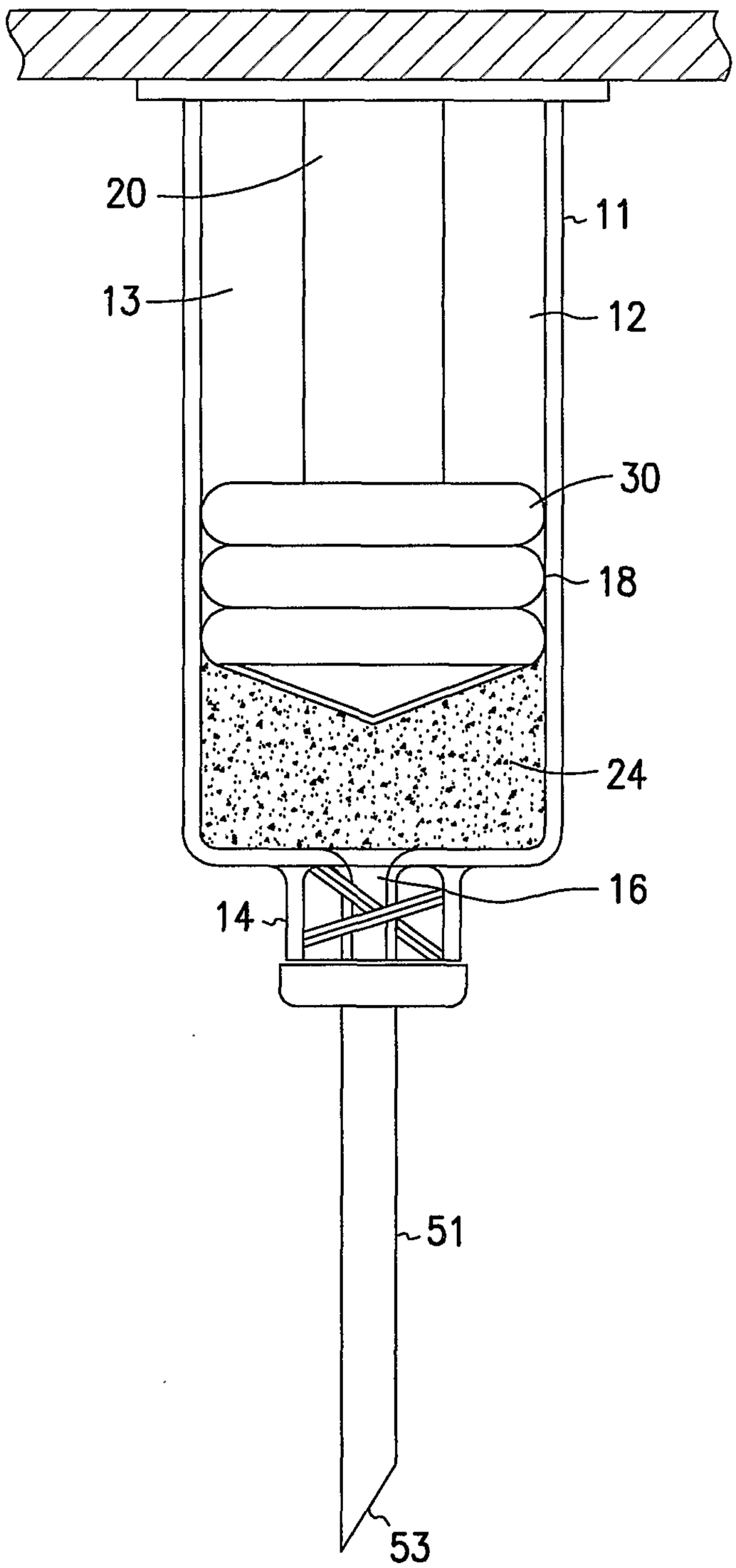


FIG. 13

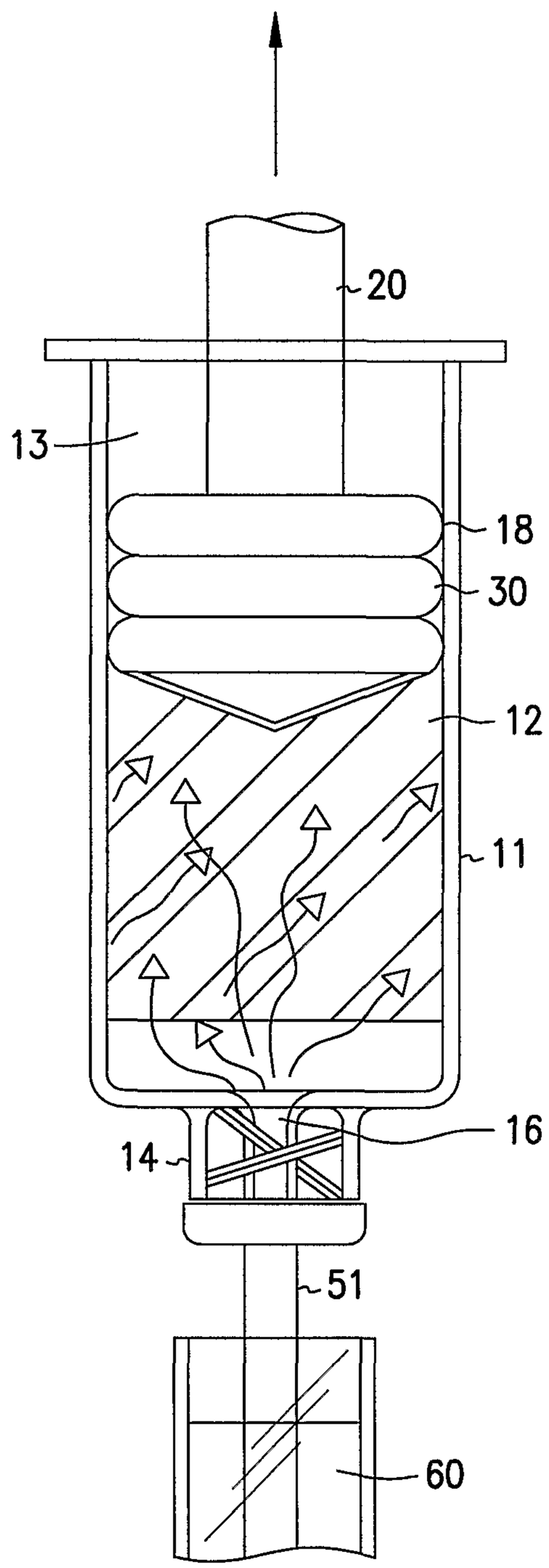
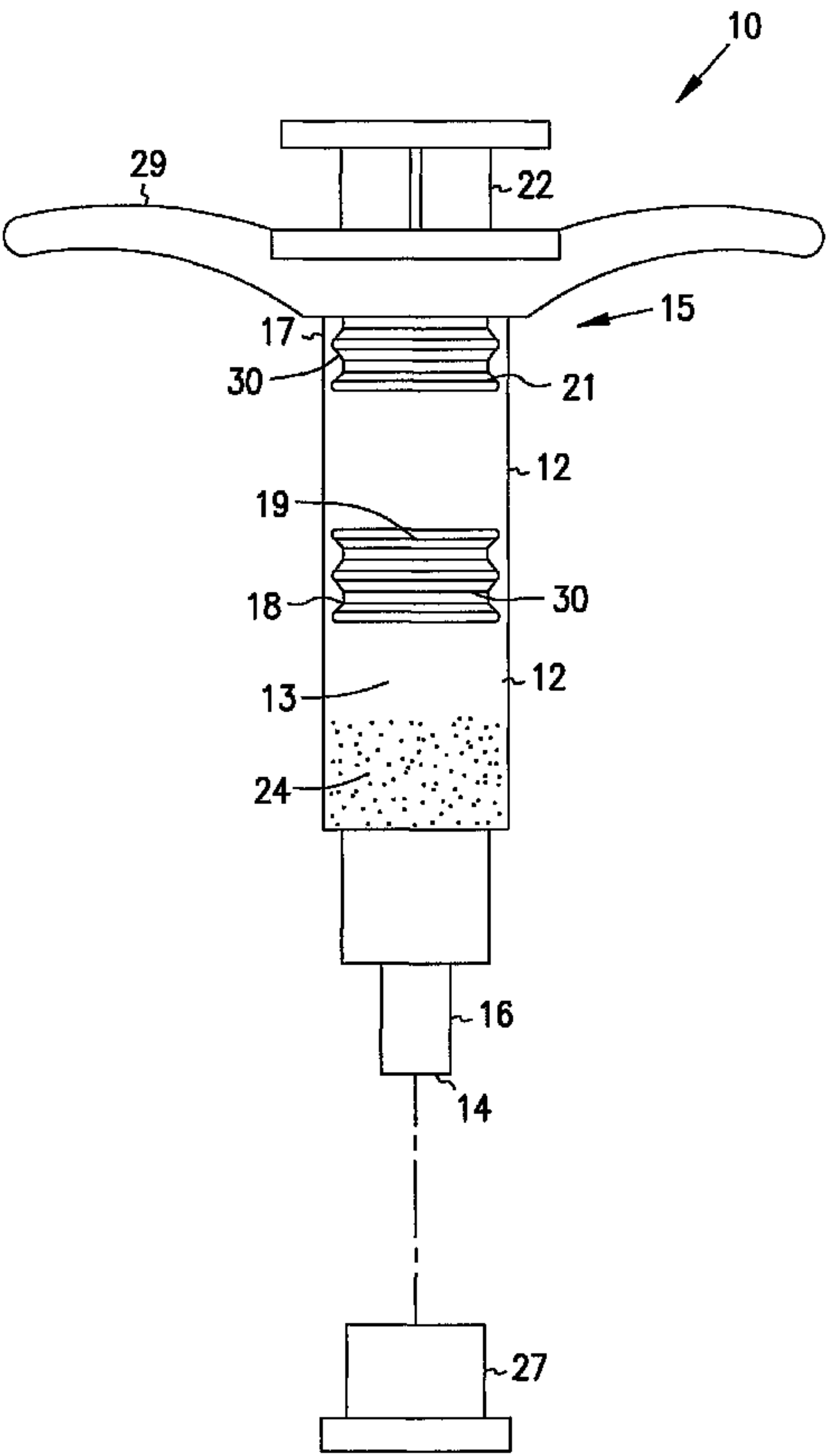


FIG. 14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