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(54) Title: SYRINGE FOR MIXING TWO COMPONENTS AND FOR RETAINING A VACUUM IN A STORAGE CONDITION

(57) Abrégé/Abstract:
The present disclosure relates to a syringe for mixing two substances which have been retained separately inside the syringe, for instance in a storage condition.In particular the present disclosure relates to a syringe for 1) retaining a dry composition in a vacuum, and 2)mixing the dry composition with an aqueous medium to form a flowable substance. One embodiment relates to a syringe for retaining and mixing first and second substances comprising: a barrel comprising a sealable and/or closable distal outlet and a vacuum chamber for holding a first substance, a plunger incorporating a reservoir chamber for holding a second substance and configured to be axially displaced through a proximal end of the barrel, a membrane separating the vacuum chamber and the reservoir chamber, and a pointed member, such as one or more needles, for penetrating the membrane.

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(54) **Title**: SYRINGE FOR MIXING TWO COMPONENTS AND FOR RETAINING A VACUUM IN A STORAGE CONDITION

(57) **Abstract**: The present disclosure relates to a syringe for mixing two substances which have been retained separately inside the syringe, for instance in a storage condition.In particular the present disclosure relates to a syringe for 1) retaining a dry composition in a vacuum, and 2)mixing the dry composition with an aqueous medium to form a flowable substance. One embodiment relates to a syringe for retaining and mixing first and second substances comprising: a barrel comprising a sealable and/or closable distal outlet and a vacuum chamber for holding a first substance, a plunger incorporating a reservoir chamber for holding a second substance and configured to be axially displaced through a proximal end of the barrel, a membrane separating the vacuum chamber and the reservoir chamber, and a pointed member, such as one or more needles, for penetrating the membrane.

SYRINGE FOR MIXING TWO COMPONENTS AND FOR RETAINING A VACUUM IN A STORAGE CONDITION

Field of invention

The present disclosure relates to a syringe for mixing two substances which have been retained separately inside the syringe, for instance in a storage condition. In particular the present disclosure relates to a syringe for 1) retaining a dry composition in a vacuum, and 2) mixing the dry composition with an aqueous medium to form a flowable substance.

Background of invention

Mixing procedures and manipulations of different substances can be time consuming. Some types of medication are provided and stored in two separate chambers. Such medication may include a solid component and a liquid solvent and are known as two-part formulations. The solid component can be for example a powdered medicament. The substances can also include two liquid substances and/or two medicaments. Before the medicament is delivered, the components have to be mixed.

A syringe can generally be seen as a simple pump device consisting of a plunger in a tube, used to administer injections, insert intravenous drugs or apply compounds. There are a number of syringes capable of mixing and delivering two substances, including autoinjectors. In some of these syringes there are two chambers and a mechanism for mixing the substances either in one of the chambers or in a third chamber, before the mix is delivered, typically through a needle.

US 4,048,999 shows a two-chamber syringe for medicinal purposes having one chamber for a liquid and one container for a solid or another liquid. The syringe has a stopper with an axial bore connecting the syringe to a vial and a second stopper sealing the axial bore and adapted to be ejected with the liquid in the syringe into the container by inward activation of the piston of the syringe.

It can be considered to be known in the art to include an inner needle in the syringe capable of transferring one component from one chamber to the other, thereby mixing the components. WO 2010/020800 A1 shows an autoinjector with mixing means, having a first and a second chamber for two different components. The autoinjector comprises both an injection needle and an internal transfer needle, wherein the transfer

needle is capable of penetrating the stopper inside the autoinjector to establish fluid connection through the needle and mix the two components before they are injected.

The known syringes with several chambers and means for mixing several components are associated with a number of disadvantages. The mixing and injection are typically dependent on a manual movement lacking precise control or uses electrical power to control the mixing and injection. These designs are often overly complex and require precise finishing in order to work.

Summary of invention

The present disclosure relates to a syringe for retaining and mixing first and second substances comprising a barrel comprising a sealable and/or closable distal outlet and a vacuum chamber for holding a first substance. The syringe preferably comprises a plunger, said plunger preferably incorporating a reservoir chamber for holding a second substance. The plunger may be configured to be axially displaced through a proximal end of the barrel. The syringe preferably comprises a membrane separating the vacuum chamber and the reservoir chamber. A pointed member, such as one or more needles, may be provided as part of the syringe suitable for penetrating the membrane. The syringe is preferably configured such that the membrane and the pointed member are axially slidable in relation to each other, preferably in correspondence with an axial displacement of the barrel relative to the plunger. I.e. the syringe is preferably configured such that an axial displacement of the plunger relative to the barrel corresponds to an axial displacement of the membrane and the pointed member relative to each other. For example if the membrane is attached to the plunger and the pointed member is attached to the barrel or vice versa.

The syringe may be configured such that an axial displacement of the plunger from a first position to a predefined second position in the barrel penetrates the membrane by the pointed member and establishes a fluid passageway between the reservoir chamber and the vacuum chamber. Preferably the vacuum in the vacuum chamber thereby aspirates the second substance into the vacuum chamber; the vacuum in the vacuum chamber thereby causing a transfer of the content of the reservoir chamber into the vacuum chamber, preferably without displacement of the plunger from said predefined second position. I.e. the reservoir chamber is thereby emptied or nearly emptied.

One advantage of the presently disclosed syringe is that a reservoir chamber is incorporated in the plunger for holding the second substance. Using the space inside the plunger to store one of the components makes the syringe more compact and lighter. The fact that the plunger is the movable part of the syringe (in relation to the barrel) can also render the design simple in that it is possible to mount the pointed member on the barrel, which is generally more stable than having the needle as a moving part.

Another advantage of the presently disclosed syringe is the vacuum chamber in the barrel for holding a first substance. If vacuum is created in the vacuum chamber, the vacuum may be utilized to move the plunger towards / inside the vacuum chamber and to aspirate the second substance from the reservoir chamber to the vacuum chamber. By first applying vacuum in the vacuum chamber and then letting the vacuum 1) pull the plunger, and 2) draw the content of the reservoir chamber into the vacuum chamber whereby the substances are mixed, the mixing process can be provided in a very controlled and automatic manner without involving manual force or manual movement of the plunger. If the parts of the plunger are produced in a process in which the parts always have the same size and shape, and the vacuum generation is applied in the same way, it can also be expected that the mixing will be performed in the same way every time.

The pointed member suitable for penetrating the membrane, wherein the syringe is configured such that the membrane and the pointed member are axially slidable in relation to each other, is another advantage of the presently disclosed syringe. If the needled is attached to the barrel and axially slidable in relation to the pointed member (which may be part of the plunger, constituting a separating barrier between the two chambers), the vacuum in the vacuum chamber may be used to move the plunger towards the vacuum chamber, the pointed member thereby penetrating the member and providing a fluid connection between the two chambers.

The combination of several of the abovementioned features can also be considered to further improve the design, which can be used with a range of additional mechanisms in order to make use of the invention. For example, the syringe may further comprise different kind of locking members to control the axial positions of the plunger inside the barrel. If vacuum is applied inside the vacuum chamber a mechanical locking

mechanism can ensure that the plunger is not moved towards the vacuum chamber until the user removes the lock.

Furthermore, an axially slidable plug inside the plunger can be used to limit the reservoir chamber in the plunger. The syringe can be configured such that the plug slides distally inside the plunger when the substance in the reservoir chamber is transferred to the vacuum chamber. The plug can furthermore be used to plug the fluid connection between the two chambers when the substance of the reservoir of the first chamber has been transferred to the vacuum chamber. Preferably the plug is made of a material that can also be penetrated by the pointed member. Since, in one embodiment, the pointed member protrudes through the membrane after having penetrated the membrane, in a preferred embodiment the plug is made of a material that can also be penetrated by the pointed member, which allows that the plug is aspirated by the vacuum of the vacuum chamber to a position in which it abuts the distal end of the plunger or the member.

These and other aspects of the invention are set forth in the following detailed description if the invention.

Description of drawings

Fig. 1A shows a cross-sectional illustration of one embodiment of the presently disclosed syringe with first and second locking elements, retaining vacuum in the vacuum chamber in a first configuration.

Fig. 1B shows the syringe of fig. 1A where the first locking element has been removed and the aspiration force by the vacuum in the vacuum chamber has moved the plunger to a position in which a second substance in the reservoir chamber is transferred to the vacuum chamber through an axial separation section between the pointed member and the membrane. A second locking element prevents the plunger form moving further towards the vacuum chamber.

Fig. 1C shows the syringe of fig. 1A-B where the vacuum in the vacuum chamber has emptied the reservoir chamber and moved the plug to abut the membrane. The second locking element still prevents the plunger from moving further towards the vacuum chamber.

Fig. 1D shows the syringe of fig. 1A-C where the second locking element has been removed. The plug abuts the membrane. In this configuration the plunger can be pushed downwards to deliver the mixed content in the vacuum chamber through the outlet of the syringe.

Fig. 1E shows the syringe of fig. 1A-D where the plunger and plug has been pushed downwards towards the vacuum chamber to empty the content of the vacuum chamber. The plug has been penetrated by the pointed member in this position.

Fig. 1F shows the syringe of fig. 1A-E in the position where all the content of the vacuum chamber has been emptied by pushing the plunger to a final position.

Fig. 2 shows the proximal end of one embodiment of the presently disclosed syringe with a locking element engaging the plunger, a vacuum bypass channels, and a longitudinal protrusions adapted to match the vacuum bypass channel.

Fig. 3A shows an illustration of an exemplary plunger of the presently disclosed syringe.

Fig. 3B shows a cross-sectional illustration of the plunger in fig. 3A.

The drawings are exemplary only and should not be construed as limiting the scope of the invention.

Definitions

“Ambient pressure” is herein used interchangeably with the term “atmospheric pressure”. It is the pressure in the surrounding area, i.e. the pressure in the location in which a process takes place.

A “reduced pressure” is a pressure below ambient pressure, i.e. a pressure below that of the pressure in the surrounding area in which a certain process operates.

“Vacuum” is herein defined as a region with a gaseous pressure less than the ambient pressure, i.e. the surrounding atmospheric pressure. At sea level on Earth the atmospheric pressure is approximately 1 bar, i.e. 1000 mbar at 25°C. The below table

shows the approximate pressures in “low”, “medium” and “high” vacuum at sea level on earth in millibar (mbar).

	pressure (mbar)
Atmospheric pressure	1000
Low vacuum	1000 to 100
Medium vacuum	100 to 0.001
High vacuum	<0.001

Detailed description of the invention

As stated the present disclosure relates to a syringe for retaining and mixing first and second substances comprising a barrel comprising a sealable and/or closable distal outlet and a vacuum chamber for holding a first substance, a plunger incorporating a reservoir chamber for holding a second substance and configured to be axially displaced through a proximal end of the barrel, a membrane separating the vacuum chamber and the reservoir chamber, and a pointed member, such as one or more needles, for penetrating the membrane, wherein the syringe is configured such that the membrane and the pointed member are axially slidable in relation to each other.

By incorporating the plunger in the reservoir chamber, the syringe can be made more compact and lighter compared to a solution in which the barrel contains two chambers for separates substances. In one embodiment the reservoir chamber is completely contained in the plunger, and/or wherein the reservoir chamber is at least partly defined by outer walls of the plunger. Preferably the reservoir chamber is a closed volume within the walls of the plunger, possible having a lid or cap, alternatively having a plug inside the hollow plunger. In one embodiment the reservoir chamber is defined by a hollow portion of the plunger.

The syringe is preferably configured such that the membrane and the pointed member are axially slidable in relation to each other. The idea is that a membrane keeps the two substances in separate containers (i.e. reservoir chamber and vacuum chamber), initially without a fluid connection between the two. The fact that the membrane and the pointed member are axially slidable in relation to each other implies that the pointed member can penetrate and break the membrane when they meet if the pointed member is configured such that the pointed end of the pointed member points towards

the membrane. Preferably, in such a design the pointed member is attached inside the barrel, preferably attached at the distal end of the barrel pointing towards the plunger and the membrane. This can be seen as a stable solution compared to having a needle that is moved inside the barrel.

Configurations and locking mechanism

The presently disclosed syringe may operate in one or several configurations. In one embodiment the syringe may be configured to retain vacuum in the vacuum chamber in a first configuration, said first configuration preferably being a storage condition of the syringe. In such a configuration the vacuum chamber is a closed container. Such a configuration may be useful not only to store the substance in the vacuum chamber, but can also be considered a “charged” state in that there is in an inherent energy in a vacuum chamber. When a vacuum chamber changes from a closed container to being in connection with another volume, an aspiration force arises. Therefore, if the syringe is configured to retain vacuum in the vacuum chamber in a first configuration, this force could then be released by connecting the vacuum chamber to the reservoir chamber. In the first configuration, the syringe can be said to be in a state with inherent energy that could later be used to mix the substances of the two chambers, preferably without adding any external manual force to move the plunger.

In the first configuration, the membrane and pointed member are preferably axially separated inside the barrel. This ensures that the vacuum chamber remains a closed volume, retaining the vacuum, until the pointed member penetrates the membrane.

In one embodiment, the syringe is, in a second configuration, configured to provide a liquid communication between the vacuum chamber and the reservoir chamber. Preferably, in this configuration the pointed member penetrates the membrane. The pointed member can be said to create the liquid communication between the two chambers. If vacuum has been applied to the vacuum chamber in the first configuration, the second configuration may then serve as a configuration in which the two substances are mixed in the vacuum chamber. This is achieved by the aspirating force from the vacuum chamber in combination with that fact that the two chambers now are in liquid communication. According to this description, the reservoir chamber and the vacuum chamber may therefore be fluidly disconnected in a first configuration, and fluidly connected in a second configuration.

The presently disclosure also relates to mechanical means for implementing the abovementioned configurations. In the first configuration, the membrane and pointed member are preferably axially separated inside the barrel while vacuum is retained in the vacuum chamber. As stated, in the vacuum state there is an inherent force that pulls the (typically axially movable) plunger towards the vacuum chamber. The displacement of the plunger can be prevented mechanically by a locking mechanism; therefore, in one embodiment, the presently disclosed syringe further comprises a removable locking member configured to engage and restrict the plunger from distal axial displacement inside the barrel. There are several ways of implementing such a locking mechanism. In one embodiment, the locking member is configured to engage the proximal part of the plunger extending from the proximal end of the barrel. An example of such a solution is shown in fig. 1A. In this example, first locking element 9 abuts the plunger flange 11 and prevents the plunger from moving towards the vacuum chamber. In one embodiment, the first position is determined by the first and second locking elements engaging the plunger in combination, and wherein the second position is determined by only the second locking element engaging the plunger. In the mentioned example (figs. 1A and 1B), the first locking element is indirectly locked by the upper side of the barrel flange 12 (having a second locking element 10 in between the first locking element 9 and the barrel flange 12). The example shall not be seen as restricting the first locking element to this solution – other mechanical locking solutions of a removable locking member to restrict the plunger from distal axial displacement inside the barrel can be imagined. Therefore, in another embodiment, the locking member is configured to engage and restrict the plunger from distal axial displacement inside the barrel in two different axial positions of the plunger relative to the barrel.

In one embodiment of the presently disclosed syringe, the locking member comprises a first locking element and a second locking element, each of said locking elements configured to engage and restrict the plunger from distal axial displacement inside the barrel. The two locking elements may be placed such that the first and second locking elements are configured to engage the plunger in axial extension of each other. The second locking element can be used to lock the plunger in a second position in relation to the barrel (and possibly the pointed member). In this state the two substances can be mixed in the vacuum chamber, but the plunger is mechanically prevented from being further moved towards the distal end of the barrel to deliver the mixed content. Therefore, in one configuration of the presently disclosed syringe, the axial displacement of the plunger from a first position to a predefined second position

penetrates the membrane by the pointed member and establishes a fluid passageway between the reservoir chamber and the vacuum chamber. Examples of the two configurations are shown in fig 1A and b respectively. In one embodiment the first configuration corresponds to a first axial position of the plunger (figs. 1A, first and second locking element present) in the barrel and the second configuration corresponds to a second axial position of the plunger in the barrel (fig. 1B, first locking element removed, second locking element present). As stated, and as can be seen in the example in figs 1A and 1B, in one embodiment the syringe is configured such that the plunger is locked in a first configuration, and, in one embodiment the syringe is configured such that the plunger is locked in said second configuration.

In one embodiment, the presently disclosed syringe is configured such that the plunger is restricted from axial displacement in a distal direction in said first configuration, preferably by means of the removable first and second locking elements for engaging and locking the plunger in said first configuration. Distal direction in this context has the meaning that the plunger moves towards the distal end of the barrel. As stated this means, in a preferred embodiment, that the plunger is locked in the distal direction such that the pointed member does not penetrate the membrane and the substance cannot be mixed. When the plunger is unlocked (e.g. by removing the locking member), a vacuum in the vacuum chamber causes an axial displacement of the plunger from a first position to a second position. Similarly, in the second configuration, the plunger may be restricted from axial displacement in a distal direction, preferably by means of the removable second locking element adapted for engaging and locking the plunger in said second configuration.

A further aspect of the presently disclosed syringe relates to the pointed member comprising one or more liquid bypass channels configured to provide liquid communication between the reservoir chamber and the vacuum chamber upon penetration of the membrane, which is further explained below. In relation to the configuration and/or position of the parts of the syringe, the presently disclosed invention presents a solution of how to provide a liquid path between the two chambers upon penetration of the membrane by the pointed member. The inventors have realized that by locking the membrane (preferably located at the distal end of the plunger) in an axial direction in relation to the pointed member, the bypass channel can be positioned such that it allows substance to flow from the reservoir chamber to the vacuum chamber. Therefore, in one embodiment, the syringe is configured such that in

the second configuration and/or second position the at least one of said one or more bypass channels are axially aligned with the membrane. An example of such an alignment can be seen in fig. 1B, in which the bypass channel 15 (small recess or groove in the pointed member) is axially aligned with the membrane 7, such that substance can flow from the reservoir chamber 6 to the vacuum chamber 4.

Membrane and pointed member

As stated, the presently disclosed syringe has a membrane separating the vacuum chamber and the reservoir chamber, and a pointed member, such as one or more needles, for penetrating the membrane. In a preferred embodiment, the membrane separates a proximal end of the vacuum chamber and a distal end of the reservoir chamber. In one embodiment, the membrane is attached to and/or forms the distal end of the plunger. If the plunger has a hollow body or hollow portion, this means that the membrane constitutes a portion or the whole of the bottom/distal side of the plunger. An example of such an implementation is shown in figs 1A-F. A plunger of a syringe may be cylindrical having a rounded end (like a test tube) or a substantially flat distal end, wherein the distal end is substantially circular in the case of a cylindrical shape of the plunger. Therefore, in one embodiment, a part of the distal end may be replaced by a material that can be penetrated by the pointed member. Preferably, the plunger is made of a hard material, such as plastic, and the membrane is made of a soft/softer material, e.g. rubber like material. The idea of this embodiment is that the pointed member should penetrate the membrane upon a distal displacement of the plunger inside the barrel. In this regard the plunger (including the membrane) can be considered to be the moving part of the design, whereas the barrel can be considered to be the fixed part. The syringe preferably comprises a sealed engagement between the plunger and barrel, e.g. in the form of a rubber seal in a distal end of the plunger, also helping to retain a vacuum in the vacuum chamber in the first configuration of the presently disclosed syringe. As illustrated in fig. 3 the membrane 7 can be attached to the distal end of the plunger 5 via annular protrusion 19. The membrane 7 comprises the penetratable membrane barrier 7' and a sealing flange 20 providing a sealed engagement with the barrel 2.

In one embodiment the pointed member is attached inside the barrel, preferably attached at the distal end of the barrel. In this configuration, the pointed member and the membrane can move in relation to each other. The pointed member preferably extends axially inside the barrel, i.e. in the longitudinal direction of the barrel. In the

example in fig 1A it can be seen how the pointed member is attached to the distal end of the barrel, extending axially inside the barrel from the distal end of the barrel and pointing towards the proximal end of the barrel.

As stated, the idea of having a pointed member that can penetrate the membrane between the reservoir chamber and the vacuum chamber is to provide a bypass channel that makes use of the vacuum of the vacuum chamber to aspirate substance from the reservoir chamber to mix with the substance of the vacuum chamber. Therefore, in one embodiment of the presently disclosed syringe, the pointed member comprises one or more liquid bypass channels configured to provide liquid communication between the reservoir chamber and the vacuum chamber upon penetration of the membrane. The liquid bypass channel could be in the form of a hollow needle. The liquid bypass channel could also make use of the locking mechanism and second configuration described above. The inventors have realized that if the second configuration corresponds to a second locked axial position of the plunger in the barrel, this known position can be used to design the liquid bypass channel. As can be seen in e.g. fig. 1B, a locking mechanism ensures that the pointed member and the member have a predefined locked position in relation to each other. In this configuration the liquid communication between the reservoir chamber and the vacuum chamber is provided for predefined axial position of the plunger, preferably only for said predefined axial position. In fig. 1B the bypass channel 15 is axially aligned with the membrane, thereby providing a liquid path between the reservoir chamber and the vacuum chamber through small recesses of the pointed member. Since the pointed member is radially thinner in level with the recesses, and a radically thicker part has penetrated the membrane to reach this locked position, the membrane can be considered to have an opening that is larger than the cross-section of the pointed member in level with the recesses, thereby providing a liquid bypass channel between the two chambers. A further advantage of the liquid bypass channel formed as a recess as exemplified in the drawings is that the liquid (and fluid) communication is only established in one predefined axial position of the plunger relative to the barrel. If the plunger is moved further distally inside the plunger, as illustrated in figs. 1E and 1F, the liquid (and fluid) communication between the reservoir chamber and the vacuum chamber is closed again if the membrane and the pointed member are configured to provide a fluid and/or liquid tight engagement when the membrane is penetrated by the pointed member but the membrane is separated from the liquid bypass channel. Hence, the presently disclosed syringe may be configured such that the membrane and

the pointed member form a sealed engagement when the pointed member penetrates the membrane and the membrane is axially separated from said one or more liquid bypass channels.

"Pointed" in relation to the presently disclosed syringe should be construed broadly in the sense that it could be any pointed structure capable of penetrating or breaking the membrane, typically a structure having a sharp top, such as a needle. In one embodiment, the pointed member is formed as an elongated pointed element wherein one end of the pointed element, preferably the proximal end, is pointed, such as pointed like a needle. Proximal is defined in the same way as proximal of the plunger and the barrel, i.e. opposite to distal i.e. opposite to the outlet and outer needle of the syringe.

In one embodiment, the liquid bypass channels are located adjacent to the proximal end of the pointed member. This has the advantage that the rest of the pointed member (i.e. below the bypass channel towards the distal part of the vacuum chamber) can be maintained as a mixing container in the locked second position. In one embodiment, one or more liquid bypass channels are formed as one or more recesses, such as one or more radial recesses, of the pointed member located distal from the proximal part of the pointed element. The liquid bypass channels, formed as one or more recesses, may be placed less than 1 mm, or less than 2 mm, or less than 3 mm, or less than 4 mm, or less than 5 mm, or less than 6 mm, or less than 7 mm, or less than 8 mm, or less than 10 mm, or less than 12 mm, or less than 14 mm, or less than 16 mm, or less than 18 mm, or less than 20 mm from the proximal end of the pointed member.

Plug

In a further embodiment of the presently disclosed invention, the syringe further comprises an axially slidable plug inside the plunger, preferably sealably engaged with the inside of the plunger which may be hollow, such that the reservoir chamber can be defined (proximally) by the plug inside the hollow plunger. This means that the plug can constitute a proximate sidewall of the closed reservoir chamber – the reservoir chamber is preferably located in the distal end of the plunger and defined distally by the distal end of the plunger and proximally by the axially slidable plug. Preferably, the plug is axially slidable inside the plunger, and can be used to plug the fluid connection between the two chambers when the substance of the reservoir of the first chamber

has been transferred to the vacuum chamber. Since the plug defines a proximate sidewall of the reservoir, the reservoir chamber can alternatively be seen as an empty or nearly empty volume when the plug has been aspirated to a distal position abutting the distal end of the plunger or the member. In this position the content of the reservoir chamber has been transferred to the vacuum chamber.

Since, in one embodiment, the pointed member protrudes through the membrane after having penetrated the membrane, in a preferred embodiment the plug is made of a material that can also be penetrated by the pointed member, which allows that the plug is aspirated by the vacuum of the vacuum chamber to a position in which it abuts the distal end of the plunger or the member.

In a preferred embodiment, the plug is placed inside the plunger, and in an even more preferred embodiment, the plug is completely contained within the hollow body of the plunger. If the plunger is cylindrical, i.e. having a substantially circular cross-section, the plug should also have a substantially similar cross-section in order to seal the reservoir chamber. In this kind of embodiment, the plug can be considered to be recessed within the hollow body of the plunger. Preferably, the axially slidable plug is suitable for being penetrated by the pointed member, preferably only by means of the aspiration force exerted by the vacuum in the vacuum chamber.

When the discharge/transfer of substance from the reservoir chamber to the vacuum chamber takes place, the plug is typically aspirated towards the distal end of the plunger. Therefore, in one configuration of the presently disclosed syringe, upon penetration of the membrane and provision of a liquid communication between the vacuum chamber and the reservoir chamber, a vacuum in the vacuum chamber draws liquid contained in the reservoir chamber into the vacuum chamber along with an axial distal displacement of the plug within the hollow body. Furthermore, in such a configuration, the plug is configured to be axially displaced distally within the hollow body of the plunger during discharge / flushing of the second substance in the reservoir chamber into the vacuum chamber.

Other embodiments of the plug are also possible. The plug can be made of an expandable or elastic material, or, alternatively, the plug can be formed as a second small plunger adapted to fit and be recessed within the hollow plunger. Besides the advantage that plungers have proved to work for the purpose of keeping an inner

volume sealed and push the volume to deliver it through a needle or other liquid connection, it opens the possibility for having a third chamber (i.e. a second separate reservoir) in the second plunger and mix more than two substances.

Vacuum bypass channel

As stated, the presently disclosed invention relates to a syringe including a vacuum chamber for holding a first substance. There are several ways of achieving vacuum in a closed volume (chamber). One embodiment of the presently disclosed syringe further comprising one or more vacuum bypass channels located in the barrel and/or in the plunger and configured such that the plunger sealably engages the vacuum chamber in at least a first axial position of the plunger inside the vacuum chamber, i.e. the state where a vacuum is retained, and such that fluid communication is established across the plunger in at least a second axial position of the plunger inside the vacuum chamber via said one or more vacuum bypass channels. Thus, the vacuum bypass channel(s) may be configured to break the sealing between the vacuum chamber and the plunger at a predefined axial position of the plunger inside the vacuum chamber. This may for example be provided if said one or more vacuum bypass channels 16 are one or more longitudinal grooves 17 formed in the inner surface of the proximal end of the vacuum chamber as illustrated in fig. 2. Alternatively the one or more vacuum bypass channels may be formed in the plunger. One or more vacuum bypass channels are configured such that a fluid communication can be provided directly between the vacuum chamber and the ambient atmosphere independent of the position of the plunger, e.g. via a pressure valve located directly at the vacuum chamber.

Substances

The presently disclosed syringe works for a number of different substances in the two chambers. Some types of medication are provided and stored in two separate chambers, and are mixed before use. Such medication may include a solid component and a liquid solvent and are known as two-part formulations. The solid component can be for example a powdered medicament. In one embodiment of the syringe, the chambers are prefilled with first and second substances, wherein the first substance is a dry composition, and wherein the second substance is an aqueous medium. Preferably, the dry composition is placed in the vacuum chamber and the aqueous medium in the reservoir chamber. Similarly, the syringe may be prefilled with first and second substances, wherein the first substance is a dry component of a medicament and wherein the second substance is an aqueous medium in a wet component of said

medicament. The presently disclosed syringe is also suitable for being used with a lyophilized substance, such as a lyophilized drug, as the first substance.

Other barrel and plunger related aspects

The barrel preferably comprises an outlet for disposing the mixed final product. This outlet is preferably closable and/or sealable in order to retain the vacuum in the vacuum chamber. The outlet may e.g. be a Luer type outlet and it is advantageously located at the distal end of the barrel. The outlet may further be formed as a connector portion suitable for connecting with another mating connector, e.g. suitable for connecting a hose to the syringe. The connector portion may be a connector portion of a standard type, such as a Luer lock or Luer slip connector, preferably a male Luer lock or Luer slip connector. The connector portion may be provided with a threaded portion for secure connection with matching connector. This threaded portion may be provided at the inside of the connector portion.

Preferably, the barrel has an open proximal end, wherein the plunger extends through the proximal end, which can be considered to be a standard solution for a syringe. Typically the syringe is configured such that the plunger can be axially displaced through an open proximal end of the barrel.

The volume capacity presently disclosed syringe is scalable by shaping and scaling the barrel and the plunger. The volume of the vacuum chamber and the reservoir chamber can then be selected within the limits of the barrel and the plunger. The volume of the barrel and/or the volume of the vacuum chamber may be between 0.1 and 500 mL, more preferred between 1 and 100 mL, more preferred between 2 and 50 mL, more preferred between 3 and 30 mL, more preferred less than 25 mL, more preferred less than 20 mL, more preferred less than 15 mL, more preferred less than 10 mL, most preferred between 5 and 10 mL.

Correspondingly the volume of the hollow body of the plunger and/or the volume of the reservoir chamber is between 0.1 and 500 mL, more preferred between 1 and 100 mL, more preferred between 2 and 50 mL, more preferred between 3 and 30 mL, more preferred less than 25 mL, more preferred less than 20 mL, more preferred less than 15 mL, more preferred less than 10 mL, most preferred between 5 and 10 mL.

The presently disclosed syringe is preferably a single-use disposable syringe. The

different components of the syringe (barrel, plunger, plug, valve, valve part, etc.) are preferably suitable for manufacture by means of single cycle injection molding.

Examples

One embodiment of the presently disclosed syringe 1 is exemplified in figs. 1A-1F. The barrel 2 is provided with a vacuum chamber 4, an outlet 3, an outer needle 14 and a barrel flange 12. The plunger 5 has a reservoir chamber 6 and a plunger flange 11. The membrane 7 forms the distal end of the plunger 5. Inside the barrel 2 there is a pointed member 8 attached at the distal end of the barrel 2, the pointed member 8 having a bypass channel 15. The syringe further comprises an (axially slidable) plug 13 inside the plunger 5, sealably engaged with the inside of the plunger 5. The syringe also comprises first and second locking elements 9 and 10, respectively, to lock the positions of the plunger 5 and barrel 2) in relation to each other (i.e. also the positions between the membrane and the pointed member in relation to each other).

Figs 1A-F can be said to show a process in which the syringe goes from a preloaded state having two substances separated in the vacuum chamber 4 and the reservoir chamber 6, through a state where the substances are mixed, and finally the mixed substance delivered.

In fig. 1A the syringe 1 is locked in a first configuration. In this configuration a vacuum generator can be connected to the vacuum chamber 4 and vacuum created, thereby building up inherent energy of the syringe and a vacuum force pulling the plunger 5 towards the vacuum chamber 4. However, the first and second locking element 9 and 10 prevent the plunger from moving.

In fig. 1B the first locking element 9 has been removed and, as a consequence, the plunger has been pulled by the vacuum force to a second position, where it is blocked from further moving by the second locking element 10. The pointed member 8 has penetrated the membrane 7 and the first substance can start to flow from the reservoir chamber 6 to the vacuum chamber 4 through the bypass channel 15, which is axially aligned with the (penetrated) membrane 7.

In fig. 1C the content (substance) of the reservoir chamber 6 has been transferred to the vacuum chamber 4, where the two substances have been mixed. The plug 13 has also been pulled by the vacuum force to abut the distal end of the plunger 5.

In fig. 1D the second locking element 10 has been removed, enabling the possibility to push the plunger 5 further towards the vacuum chamber 4 to eject the mixed content through the outlet 3 and outer needle 14.

In fig. 1E the plunger 5 has been pushed (or further pulled by the vacuum force) further towards the vacuum chamber 4. Finally, in fig. 1F the mixed content has been ejected/delivered by pushing plunger 5 in the distal direction to a final position.

Fig. 2 shows the proximal part of the syringe 1 where a first locking element 9 is snap fitted to the proximal end of the plunger 5 restricting that the plunger 5 can be moved in a distal direction into the barrel 2. The barrel 2 comprises vacuum bypass channel 16. The first locking element 9 is provided with longitudinal protrusion 17 adapted to match the vacuum bypass channel 16 in the barrel 2. The first locking element 9 is a rigid plastic element that grabs the proximal part of the plunger 5 and the rigidity and the extension of the locking element 9 locks the plunger 5 in an axial position relative to the barrel 2 defined by the length of the locking element 9. The locking element 9 does not prevent the plunger 5 from moving in a proximal direction out of the barrel 2. However, when a vacuum is retained in the vacuum chamber, the lower pressure of the vacuum will draw the plunger 5 towards the vacuum chamber. I.e. the syringe is configured such that the plunger 5 can be locked in the barrel 2, i.e. restricted from longitudinal / axial movement in both the proximal and distal direction. The longitudinal protrusion 17 in the locking element 9 is adapted to match the vacuum bypass channels 16 in the barrel 2 to provide a rotational lock of the locking element 9 in this locked configuration helping to ensure that the syringe 1 cannot be easily tampered with in the locked configuration.

Figs. 3A and 3B show illustrations of an exemplary plunger 5 of the presently disclosed syringe. The plunger 5 comprises a plunger flange 11 and a reservoir chamber 6 which is defined by the slidable plug 13 (not shown in fig. 3). The membrane 7 is attached to the distal end of the plunger 5. The membrane 7 comprises an annular protrusion 20 such that the plunger engages sealingly with the inside of the barrel 2. The membrane 7 further comprises a thin membrane barrier 7' that can be penetrated by the pointed member 8. The membrane is attached to the plunger by engagement with the circular protrusion 19. The plunger further comprises longitudinal

protrusions 18 adapted to match the vacuum bypass channels 16 in the barrel 2 and/or the longitudinal protrusions 17 of the first locking element 9.

Further details of the invention

1. A syringe for retaining and mixing first and second substances comprising
   - a barrel comprising a sealable and/or closable distal outlet and a vacuum chamber for holding a first substance,
   - a plunger incorporating a reservoir chamber for holding a second substance and configured to be axially displaced through a proximal end of the barrel,
   - a membrane separating the vacuum chamber and the reservoir chamber, and
   - a pointed member, such as one or more needles, for penetrating the membrane,

   wherein the syringe is configured such that the membrane and the pointed member are axially slidable in relation to each other.

2. The syringe according to any of the preceding items, wherein the reservoir chamber is (completely) contained in the plunger, and/or wherein the reservoir chamber is at least partly defined by outer walls of the plunger.

3. The syringe according to any of the preceding items, wherein an axial displacement of the plunger relative to the barrel corresponds to an axial displacement of the membrane and the pointed member relative to each other.

4. The syringe according to any of the preceding items, wherein the syringe is configured such that the membrane and the pointed member are axially slidable in relation to each other in correspondence with an axial displacement of the barrel relative to the plunger.

5. The syringe according to any of the preceding items, configured such that an axial displacement of the plunger from a first position to a predefined second position in the barrel penetrates the membrane by the pointed member and establishes a fluid passageway between the reservoir chamber and the vacuum chamber.

6. The syringe according to any of the preceding items 5, whereupon the vacuum in the vacuum chamber aspirates the second substance into the vacuum chamber thereby transferring the content of the reservoir chamber into the vacuum chamber, preferably without displacement of the plunger from said predefined second position.

7. The syringe according to any of the preceding items, configured to retain a vacuum in the vacuum chamber in a first configuration, said first configuration preferably being a storage condition of the syringe.

8. The syringe according to item 7, configured such that in said first configuration the membrane and the pointed member are separated, preferably axially separated inside the barrel.

9. The syringe according to any of the preceding items, configured to provide a liquid communication between the vacuum chamber and the reservoir chamber in a second configuration.

10. The syringe according to item 9, configured such that in said second configuration the pointed member penetrates the membrane.

11. The syringe according to any of the preceding items 9-10, further comprising a liquid bypass arrangement and configured such that said liquid communication between the vacuum chamber and the reservoir chamber is provided by means of said liquid bypass arrangement.

12. The syringe according to any of the preceding items, wherein the membrane is separating a proximal end of the vacuum chamber and a distal end of the reservoir chamber.

13. The syringe according to any of the preceding items, configured such that the pointed member penetrates the membrane upon a distal displacement of the plunger inside the barrel.

14. The syringe according to any of the preceding items, wherein the membrane is attached to and/or forms the distal end of the plunger.

15. The syringe according to any of the preceding items, wherein the pointed member is attached inside the barrel, preferably attached at the distal end of the barrel.

16. The syringe according to any of the preceding items, wherein the pointed member is extending axially inside the barrel.

17. The syringe according to any of the preceding items, wherein the pointed member is extending axially inside the barrel from the distal end of the barrel and pointing towards the proximal end of the barrel.

18. The syringe according to any of the preceding items, wherein the pointed member comprises one or more liquid bypass channels configured to provide liquid communication between the reservoir chamber and the vacuum chamber upon penetration of the membrane.

19. The syringe according to item 18, wherein said liquid communication between the reservoir chamber and the vacuum chamber is provided for predefined axial position of the plunger, preferably only for said predefined axial position.

20. The syringe according to any of the preceding items 18-19, configured such that the membrane and the pointed member form a sealed engagement when the pointed member penetrates the membrane and the membrane is axially separated from said one or more liquid bypass channels.

21. The syringe according to any of the preceding items, further comprising a removable locking member configured to engage and restrict the plunger from distal axial displacement inside the barrel.

22. The syringe according to item 21, wherein the locking member is configured to engage the proximal part of the plunger extending from the proximal end of the barrel.

23. The syringe according to any of the preceding items 21-22, wherein the locking member is configured to engage and restrict the plunger from distal axial displacement inside the barrel in two different axial positions of the plunger relative to the barrel.

24. The syringe according to any of the preceding items 21-23, wherein the locking member comprises a first locking element and a second locking element, each of said locking elements configured to engage and restrict the plunger from distal axial displacement inside the barrel.

25. The syringe according to item 24, wherein the first and second locking elements are configured to engage the plunger in axial extension of each other.

26. The syringe according to any of the preceding items, wherein the first configuration corresponds to a first axial position of the plunger in the barrel and wherein the second configuration corresponds to a second axial position of the plunger in the barrel.

27. The syringe according to any of the preceding items, configured such that the plunger is locked in said first configuration.

28. The syringe according to any of the preceding items, configured such that the plunger is locked in said second configuration.

29. The syringe according to any of the preceding items, configured such that the plunger is restricted from axial displacement in a distal direction in said first configuration, preferably by means of the removable first and second locking elements for engaging and locking the plunger in said first configuration.

30. The syringe according to any of the preceding items, configured such that the plunger is restricted from axial displacement in a distal direction in said second configuration, preferably by means of the removable second locking element adapted for engaging and locking the plunger in said second configuration.

31. The syringe according to any of the preceding items, configured such that upon unlocking the plunger, a vacuum in the vacuum chamber causes an axial

displacement of the plunger from a first position to a second position.

32. The syringe according to any of the preceding items, configured such that an axial displacement of the plunger from a first position to a predefined second position penetrates the membrane by the pointed member and establishes a fluid passageway between the reservoir chamber and the vacuum chamber.

33. The syringe according to item 32, wherein the first position is determined by the first and second locking elements engaging the plunger in combination, and wherein the second position is determined by only the second locking element engaging the plunger.

34. The syringe according to any of the preceding items, wherein the plunger is hollow.

35. The syringe according to any of the preceding items, further comprising an axially slidable plug inside the plunger, said plug sealably engaged with the inside of the plunger which is hollow, such that the reservoir chamber is defined by the plug inside the hollow plunger.

36. The syringe according to item 35, wherein the reservoir chamber is located in the distal end of the plunger and defined distally by the distal end of the plunger and proximally by the axially slidable plug.

37. The syringe according to any of the preceding items 35-36, wherein the plug is completely contained within the hollow body of the plunger

38. The syringe according to any of the preceding items 35-37, wherein the plug is recessed within the hollow body of the plunger,

39. The syringe according to any of the preceding items 35-38, wherein the plug is configured to be axially displaced distally within the hollow body of the plunger during discharge / flushing of the second substance in the reservoir chamber into the vacuum chamber.

40. The syringe according to any of the preceding items 35-39, configured such that upon penetration of the membrane and provision of a liquid communication between the vacuum chamber and the reservoir chamber, a vacuum in the vacuum chamber draws liquid contained in the reservoir chamber into the vacuum chamber along with an axial distal displacement of the plug within the hollow body.

41. The syringe according to any of the preceding items 35-40, wherein the axially slidable plug is configured to be penetrated by the pointed member.

42. The syringe according to any of the preceding items, wherein the pointed member is formed as an elongated pointed element wherein one end of the pointed element, preferably the proximal end, is pointed, such as pointed like a needle.

43. The syringe according to any of the preceding items, wherein the pointed member comprises one or more liquid bypass channels.

44. The syringe according to item 43, wherein said one or more liquid bypass channels are located adjacent to the proximal end of the pointed member.

45. The syringe according to any of the preceding items 43-44, wherein said one or more liquid bypass channels are formed as one or more recesses, such as one or more radial recesses, of the pointed member located distal from the proximal part of the pointed element.

46. The syringe according to any of the preceding items 43-45, configured such that in said second configuration and/or second position the at least one of said one or more bypass channels are axially aligned with the membrane.

47. The syringe according to any of the preceding items, further comprising one or more vacuum bypass channels located in the barrel and/or in the plunger and configured such that the plunger sealably engages the vacuum chamber in at least a first axial position of the plunger inside the vacuum chamber, and such that fluid communication is established across the plunger in at least a second axial position of the plunger inside the vacuum chamber via said one or more

vacuum bypass channels.

48. The syringe according to any of the preceding items, wherein the syringe is prefilled with first and second substances and wherein the first substance is a dry composition, and wherein the second substance is an aqueous medium.

49. The syringe according to any of the preceding items, wherein the syringe is prefilled with first and second substances and wherein the first substance is a dry component of a medicament and wherein the second substance is an aqueous medium in a wet component of said medicament.

50. The syringe according to any of the preceding items, wherein the first substance is a lyophilized substance, such as a lyophilized drug.

51. The syringe according to any of the preceding items, wherein the barrel comprises an open proximal end.

52. The syringe according to any of the preceding items, configured such that a proximal end of the plunger extends through an open proximal end of the barrel.

53. The syringe according to any of the preceding items, configured such that the plunger can be axially displaced through an open proximal end of the barrel.

54. The syringe according to any of the preceding items, wherein the barrel comprises a sealable / closable outlet, such as a Luer type outlet.

55. The syringe according to any of the preceding items, wherein the barrel comprises a sealable / closable outlet located at the distal end of the barrel.

56. The syringe according to any of the preceding items, wherein the outlet comprises a connector portion at a distal end, such as a Luer type connector portion.

57. The syringe according to any of the preceding items, further comprising a sealed engagement between the plunger and barrel.

58. The syringe according to any of the preceding items, wherein the reservoir chamber is defined by a hollow portion of the plunger.

59. The syringe according to any of the preceding items, wherein the plug is formed as a small plunger adapted to fit and be recessed within the hollow plunger.

60. The syringe according to any of the preceding items, wherein the reservoir chamber and the vacuum chamber are fluidly disconnected in said first configuration.

61. The syringe according to any of the preceding items, wherein the reservoir chamber and the vacuum chamber are fluidly connected in said second configuration.

62. The syringe according to any of preceding items, wherein said one or more vacuum bypass channels are configured to break the sealing between the vacuum chamber and the plunger at a predefined axial position of the plunger inside the vacuum chamber.

63. The syringe according to any of preceding items, wherein said one or more vacuum bypass channels are one or more longitudinal grooves formed in the inner surface of the proximal end of the vacuum chamber.

64. The syringe according to any of preceding items, wherein said one or more vacuum bypass channels are formed in the plunger.

65. The syringe according to any of preceding items, wherein the volume of the barrel and/or the volume of the vacuum chamber is between 0.1 and 500 mL, more preferred between 1 and 100 mL, more preferred between 2 and 50 mL, more preferred between 3 and 30 mL, more preferred less than 25 mL, more preferred less than 20 mL, more preferred less than 15 mL, more preferred less than 10 mL, most preferred between 5 and 10 mL.

66. The syringe according to any of preceding items, wherein the volume of the hollow body of the plunger and/or the volume of the reservoir chamber is between 0.1 and 500 mL, more preferred between 1 and 100 mL, more

preferred between 2 and 50 mL, more preferred between 3 and 30 mL, more preferred less than 25 mL, more preferred less than 20 mL, more preferred less than 15 mL, more preferred less than 10 mL, most preferred between 5 and 10 mL.

67. The syringe according to any of preceding items, wherein the barrel, the plunger, the plug, the valve and/or the axially displaceable valve element is/are suitable for manufacture by means of single cycle injection moulding.

Claims

1. A syringe for retaining and mixing first and second substances comprising
   - a barrel comprising a sealable and/or closable distal outlet and a vacuum chamber for retaining a first substance in a vacuum,
   - a plunger incorporating a reservoir chamber for holding a second substance and configured to be axially displaced through a proximal end of the barrel,
   - a membrane separating the vacuum chamber and the reservoir chamber, and
   - a pointed member, such as one or more needles, for penetrating the membrane,

   wherein the syringe is configured such that an axial displacement of the plunger from a first position to a predefined second position in the barrel penetrates the membrane by the pointed member and establishes a fluid passageway between the reservoir chamber and the vacuum chamber whereupon the vacuum in the vacuum chamber aspirates the second substance into the vacuum chamber thereby transferring the content of the reservoir chamber into the vacuum chamber without displacement of the plunger from said predefined second position.

2. The syringe according to any of the preceding claims, configured to retain the vacuum in the vacuum chamber in a first configuration, said first configuration preferably being a storage condition of the syringe.

3. The syringe according to any of the preceding claims, wherein the pointed member is attached inside the barrel

4. The syringe according to any of the preceding claims, wherein the pointed member is attached at the distal end of the barrel.

5. The syringe according to any of the preceding claims, further comprising a removable locking member configured to engage and restrict the plunger from distal axial displacement inside the barrel, said locking member comprising a first locking element and a second locking element, each of said locking elements configured to engage and restrict the plunger from distal axial displacement inside the barrel.

6. The syringe according to any of the preceding claims 6, wherein the removable locking member is configured to engage and restrict the plunger from distal axial displacement inside the barrel in two different axial positions of the plunger relative to the barrel.

7. The syringe according to any of the preceding claims 2-6, wherein the first configuration corresponds to a first axial position of the plunger in the barrel and wherein a second configuration corresponds to a second axial position of the plunger in the barrel.

8. The syringe according to any of the preceding claims 6-7, wherein the two different axial positions of the plunger relative to the barrel correspond to said first and second axial positions of the plunger in the barrel, respectively.

9. The syringe according to any of the preceding claims 5-8, wherein the first and second locking elements are configured to engage the plunger in axial extension of each other.

10. The syringe according to any of the preceding claims 2-8, configured such that the plunger is locked in said first configuration.

11. The syringe according to any of the preceding claims 6-9, configured such that the plunger is locked in said second configuration.

12. The syringe according to any of the preceding claims 2-11, configured such that the plunger is restricted from axial displacement in a distal direction in said first configuration by means of the removable first and second locking elements for engaging and locking the plunger in said first configuration.

13. The syringe according to any of the preceding claims 6-12, configured such that the plunger is restricted from axial displacement in a distal direction in said second configuration by means of the removable second locking element adapted for engaging and locking the plunger in said second configuration.

14. The syringe according to any of the preceding claims, further comprising an axially slidable plug inside the plunger, said plug being sealably engaged with the inside of the plunger which is hollow, such that the reservoir chamber is defined by the plug inside the hollow plunger.

15. The syringe according to claim 14, wherein the plug is configured to be axially displaced distally within the hollow body of the plunger during discharge / flushing / transfer of the second substance in the reservoir chamber into the vacuum chamber.

16. The syringe according to any of the preceding claims 14-15, configured such that upon penetration of the membrane and provision of a liquid communication between the vacuum chamber and the reservoir chamber, the vacuum in the vacuum chamber draws liquid contained in the reservoir chamber into the vacuum chamber along with an axial distal displacement of the plug within the hollow body.

17. The syringe according to any of the preceding claims, wherein the pointed member comprises one or more liquid bypass channels configured to provide liquid communication between the reservoir chamber and the vacuum chamber upon penetration of the membrane.

18. The syringe according to any of the preceding claims, wherein the pointed member comprises one or more liquid bypass channels, said one or more liquid bypass channels formed as one or more recesses, such as one or more radial recesses, of the pointed member located distal from the proximal part of the pointed element.

19. The syringe according to claim 17-18, configured such that in said second configuration and/or second position the at least one of said one or more bypass channels are axially aligned with the membrane.

20. The syringe according to any of claims 17-19, configured such that the membrane and the pointed member form a sealed engagement when the pointed member penetrates the membrane and the membrane is axially separated from said one or more liquid bypass channels.

21. The syringe according to any of the preceding claims, wherein the reservoir chamber is defined by a hollow portion of the plunger and wherein the membrane is attached to and/or forms the distal end of the plunger such that the membrane is separating a proximal end of the vacuum chamber and a distal end of the reservoir chamber.

22. The syringe according to any of the preceding claims, wherein the syringe is prefilled with first and second substances and wherein the first substance is a dry component of a medicament and wherein the second substance is an aqueous medium in a wet component of said medicament.

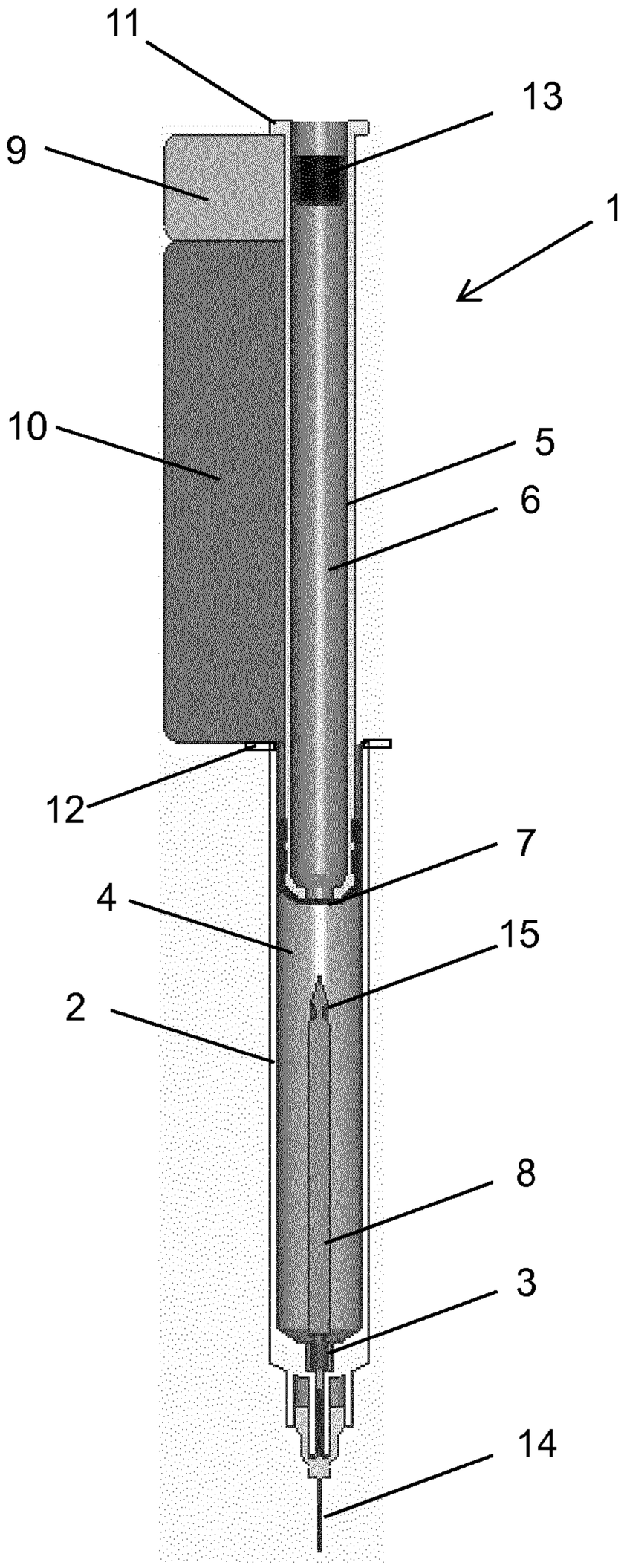

Fig. 1A

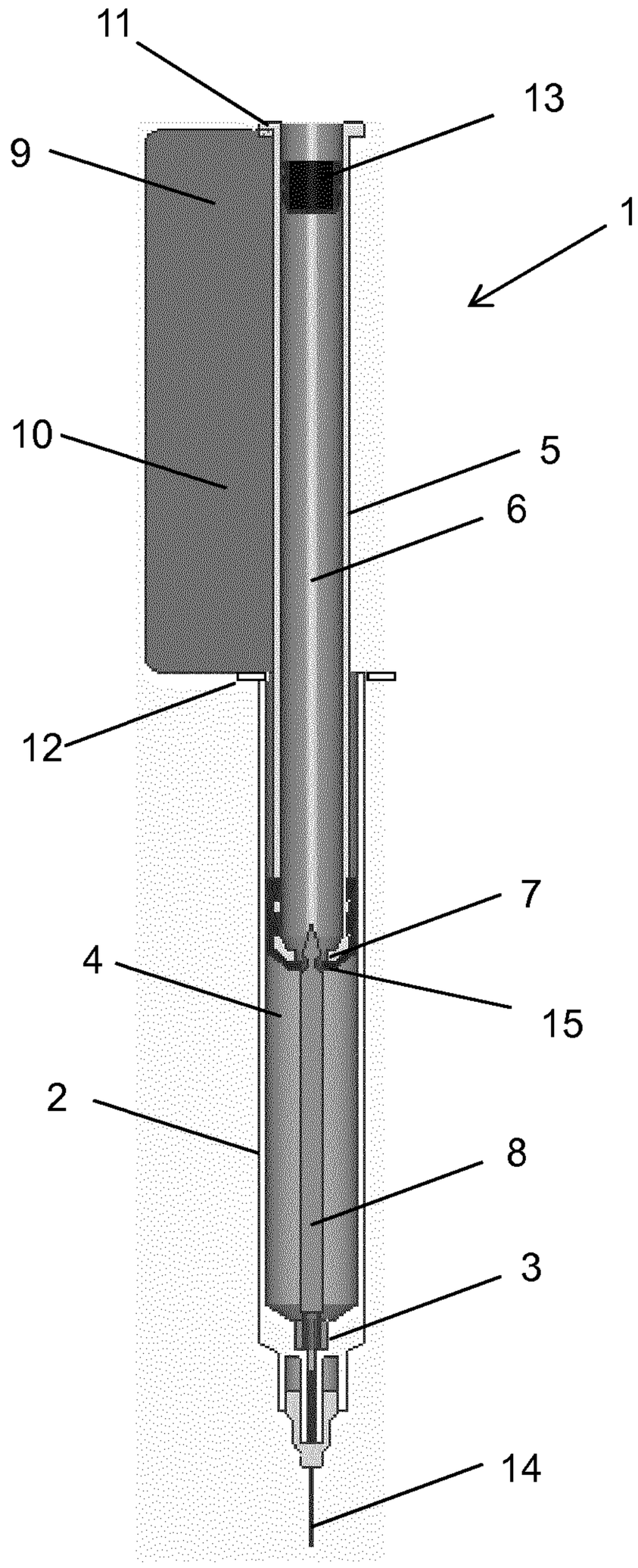

Fig. 1B

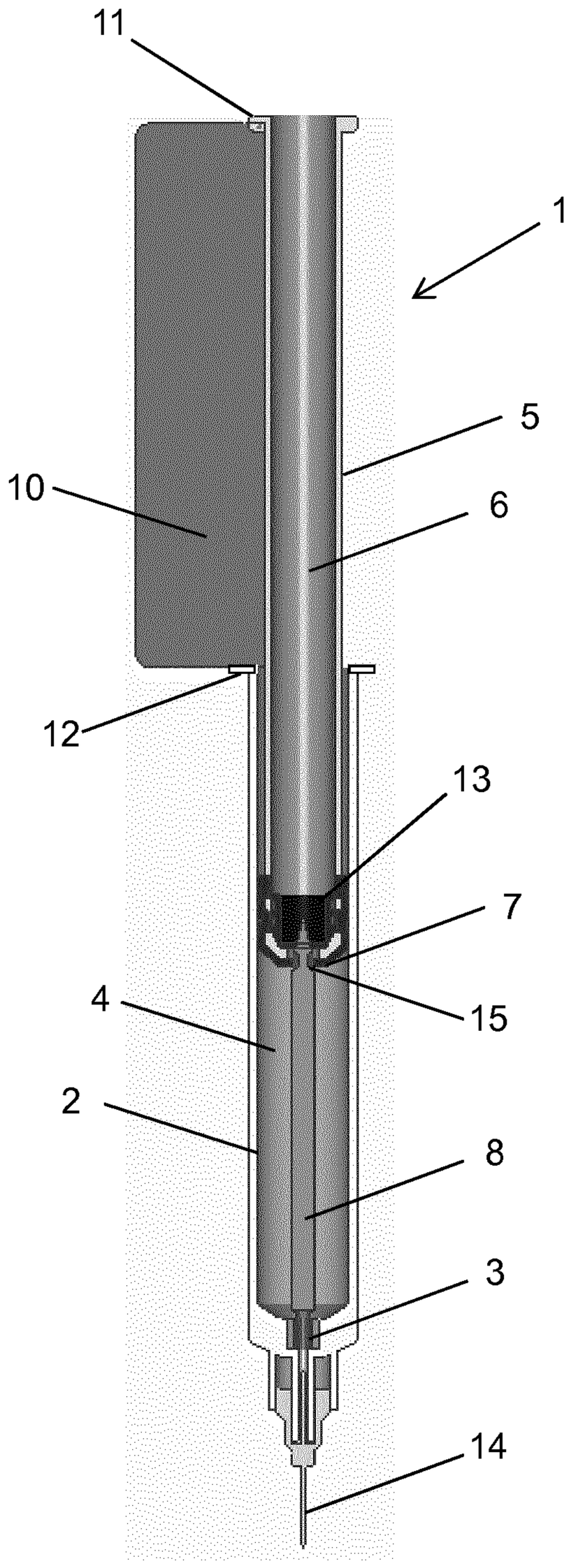

Fig. 1C

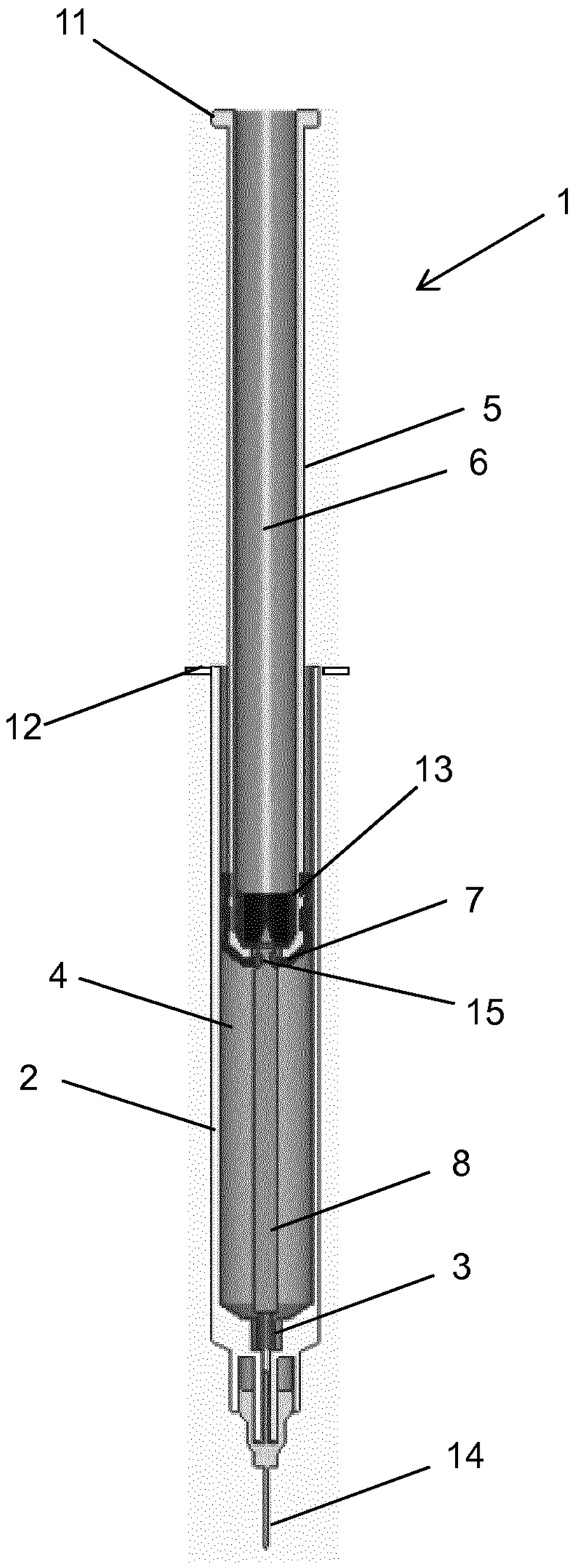

Fig. 1D

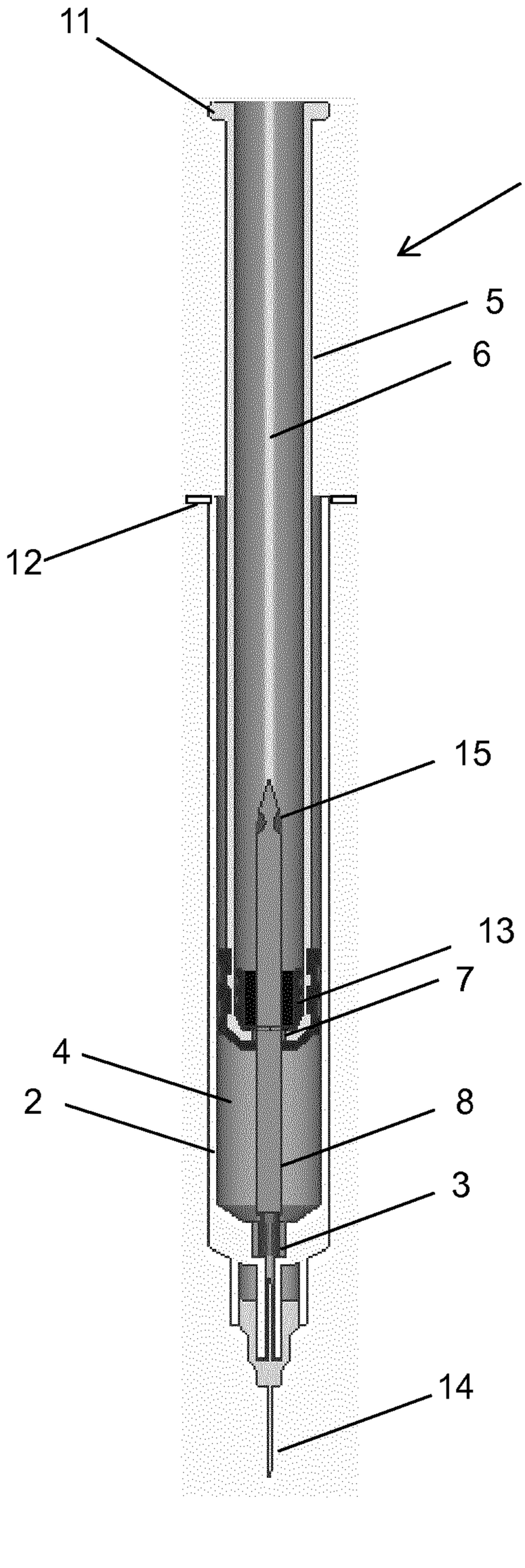

Fig. 1E

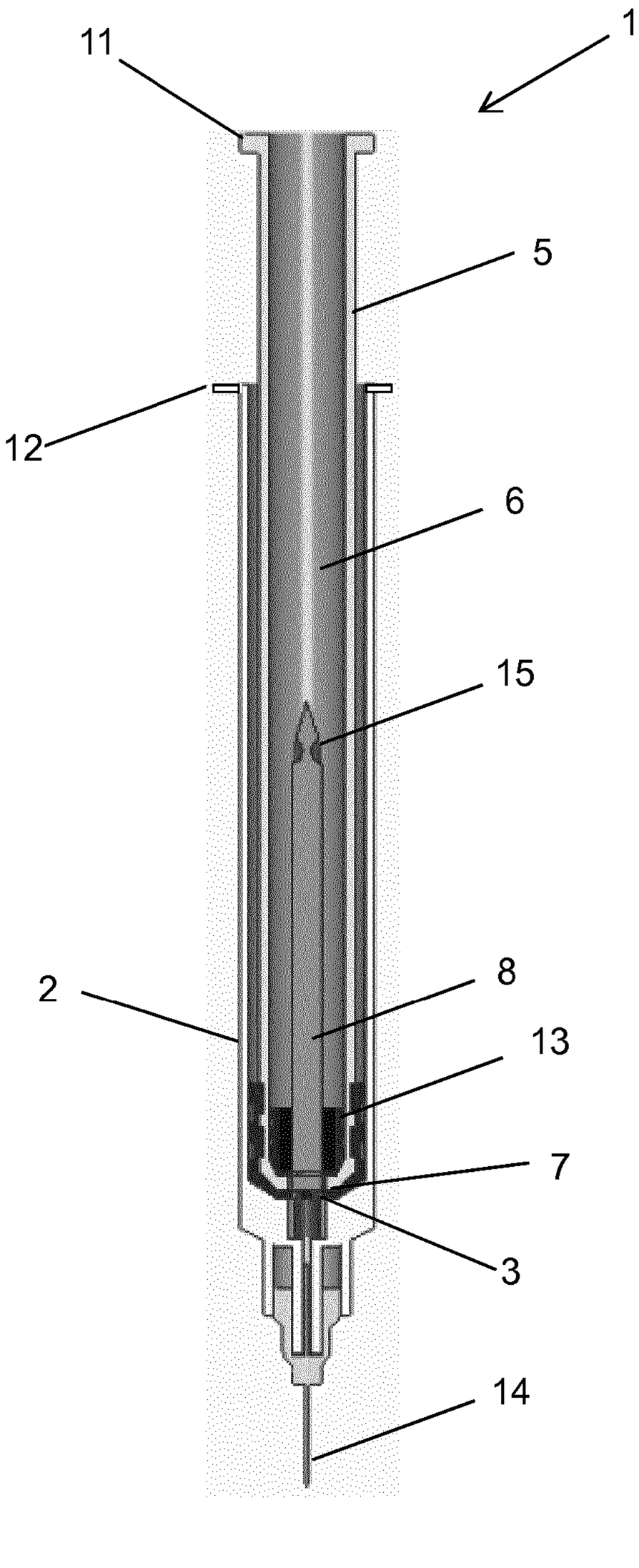

Fig. 1F

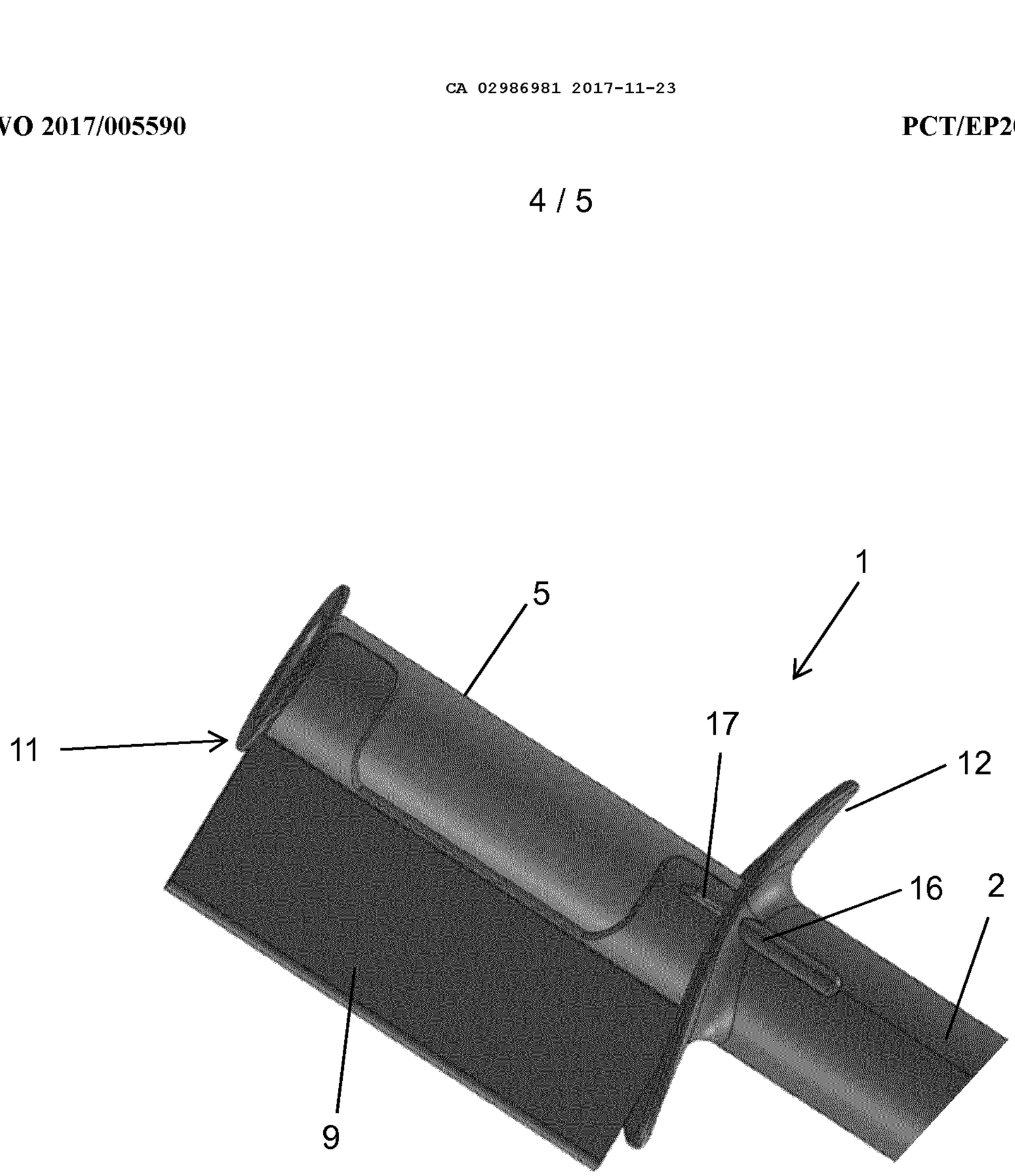

Fig. 2

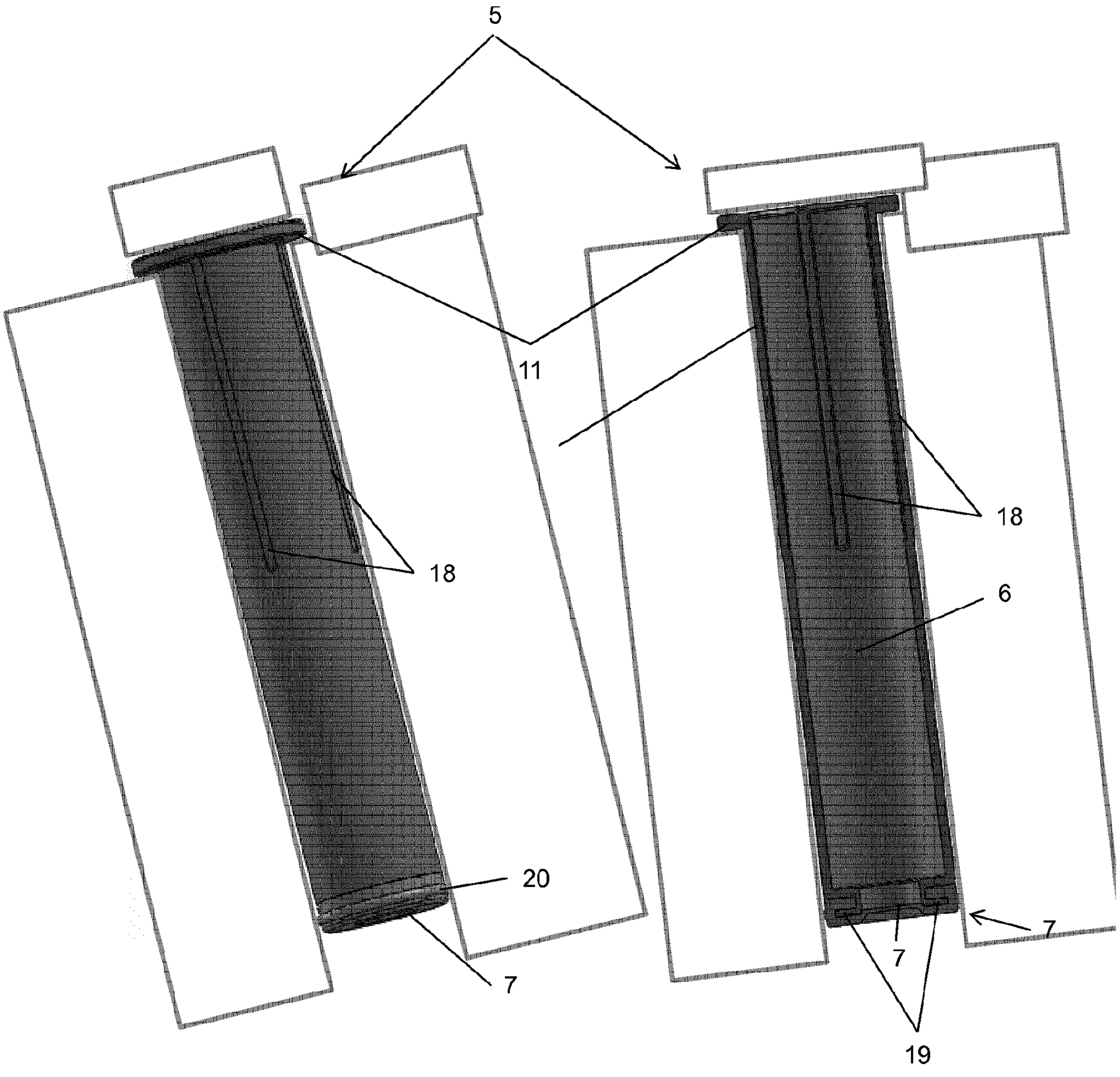

Fig. 3A Fig. 3B