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(54) **SYRINGE FOR MEDICAMENT CARTRIDGES HAVING VARYING SIZES**

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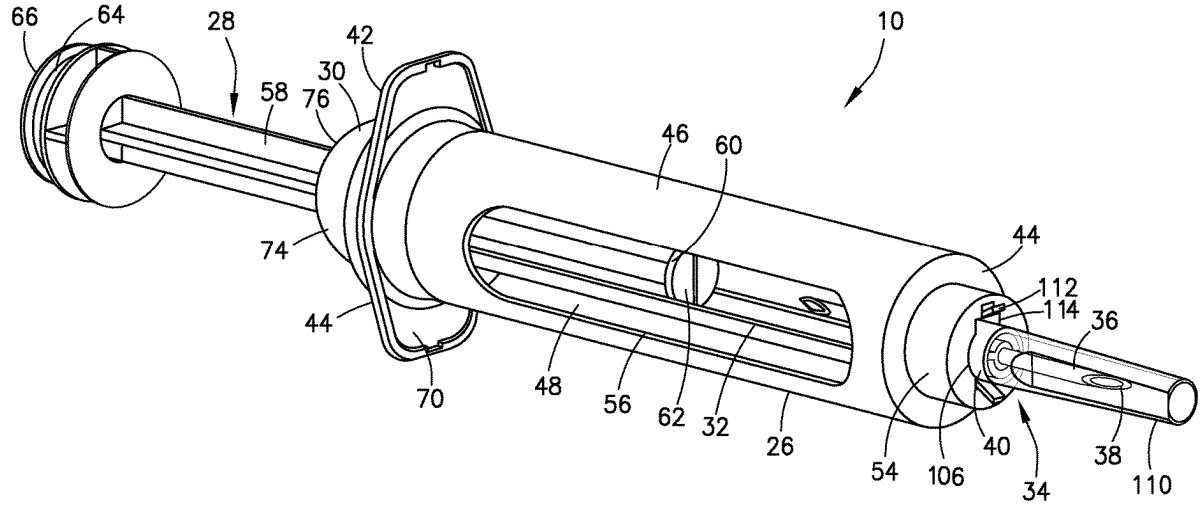
(57) **ABSTRACT**

A syringe for dispensing medicament from a cartridge, the syringe including a housing having a proximal end, a distal end, and a sidewall defining a passageway adapted to receive the cartridge, an adjustment system comprising an adjustment knob positioned at the proximal end of the housing and two or more adjustment plates extending into the passageway of the housing, and a plunger comprising a plunger rod, the plunger rod extending though a through-hole in the adjustment knob and into the passageway of the housing, wherein rotation of the adjustment knob with respect to the housing causes a distance between the adjustment plates to be changed and a distance between the adjustment plates and an interior of the sidewall of the housing to be changed. The syringe may also include a needle assembly.



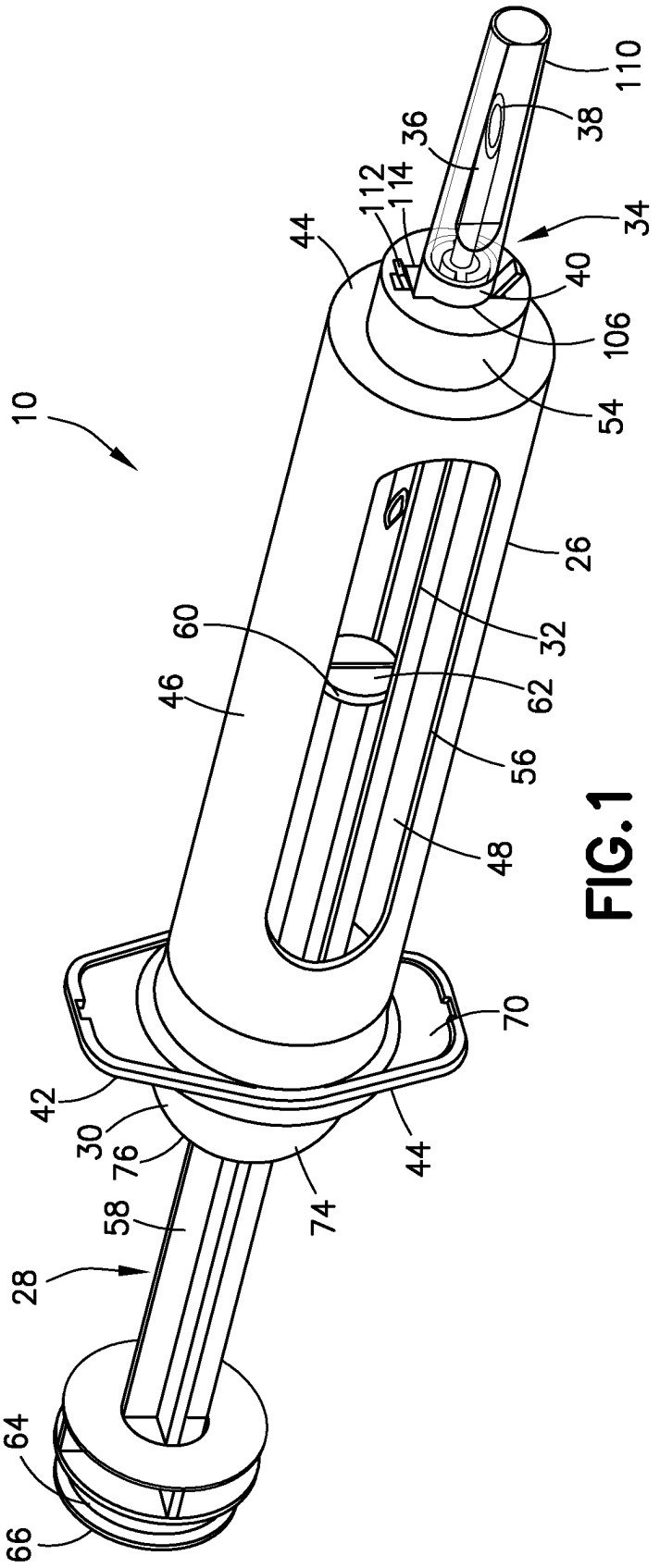

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FIG. 1

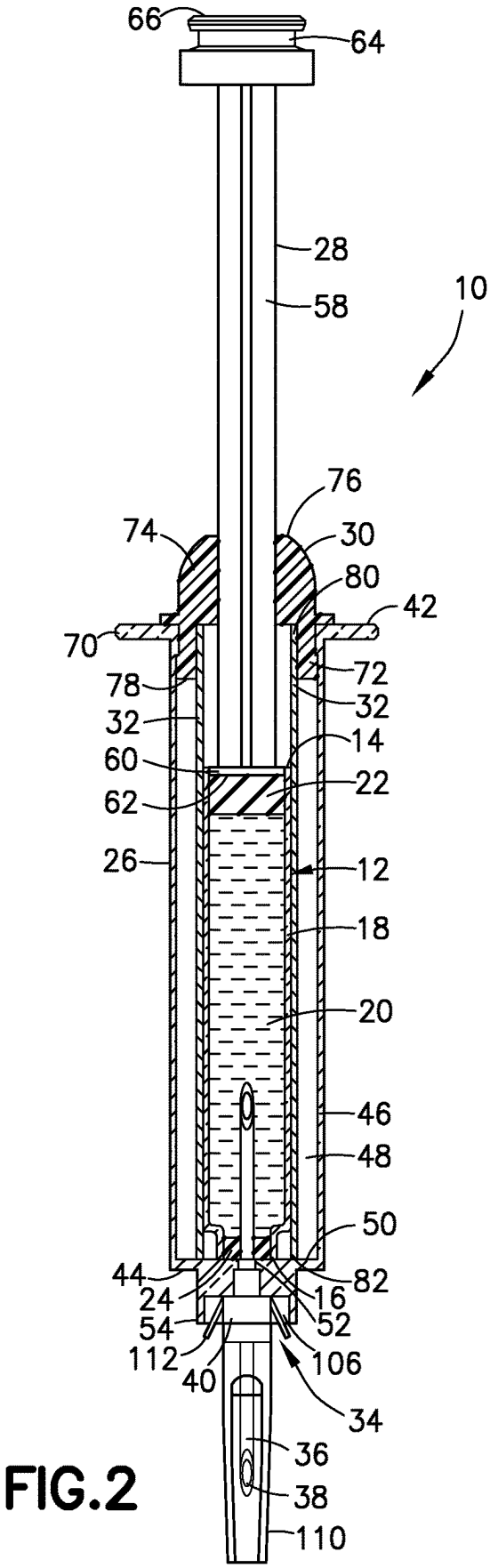
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FIG.2

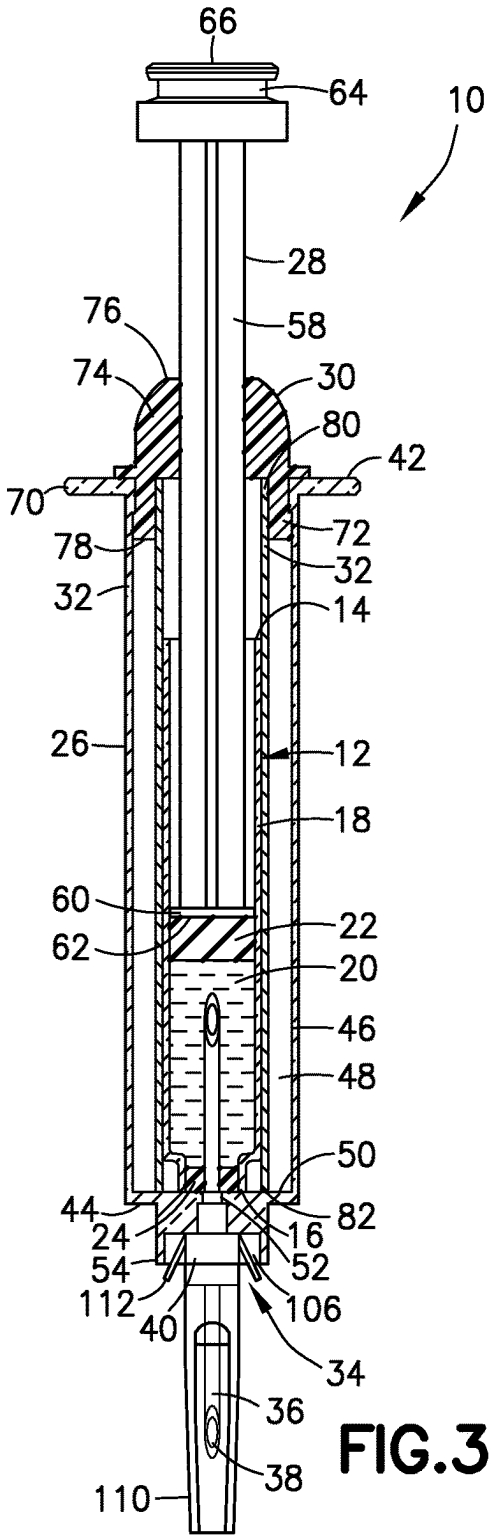
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FIG.3

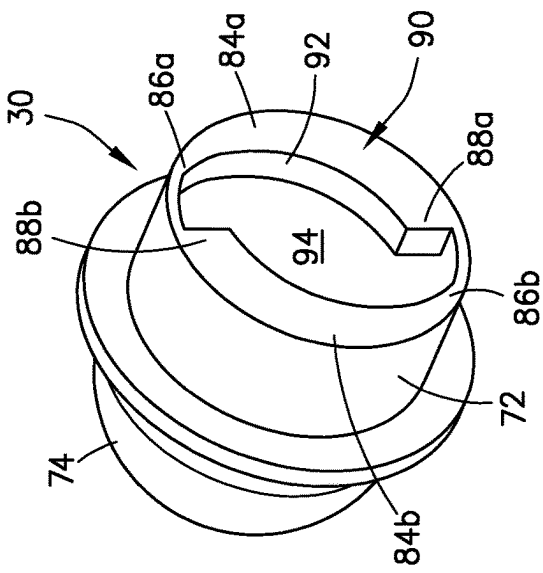

FIG.4

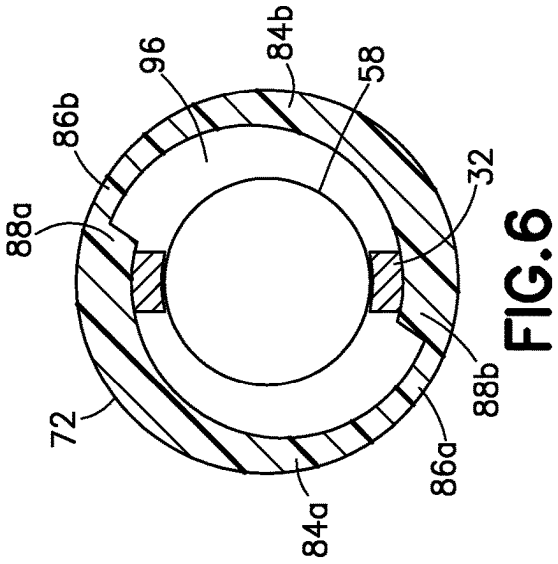

FIG.6

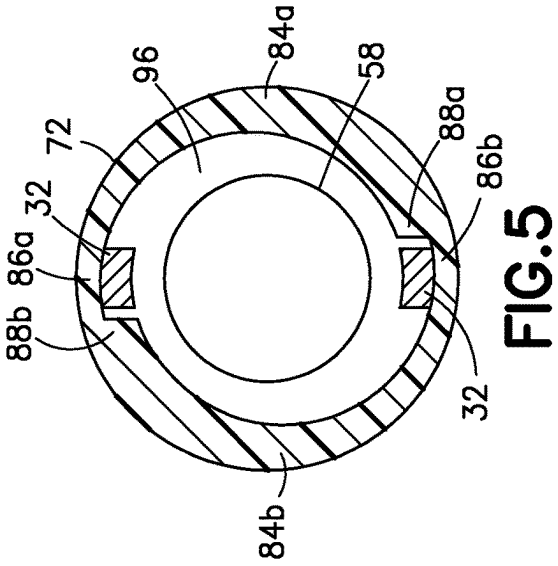

FIG.5

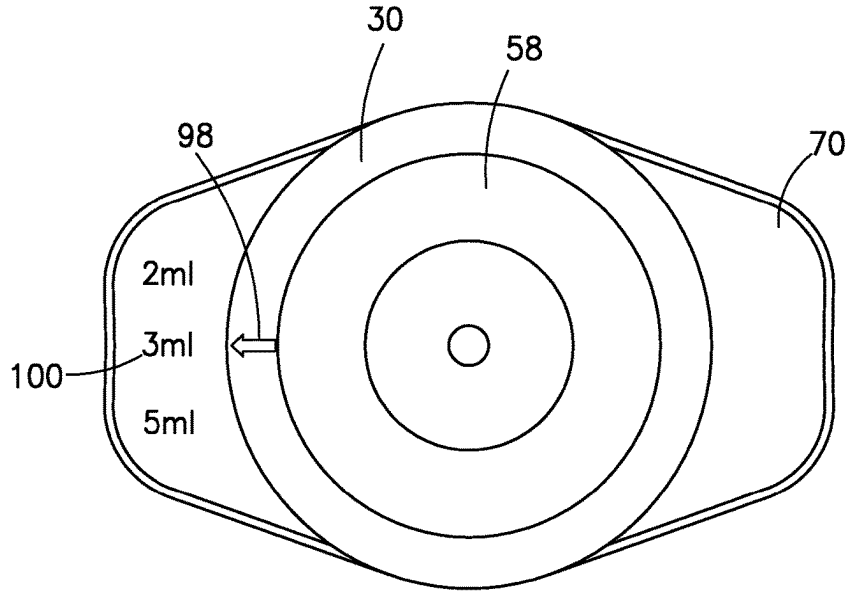

FIG.7

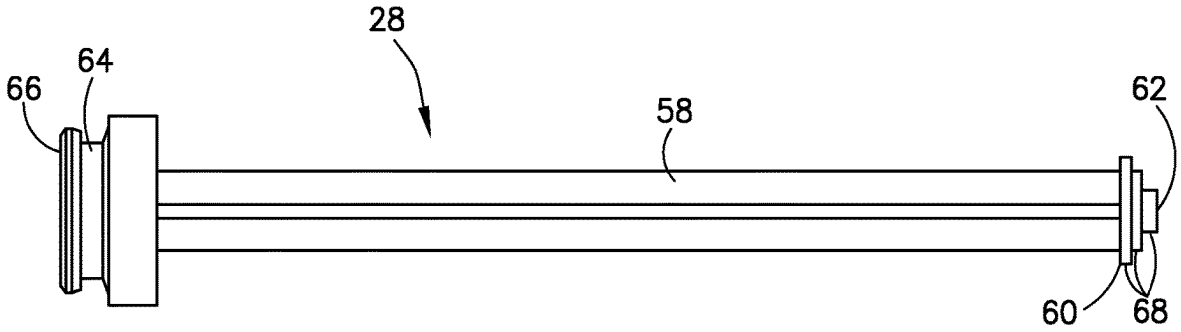

FIG.8

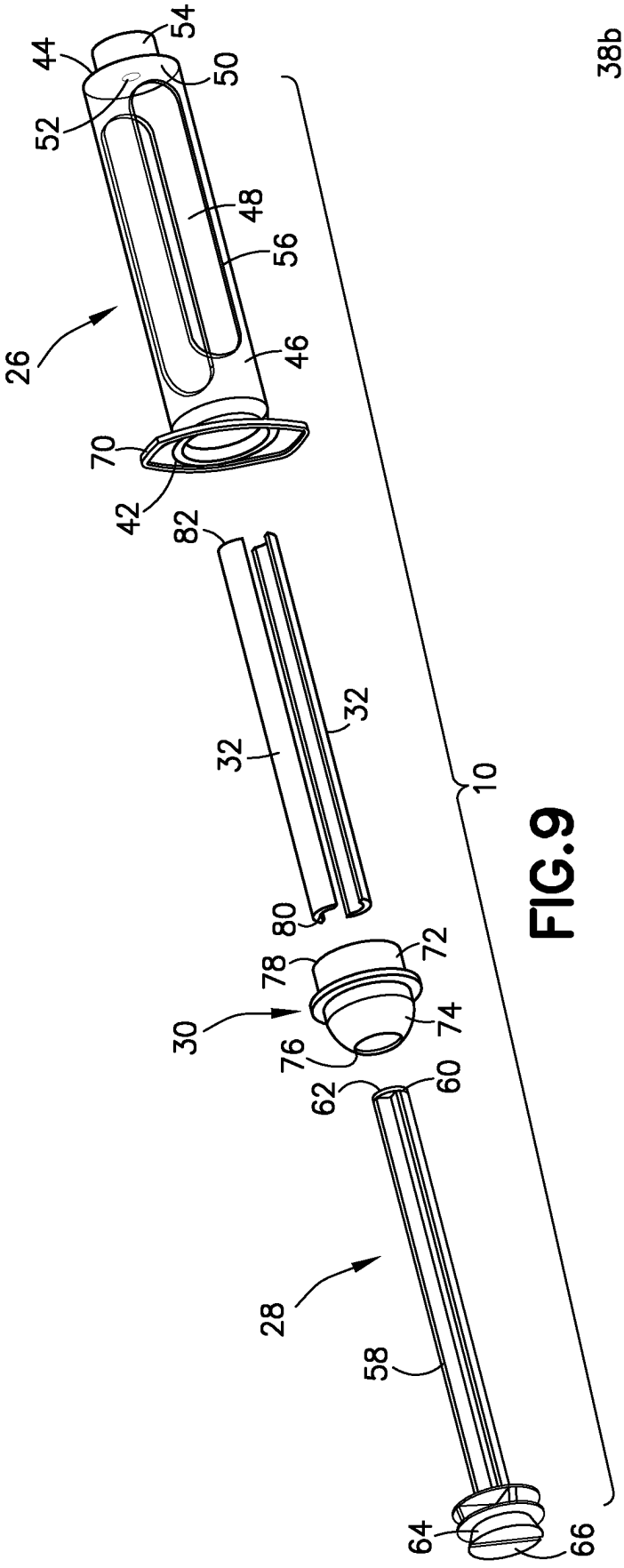
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FIG.9

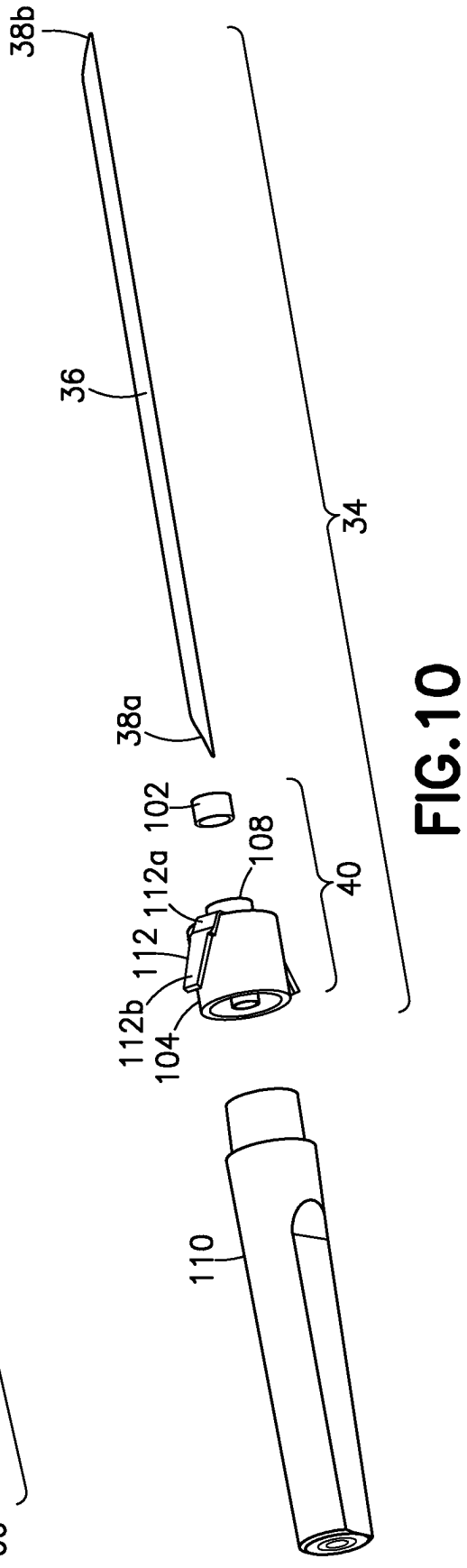
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FIG.10

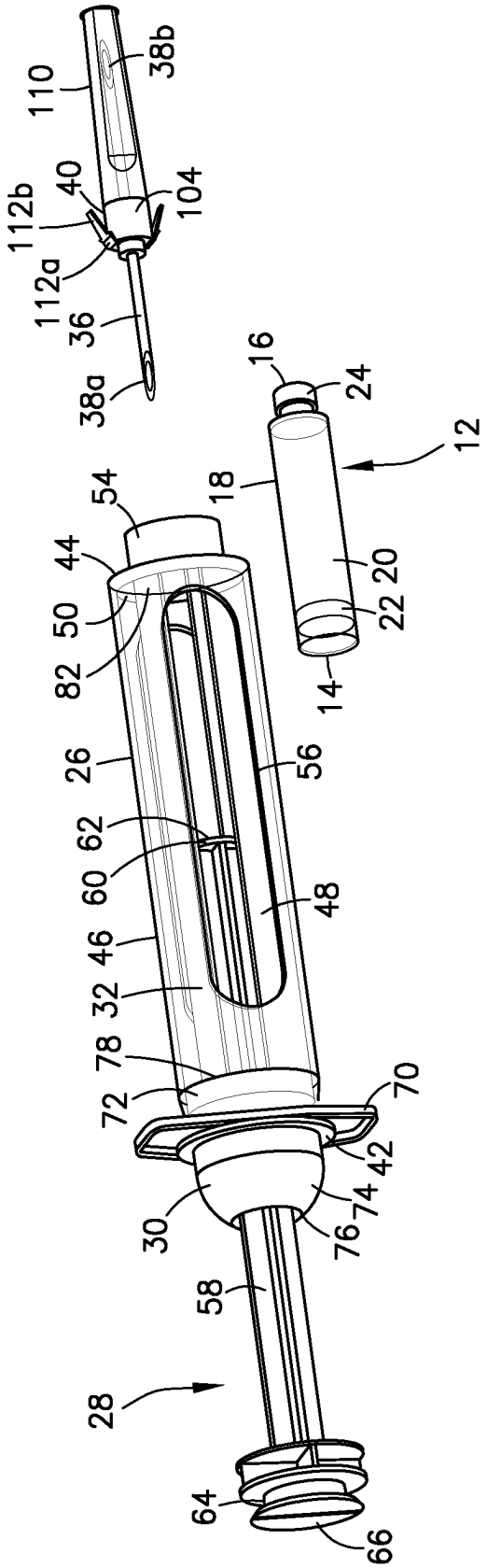
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FIG.11

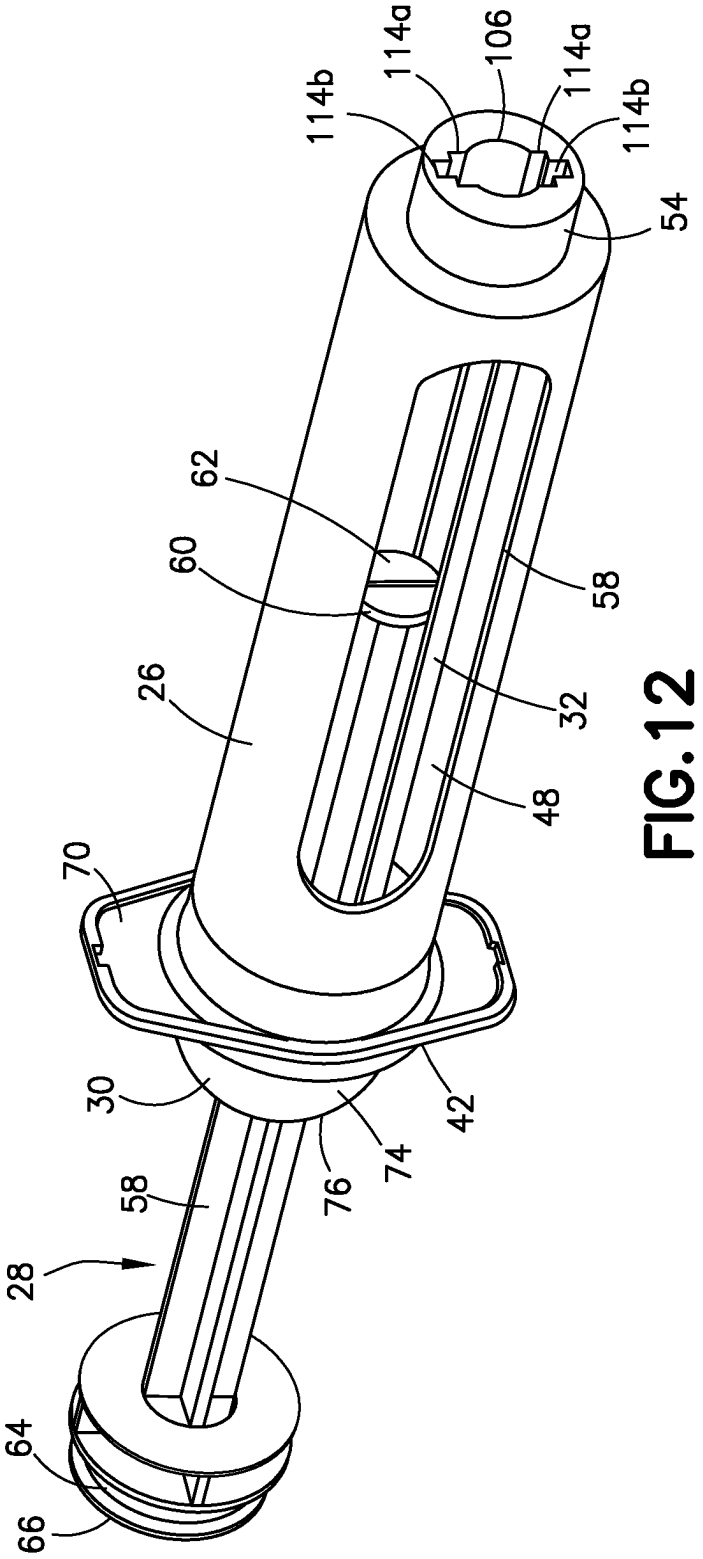
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FIG.12

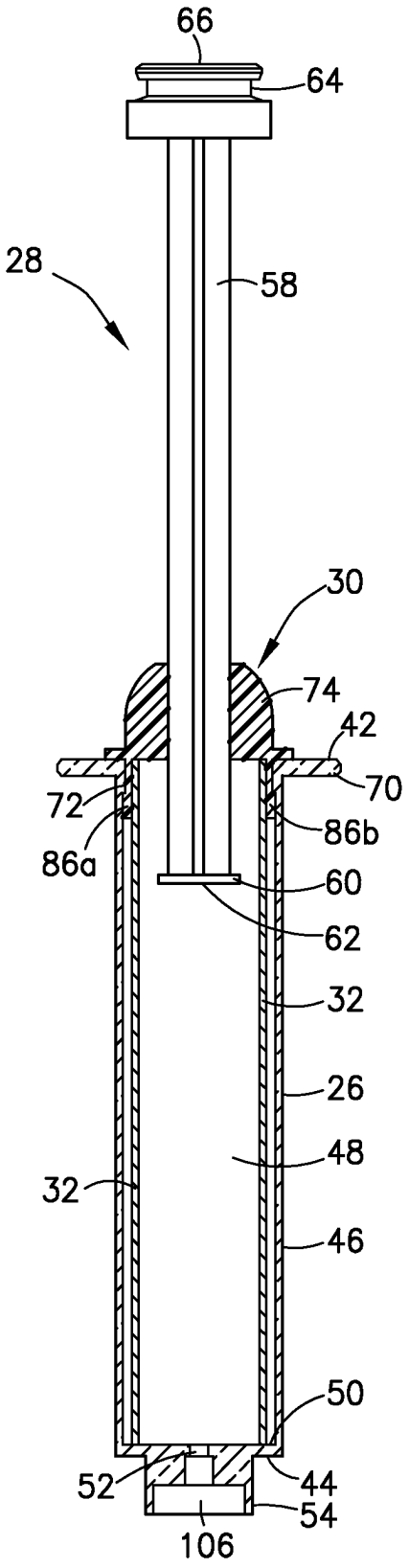

FIG. 13A

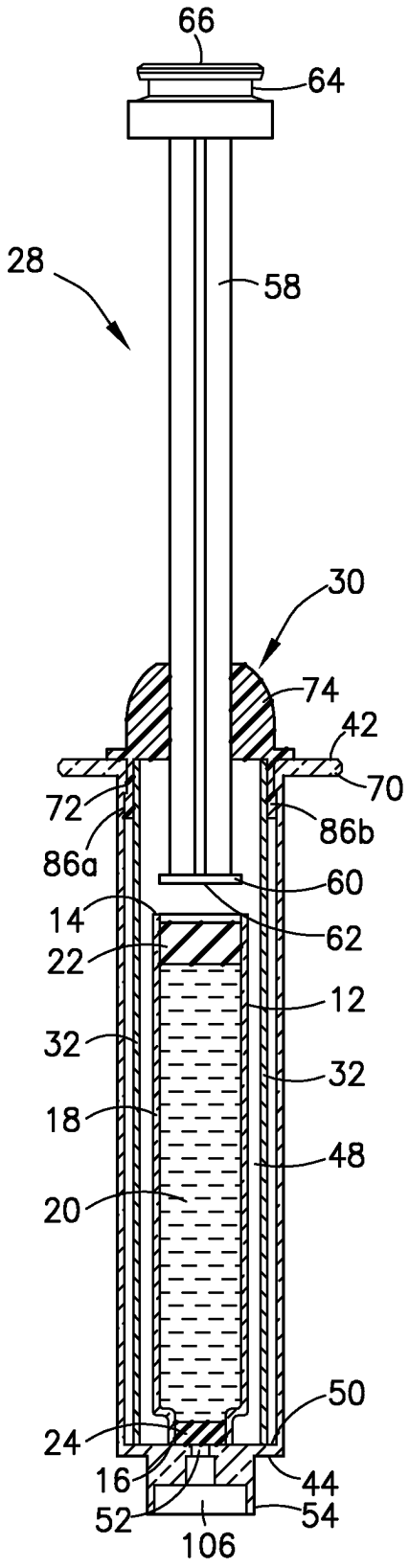

FIG. 13B

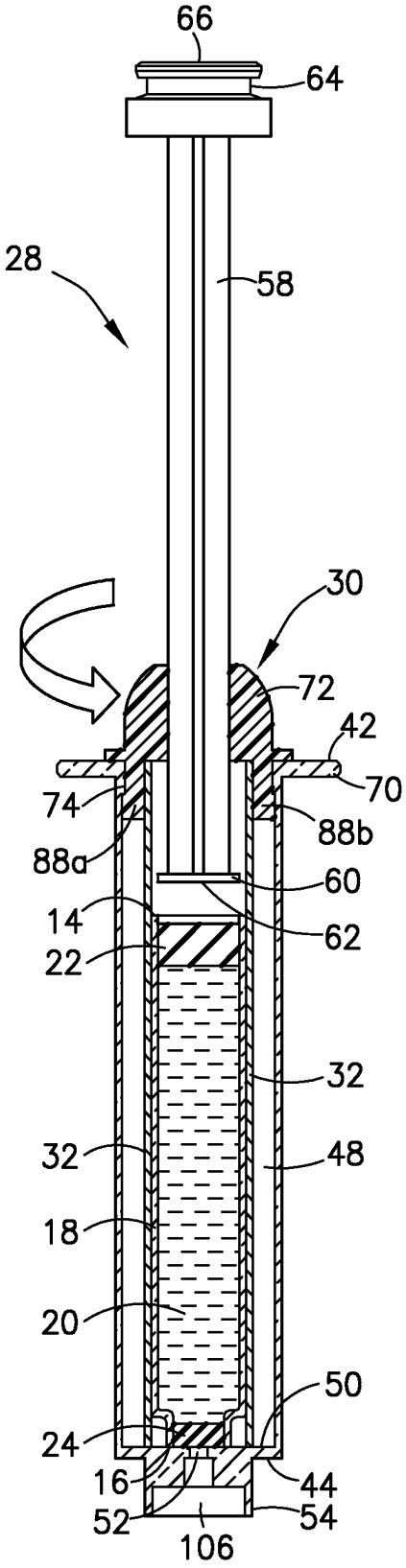

FIG. 13C

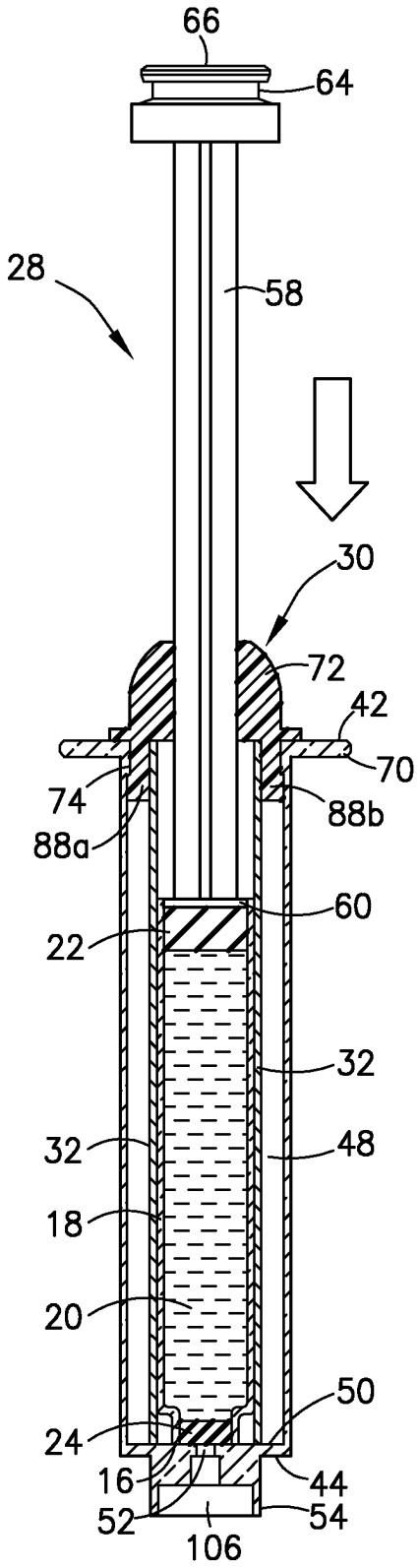

FIG. 13D

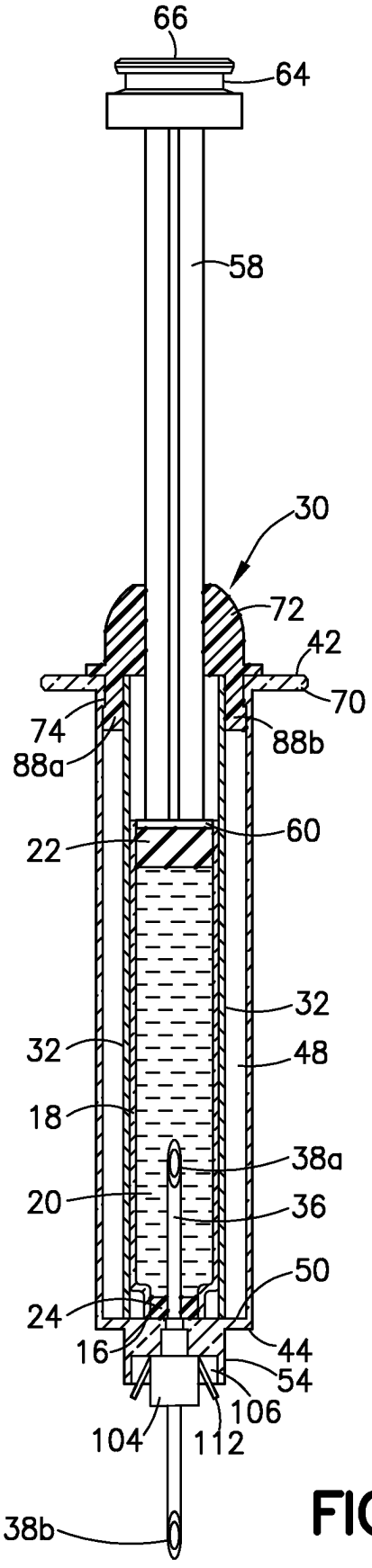
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FIG. 13E

SYRINGE FOR MEDICAMENT CARTRIDGES HAVING VARYING SIZES

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Indian Application No. 202211025346, filed Apr. 29, 2022, entitled "Syringe for Medicament Cartridges Having Varying Sizes", the entire disclosure of which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention is directed to a syringe for dispensing medicament from a cartridge, and more specifically, to a syringe for dispensing medicament from cartridges having different sizes.

Description of Related Art

[0003] The provision of medicaments in cartridges that can be used in combination with reusable syringes provides a convenient way of storing and dispensing the medicaments to patients. Such prior art reusable syringes are designed to hold a cartridge having a specific diameter. Such syringes are described in U.S. Pat. Nos. 2,475,939; 3,462,840; and 5,122,057, and European Patent No. EP 1225933. Therefore, different syringes are needed depending on the size of the cartridge that is to be used.

[0004] Medicaments, such as biologics, are being required to be administered at higher injection volumes and viscosities than in the past. Therefore, there is a need to provide a convenient packaging and delivery method for delivering these medicaments.

[0005] Thus, there is a need for a universal reusable syringe that can be utilized with cartridges having a variety of different diameters and lengths.

SUMMARY OF THE INVENTION

[0006] The present invention is directed to a syringe for dispensing medicament from a cartridge. The syringe comprises a housing having a proximal end, a distal end, and a sidewall defining a passageway adapted to receive the cartridge, an adjustment system comprising an adjustment knob positioned at the proximal end of the housing and two or more adjustment plates extending into the passageway of the housing, and a plunger comprising a plunger rod, the plunger rod extending though a through-hole in the adjustment knob and into the passageway of the housing. Rotation of the adjustment knob with respect to the housing causes a distance between the adjustment plates to be changed and a distance between the adjustment plates and an interior of the sidewall of the housing to be changed.

[0007] A bottom surface may extend inwardly from the sidewall at the distal end of the housing, an opening may be provided in the bottom surface, and a collar adapted to engage a needle hub of a needle assembly may extend around the opening. At least one opening is provided in the sidewall of the housing through which the cartridge can be placed in the passageway. A flange may extend from the proximal end of the housing.

[0008] The plunger is movable with respect to the housing such that a distal force applied to the plunger while holding the housing stationary causes the plunger to be displaced in a distal direction within the passageway of the housing. The plunger further comprises an engagement portion adapted to engage a stopper of the cartridge extending from a distal end of the plunger rod and/or a thumb pad extending from a proximal end of the plunger rod. The engagement portion of the plunger may be stepped, comprising portions having different dimensions which correspond to the dimensions of a variety of stoppers used in various cartridges.

[0009] The adjustment plates may be elongated plates that extend in a longitudinal direction from the proximal end of the housing to the distal end of the housing. The adjustment plates may have a curvature corresponding to an outer curvature of the cartridge allowing each plate to partially surround the outer surface of the cartridge when the cartridge is contained in the passageway of the housing. The adjustment plates may be positioned with respect to one another at equal increments around a circumference of the passageway of the housing. When two adjustment plates are provided, the adjustment plates may be positioned substantially opposite one another. The syringe may have an even number of adjustment plates and a corresponding number of camming portions.

[0010] The adjustment knob comprises an engagement portion that extends into the passageway of the housing and a grip portion that extends above the proximal end of the housing. Proximal ends of the adjustment plates extend into the engagement portion of the adjustment knob, and distal ends of the adjustment plates are adjacent the distal end of the housing. The engagement portion of the adjustment knob comprises two or more camming portions, each camming portion having a first end, a second end, a distal surface, and a sidewall, wherein a radial length of the distal surface of each camming portion increases from the first end to the second end, such that a radial length at the first end of each camming portion is smaller a radial length at the second end of the camming portion. The first end of a first camming surface may be adjacent the second end of a second camming portion. The sidewalls of the camming portions define an opening having a maximum width between the first ends of the camming portions and a minimum width between the second ends of the camming portions. The syringe may have two adjustment plates and two camming portions where each camming portion extends 180° around a circumference of the engagement portion of the adjustment knob.

[0011] The sidewalls of the camming portions and the plunger rod may define a slot having a radial width increasing from the second end of each camming portion to the first end of the camming portion. Proximal ends of the adjustment plates are received in the slot such that each adjustment plate is associated with a corresponding camming portion.

[0012] With the adjustment knob rotated to a position in which the adjustment plates are each received in the slot adjacent a corresponding first end of a camming portion, the adjustment plates are at a maximum distance from one another; with the adjustment knob rotated to a position in which the adjustment plates are each received in the slot adjacent a corresponding second end of a camming portion, the adjustment plates are at a minimum distance from one another, and with the adjustment knob rotated to a position in which the adjustment plates are each received in the slot at a position between the first end of a camming portion and the second end of the camming portion, the adjustment

plates are at distance from one another that is between the maximum distance and the minimum distance.

[0013] An indicator may be provided on the adjustment knob and indicia may be provided on a flange extending from the proximal end of the housing, where the indicator in combination with the indicia indicate the position of the adjustment plates.

[0014] The syringe may further comprise a needle assembly comprising a needle having a beveled point at each end and a needle holder comprising a needle hub, wherein the housing further comprises a bottom surface extending inwardly from the sidewall at the distal end of the housing, an opening in the bottom surface, and a collar extending around the opening and adapted to engage the needle hub. The needle passes through a through hole in the needle holder, such that a portion of the needle extends proximally from the needle holder, and a portion of the needle extends distally from the needle holder. When the needle hub of the needle holder is inserted into the opening in the collar of the housing, the portion of the needle extending proximally from the needle holder passes through the opening in the bottom surface of the housing and into the passageway, and when the container is contained in the passageway, the portion of the needle extending proximally from the needle holder pierces a pierceable septum of the cartridge creating a fluid path for medicament to pass from the cartridge through the needle.

[0015] A locking assembly may be provided for removably locking the needle hub within the collar of the housing. The locking mechanism may comprise at least one flexible finger extending from an outer surface of the needle hub and a corresponding recess in the opening in the collar of the housing. The flexible finger may comprise a first portion attached to the hub and a second portion extending in the longitudinal direction from the first portion, the recess may comprise a first portion and a second portion extending in a transverse direction from the first portion of the recess, and a width of the first portion of the recess in a lateral direction may correspond to a width of the first portion of the flexible finger in the lateral direction and a width of the second portion of the flexible finger in the lateral direction corresponds to a width of the second portion of the flexible finger in the lateral direction. With the needle hub inserted into the opening of the collar of the housing, the first portion of the flexible finger abuts an interior end of the second portion of the recess and locks the needle holder in the opening in the collar. Exertion of a biasing force on a portion of the second portion of the flexible finger extending from the second portion of the recess releases the engagement between the interior end of the second portion of the recess and the first portion of the flexible finger and unlocks the needle holder from the opening in the collar.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. **1** is a side perspective view of a syringe including a needle assembly according to the invention.

[0017] FIG. **2** is a cross-sectional view of a syringe including a needle assembly according to the invention prior to injection of the medicament into a patient.

[0018] FIG. **3** is a cross-sectional view of a syringe including a needle assembly according to the invention during injection of the medicament into a patient.

[0019] FIG. **4** is a side perspective view of the adjustment knob of a syringe according to the invention.

[0020] FIG. **5** is a cross-sectional view of a syringe according to the invention showing the adjustment knob and adjustment plates in a first position.

[0021] FIG. **6** is a cross-sectional view of a syringe according to the invention showing the adjustment knob and adjustment plates in a second position.

[0022] FIG. **7** is a proximal end view of a syringe according to the invention.

[0023] FIG. **8** is an alternative plunger rod for a syringe according to the invention.

[0024] FIG. **9** is an exploded side perspective view of a syringe according to the invention.

[0025] FIG. **10** is an exploded side perspective view of a needle assembly for a syringe according to the invention.

[0026] FIG. **11** is a side perspective view of a syringe according to the invention, a needle assembly for the syringe and a cartridge used with the syringe.

[0027] FIG. **12** is a side perspective view of a syringe without a needle assembly according to the invention.

[0028] FIG. **13**A is a cross-sectional view of a syringe according to the invention prior to use.

[0029] FIG. **13**B is a cross-sectional view of a syringe according to the invention after a cartridge of medicament has been inserted into the syringe.

[0030] FIG. **13**C is a cross-sectional view of a syringe according to the invention after the adjustment knob has been rotated to bring the adjustment plates into contact with the sidewall of the cartridge.

[0031] FIG. **13**D is a cross-sectional view of a syringe according to the invention after the cartridge has been fixed in the syringe by the adjustment plates and the engagement portion of the plunger rod has been brought into contact with the stopper of the cartridge.

[0032] FIG. **13**E is a cross-sectional view of a syringe according to the invention after the needle assembly has been attached.

DESCRIPTION OF THE INVENTION

[0033] As used herein, unless otherwise expressly specified, plural encompasses singular and vice versa. When ranges are given, any endpoints of those ranges and/or numbers within those ranges can be combined with the scope of the present invention. "Including", "such as", "for example" and like terms means "including/such as/for example but not limited to".

[0034] For purposes of the description hereinafter, spatial orientation terms, as used, shall relate to the referenced embodiment as it is oriented in the accompanying drawings, figures, or otherwise described in the following detailed description. However, it is to be understood that the embodiments described hereinafter may assume many alternative variations and configurations. It is also to be understood that the specific components, devices, features, and operational sequences illustrated in the accompanying drawings, figures, or otherwise described herein are simply exemplary and should not be considered as limiting.

[0035] The present invention is directed to a universal syringe **10** that is adapted to accommodate a variety of cartridges **12** for a medicament having different diameters and/or lengths. As shown in FIG. **11**, such cartridges comprise a proximal end **14**, a distal end **16**, and a sidewall **18** extending from the proximal end **14** to the distal end **16** and defining a chamber **20** adapted to contain a medicament. The proximal end **14** is closed by a stopper **22**, and the distal end

16 is closed by a pierceable septum 24. The application of a distal force to the stopper 22, moves the stopper 22 from a first position within the chamber 20 adjacent the proximal end 14 of the cartridge 12 to a second position within the chamber 20 adjacent the distal end 16 of the cartridge 12, thereby dispensing the medicament through a needle inserted through the pierceable septum 24 at the distal end 16 of the cartridge 12.

[0036] As shown in FIGS. 1-3, 9, 11, and 12, the syringe 10 comprises a housing 26, a plunger 28, and an adjustment system comprising an adjustment knob 30 and two or more adjustment plates 32. A needle assembly 34 comprising a needle 36 having a beveled point 38*a*, 38*b* at each end and needle holder 40 may be provided for attachment to the housing 26 (FIGS. 10-12).

[0037] The housing 26 has a proximal end 42, a distal end 44, and a sidewall 46 extending between the proximal end 42 and distal end 44. The sidewall 46 defines a passageway 48 adapted to receive a medicament cartridge 12. The passageway 48 may be substantially cylindrical. A bottom surface 50 extends inwardly from the sidewall 46 at the distal end 44 of the housing 26. An opening 52 is provided in the bottom surface 50 and a collar 54 extends distally from the bottom surface 50 and surrounds the opening 52. The collar 54 is adapted to engage the needle holder 40 of a needle assembly 34.

[0038] At least one opening 56 is provided in the sidewall 46 of the housing 26 through which the cartridge 12 can be placed in the passageway 48. The opening 56 may have a length extending along the sidewall 46 in a longitudinal direction L extending from the proximal end 42 to the distal end 44 and a width extending around a circumference of the sidewall 46 in a direction perpendicular to the length of the opening 56. The length and width of the opening 56 are sufficient to allow a cartridge 12 having the largest cross-section and length that the syringe 10 is intended to accommodate to be inserted through the opening 56.

[0039] The plunger 28 comprises a plunger rod 58, an engagement portion 60 extending from a distal end 62 of the plunger rod 58, and a thumb pad 64 extending from a proximal end 66 of the plunger rod 58 in a direction perpendicular to the plunger rod 58. The engagement portion 60 of the plunger 28 is contained within the passageway 48 of the housing 26 and adapted to engage the stopper 22 of the cartridge 12. The plunger 28 is movable with respect to the housing 26 such that a distal force applied to the plunger 28 while holding the housing 26 stationary causes the engagement portion 60 of the plunger 28 to be displaced in a distal direction within the passageway 48 of the housing 26. The engagement portion 60 of the plunger 28 may be stepped (FIG. 8), comprising portions 68 having different dimensions which correspond to the dimensions of a variety of stoppers 22 used in various cartridges 12.

[0040] A flange 70 may extend from the proximal end 42 of the housing 26. The flange 70 is adapted to accommodate a user's fingers to apply a counterforce when the user is using their thumb to apply a distal force to the plunger 28 to administer the medicament to a patient.

[0041] An alignment system comprising an adjustment knob 30 provided at a proximal end 42 of the housing 26 and two or more adjustment plates 32 extending into the passageway 48 of the housing 26.

[0042] The adjustment knob 30 is positioned at the proximal end 42 of the housing 26 and comprises a distal engagement portion 72 that extends into the passageway 48 and a proximal grip portion 74 that extends above the proximal end 42 of the housing 26. A through-hole extends from the proximal end 76 of the adjustment knob 30 to the distal end 78 of the adjustment knob 30. The plunger rod 58 of the plunger 28 passes through the through-hole in the adjustment knob 30.

[0043] Two or more adjustment plates 32 are provided to align and hold the cartridge 12 within the passageway 48 of the housing 26. The adjustment plates 32 are elongated plates that extend in the passageway 48 in the longitudinal direction from the proximal end 42 of the housing 26 to the distal end 44 of the housing 26. The adjustment plates 32 may have a curvature corresponding to the curvature of an outer surface of the cartridge 12 allowing each adjustment plate 32 to partially surround the outer surface of the cartridge 12 when the cartridge 12 is contained in the passageway 48 of the housing 26. The adjustment plates 32 may be positioned with respect to one another at equal increments around the circumference of the passageway 48 of the housing 26. For example, when two adjustment plates 32*a*, 32*b* are provided, the adjustment plates 32*a*, 32*b* are positioned substantially opposite one another. If four adjustment plates were provided, the adjustment plates would be positioned at 90° angles to one another. The proximal ends 80 of the adjustment plates 32 extend into the engagement portion 72 of the adjustment knob 30, and the distal ends 82 of the adjustment plates 32 abut the bottom surface 50 of the housing 26.

[0044] As shown in FIGS. 4-6, the engagement portion 72 of the adjustment knob 30 comprises two or more camming portions 84 extending in the longitudinal direction. Each camming portion 84 has a first end 86, a second end 88, a distal surface 90, and a sidewall 92. The radial length of the distal surface 90 of each camming portion 84 increases from the first end 86 to the second end 88, such that the radial length at the first end 86 of each camming portion 84 is smaller than the radial length at the second end 88 of the camming portion 84. The radial length of the distal surface 90 of each camming portion 84 may increase in a continuous manner from the first end 86 to the second end 88. When two camming portions 84 are provided, each camming portion 84 extends 180° around the circumference of the engagement portion 72 of the adjustment knob 30. The first end 86*a* of the first camming surface 84*a* is adjacent the second end 88*b* of the second camming portion 84*b*, such that the first end 86*a* of the first camming portion 84*a* is substantially opposite the first end 86*b* of the second camming portion 84*b*. The sidewalls 92 of the camming portions 84 define an opening 94 having a maximum width between the first ends 86*a*, 86*b* of the camming portions 84*a*, 84*b* and a minimum width between the second ends 88*a*, 88*b* of the camming portions 84*a*, 84*b*.

[0045] The adjustment knob 30 is rotatable with respect to the housing 26.

[0046] With the plunger rod 58 extending through the through-hole of the adjustment knob 30, the sidewalls 92 of the camming portions 84 and the plunger rod 58 define a slot 96 having a radial width increasing from the second end 88 of each camming portion 84 to the first end 86 of the camming portion 84. The proximal ends of the adjustment plates 32 are received in the slot 96 such that each adjustment plate 32 is associated with a corresponding camming portion 84.

[0047] The adjustment knob **30** may be rotated with respect to the housing **26** and the adjustment plates **32** by grasping and turning the grip portion **74** of the adjustment knob **30**. By rotating the adjustment knob **30** with respect to the housing **26**, the distance between the adjustment plates **32** and correspondingly the distance between the adjustment plates **32** and an interior of the sidewall **46** of the housing **26** can be changed.

[0048] With the adjustment knob **30** rotated to a position in which the adjustment plates **32***a*, **32***b* are each received in the slot **96** adjacent a corresponding first end **86***a*, **86***b* of a camming portion **84***a*, **84***b*, the adjustment plates **32***a*, **32***b* are at a maximum distance D_1 from one another. With the adjustment knob **30** rotated to a position in which the proximal ends **80** of the adjustment plates **32***a*, **32***b* are each received in the slot **96** adjacent a corresponding second end **88***a*, **88***b* of a camming portion **84***a*, **84***b*, the adjustment plates **32***a*, **32***b* are at a minimum distance D_2 from one another. With the adjustment knob **30** rotated to a position in which the adjustment plates **32***a*, **32***b* are each received in the slot **96** at a position between the first end **86***a*, **86***b* of a camming portion **84***a*, **84***b* and the second end **88***a*, **88***b* of a camming portion **84***a*, **84***b*, the adjustment plates **32***a*, **32***b* are at distance from one another that is between the maximum distance D_1 and the minimum distance D_2.

[0049] As the adjustment knob **30** is rotated, at the position of each of the adjustment plates **32** in the slot **96**, the radial distance of the distal surface **90** of the camming portions **84** is increased or decreased, thereby causing the sidewalls **92** of the camming portions **84** to force the adjustment plates **32** radially inward or allow the adjustment plates **32** to move radially outward, respectively. As a result of the movement of the adjustment plates **32** by the camming portions **84** of the adjustment knob **30**, the distance between the adjustment plates **32** and correspondingly the distance between the adjustment plates **32** and an interior of the sidewall **46** of the housing **26** can be changed.

[0050] With a cartridge **12** inserted in the passageway **48** of the housing **26**, the adjustment plates **32** can be brought into contact with the outer surface of the cartridge **12** by rotating the adjustment knob **30**, thereby supporting the cartridge **12** within the passageway **48** and aligning the pierceable septum **24** of the cartridge **12** with the opening **52** in the bottom surface **50** of the housing **26**.

[0051] In addition to the interaction between the adjustment plates **32***a*, **32***b* and the slot **96**, optional slots or guide plates extending in the longitudinal direction of the interior surface of the sidewall **46** of the housing **26** and/or slots or guide plates extending in the radial direction along the interior surface of the bottom surface **50** of the housing **26** may be included to aid in the positioning of the adjustment plates **32***a*, **32***b* relative to one another around the circumference of the housing **26**.

[0052] As shown in FIG. **7**, an indicator **98**, for example, an arrow, may be provided on the adjustment knob **30** and indicia **100** may be provided on the flange **70** of the housing **26**. As the adjustment knob **30** is rotated, the indicator **98** corresponds to the indicium **100** indicating the position of the adjustment plates **32**. The indicia **100** may correlate to the placement of the adjustment plates **32** to specific size cartridges holding different amount of medicament, for example, 2 ml, 3 ml, and 5 ml indicia, which indicate that the adjustment plates **32** are positioned to hold 2 ml, 3 ml, and 5 ml cartridges, respectively.

[0053] The syringe **10** may be provided with a needle assembly **34** comprising a needle **36** having a beveled point **38***a*, **38***b* at each end and needle holder **40** (FIGS. **10-12**). The needle holder **40** comprises a sleeve **102** and a needle hub **104**. The sleeve **102** fits securely around the needle **36**. The sleeve **102** may be substantially disk-shaped with a through-hole through which the needle **36** passes and may be held around the needle **36** by friction. The needle hub **104** is adapted to be received in a corresponding opening **106** in the collar **54** of the housing **26**, has a through-hole through which the needle **36** passes, and includes a recess **108** for receiving the sleeve **102**. The sleeve **102** may be frictionally engaged within the recess **108** of the needle hub **104**. Alternatively, a single piece needle hub that frictionally engages the needle **36** may be provided. The needle **36** passes through the through-holes in the sleeve **102** and the needle hub **104**, such that a portion of the needle **36** extends proximally from the needle holder **40**, and a portion of the needle **36** extends distally from the needle holder **40**. The needle holder **40** may be positioned substantially midway between the two beveled points **38***a*, **38***b* along the shaft of the needle **36**.

[0054] One or more needle shields **110** covering one or both of the beveled points **38***a*, **38***b* of the needle **36** may be provided. A needle shield **110** covering the beveled point **38***a* that is inserted into the housing **26** of the syringe **10** may be removed prior to the insertion of the needle holder **40** into the collar **54** of the housing **26**, and a needle shield covering the beveled point **38***b* that is inserted into the patient may be removed prior to the insertion of the needle **36** into the patient. In this manner, users are prevented from accidently being stuck with the beveled points of the needle and the needle is kept sterile prior to use.

[0055] When the needle hub **104** is inserted into the opening **106** in the collar **54** of the housing **26**, the portion of the needle **36** extending proximally from the needle holder **40** passes through the opening **52** in the bottom surface **50** of the housing **26** and into the passageway **48**. When a cartridge **12** is contained in the passageway **48**, the portion of the needle **36** extending proximally from the needle holder **40** pierces the pierceable septum **24** of the cartridge **12** creating a fluid path for the medicament to pass from the cartridge **12** through the needle **36**.

[0056] The needle assembly **34** may be removably locked within the collar **54** of the housing **26**. The locking assembly for removably locking the needle hub **104** within the collar **54** of the housing **26** may comprise at least one flexible finger **112** extending from an outer surface of the needle hub **104** and a corresponding recess **114** in the opening **106** in the collar **54** of the housing **26**. The locking mechanism has a longitudinal direction, which is the direction in which the needle holder **40** is inserted into the opening **106** in the collar **54** of the housing **26**, a transverse direction, which is a direction vertically perpendicular to the longitudinal direction, and a lateral direction, which is a direction horizontally perpendicular to the longitudinal direction. The flexible finger **112** comprises a first portion **112***a* attached to the hub and a second portion **112***b* extending in the longitudinal direction from the first portion **112***a*. A width of the first portion **112***a* of the flexible finger **112** in the lateral direction is greater than a width of the second portion **112***b* of the flexible finger **112** in the lateral direction. The recess **114** has first portion **114***a* and a second portion **114***b* extending in the transverse direction from the first portion **114***a*. The width of

the first portion **114***a* of the recess **114** in the lateral direction corresponds to the width of the first portion **112***a* of the flexible finger **112** in the lateral direction and the width of the second portion **114***b* of the recess **114** in the lateral direction corresponds to the width of the second portion **112***b* of the flexible finger **112** in the lateral direction.

[0057] When the needle holder **40** is inserted longitudinally into the opening **106** of the collar **54** of the housing **26**, the first portion **112***a* of the flexible finger **112** is received in the first portion **114***a* of the recess **114**, and the flexible finger **112** is biased in the transverse direction toward the needle holder **40** by the upper surface of the first portion **114***a* of the recess **114**. As the needle holder **40** is further inserted into the opening **106** of the collar **54** of the housing **26**, the first portion **112***a* of the flexible finger **112** extends past the interior end of the first portion **114***a* of the recess **114**, the biasing force is released from the flexible finger **112**, and a portion of the second portion **112***b* of the flexible finger **112** is received in the second portion **114***b* of the recess **114**. In this positon, the first portion **112***a* of the flexible finger **112** abuts the interior end of the second portion **114***b* of the recess **114**, and because the first portion **112***a* of the flexible finger **112** is wider in the lateral direction than the width of the second portion **114***b* of the recess **114** in the lateral direction, the needle hub **104** is locked in the opening **106** in the collar **54** of the housing **26**. By exerting a transverse biasing force on the portion of the second portion **112***b* of the flexible finger **112** that extends out of the second portion **114***b* of the recess **114**, the engagement between the interior end of the second portion **114***b* of the recess **114** and the first portion **112***a* of the flexible finger **112** is released, the first portion **112***a* of the flexible finger **112** can again enter the first portion **114***a* of the recess **114**, and the needle holder **40** can be pulled from the opening **106** in the collar **54** of the housing **26**.

[0058] The needle holder **40** and the opening **106** in the collar **54** of the housing **26** can be chosen such that the needle holder **40** can only be inserted in the collar in a single orientation. Alternatively, the locking assembly may be positioned such that the needle holder **40** can only be inserted in the collar in a single orientation. The needle **36** may be fixed in the needle holder in a specific direction, such that, when the needle holder **40** is inserted in the opening **106** in the collar **54** of the housing **26**, the orientation of the beveled point **38***b* of the needle **36** with respect to the syringe **10** is oriented in the desired direction for injection to be made, for example, with the bevel facing up. In this way, the desired orientation of the beveled point **38***b* of the needle **36** is automatically achieved when the needle assembly **40** is attached to the housing **26**.

[0059] In use, the plunger **28** of the syringe **10** may be pulled in a proximal longitudinal direction until the engagement portion **60** of the plunger **28** is adjacent the proximal end **42** of the housing **26**. A cartridge **12** is then inserted through the opening **56** in the sidewall **46** of the housing **26** and into the passageway **48**. The cartridge **12** is positioned such that the distal end **16** of the cartridge **12** having the pierceable septum **24** abuts the bottom surface **50** of the housing **26**. The adjustment knob **30** is then turned until the adjustment plates **32** contact and partially surround the outer surface of the cartridge **12**. The plunger **28** is then pushed in the distal longitudinal direction until the engagement portion **60** of the plunger **28** contacts the stopper **22** of the cartridge **12**. The needle holder **40** of the needle assembly **34** is then inserted into the opening **106** in the collar **54** of the housing **26** with the proximal beveled point **38***a* of the needle **36** piercing the pierceable septum **24** of the cartridge **12**, such that the medicament in the cartridge **12** can pass through the needle **36**. The distal beveled end **38***b* of the needle **36** extending from the distal end **44** of the housing **26** can be used to pierce the skin of a patient, and the plunger **28** can be pushed in a longitudinal distal direction. As the plunger **28** is pushed distally, the engagement portion **60** of the plunger **28** pushes the stopper **22** of the cartridge **12** in a distal direction, thereby forcing the medicament out of the cartridge **12** through the needle **36**, and into the patient.

[0060] The various components of the syringe **10** and needle assembly **34** can be made from any suitable material including, but not limited to high density polyethylene (HDPE), acrylonitrile butadiene styrene (ABS) or polyoxymethylene (Delrin©).

[0061] Cartridges containing 1-10 ml of medicament, having an outer diameter of 5-25 mm or 8-23 mm can be accommodated by the syringe **10**.

[0062] While the description has focused on a syringe **10** having two adjustment plates **32***a*, **32***b* and two corresponding camming portions **84***a*, **84***b*, the syringe may have more than two adjustment plates and two corresponding camming portions. By keeping an even number of adjustment plates and an even number of camming portions and having an equal number of adjustment plates and camming portions, it can be assured that all of the adjustment plates will be equally distanced from the sidewall of the housing, thereby aligning and centering the cartridge within the housing.

[0063] The inventive syringe allows medicament in cartridges of a variety of diameters and lengths to be administered to the patient with a single syringe. Because the fluid path is through the needle, the medicament is not exposed to any portion of the syringe, thereby allowing the syringe to be multiple uses without sterilization of the syringe between uses while still assuring the sterility of the medicament fluid path. The inventive syringe has a design that is simple with a camming mechanism provided for adjustment rather than a screw mechanism. This makes the inventive syringe easy to manufacture. By providing a separate needle assembly, orientation of the beveled point of the needle for proper introduction into the tissue of the patient can be accomplished. Yet, even with these advantages over the prior art syringes, the inventive syringe operates in a conventional manner that is well-known to users of the prior art syringes.

[0064] Whereas particular aspects of this invention have been described above for purposes of illustration, it will be evident to those skilled in the art that numerous variations of the details of the present invention may be made without departing from the invention.

1. A syringe for dispensing medicament from a cartridge, the syringe comprising:

- a housing having a proximal end, a distal end, and a sidewall defining a passageway adapted to receive the cartridge;
- an adjustment system comprising an adjustment knob positioned at the proximal end of the housing and two or more adjustment plates extending into the passageway of the housing; and
- a plunger comprising a plunger rod, the plunger rod extending though a through-hole in the adjustment knob and into the passageway of the housing,

wherein rotation of the adjustment knob with respect to the housing causes a distance between the adjustment plates to be changed and a distance between the adjustment plates and an interior of the sidewall of the housing to be changed.

2. The syringe of claim **1**, wherein a bottom surface extends inwardly from the sidewall at the distal end of the housing, an opening is provided in the bottom surface, and a collar adapted to engage a needle hub of a needle assembly extends around the opening.

3. The syringe of claim **1**, wherein at least one opening is provided in the sidewall of the housing through which the cartridge can be placed in the passageway.

4. The syringe of claim **1**, wherein the plunger is movable with respect to the housing such that a distal force applied to the plunger while holding the housing stationary causes the plunger to be displaced in a distal direction within the passageway of the housing.

5. The syringe of claim **1**, wherein the plunger further comprises an engagement portion adapted to engage a stopper of the cartridge extending from a distal end of the plunger rod and/or a thumb pad extending from a proximal end of the plunger rod.

6. The syringe of claim **5**, wherein the engagement portion of the plunger may be stepped, comprising portions having different dimensions which correspond to the dimensions of a variety of stoppers used in various cartridges.

7. The syringe of claim **1**, further comprising a flange extending from the proximal end to the housing.

8. The syringe of claim **1**, wherein the adjustment plates are elongated plates that extend in a longitudinal direction from the proximal end of the housing to the distal end of the housing.

9. The syringe of claim **1**, wherein the adjustment plates have a curvature corresponding to an outer curvature of the cartridge allowing each plate to partially surround the outer surface of the cartridge when the cartridge is contained in the passageway of the housing.

10. The syringe of claim **1**, wherein the adjustment plates are positioned with respect to one another at equal increments around a circumference of the passageway of the housing.

11. The syringe of claim **1**, wherein two adjustment plates are provided and the adjustment plates are positioned substantially opposite one another.

12. The syringe of claim **1**, wherein the syringe has an even number of adjustment plates and a corresponding number of camming portions.

13. The syringe of claim **1**, wherein the adjustment knob comprises an engagement portion that extends into the passageway of the housing and a grip portion that extends above the proximal end of the housing.

14. The syringe of claim **13**, wherein proximal ends of the adjustment plates extend into the engagement portion of the adjustment knob, and distal ends of the adjustment plates are adjacent the distal end of the housing.

15. The syringe of claim **13**, wherein the engagement portion of the adjustment knob comprises two or more camming portions, each camming portion having a first end, a second end, a distal surface, and a sidewall, wherein a radial length of the distal surface of each camming portion increases from the first end to the second end, such that a radial length at the first end of each camming portion is smaller a radial length at the second end of the camming portion.

16. The syringe of claim **15**, wherein the first end of a first camming surface is adjacent the second end of a second camming portion.

17. The syringe of claim **15**, wherein the sidewalls of the camming portions define an opening having a maximum width between the first ends of the camming portions and a minimum width between the second ends of the camming portions.

18. The syringe of claim **15**, wherein the syringe comprises two adjustment plates and two camming portions where each camming portion extends 180° around a circumference of the engagement portion of the adjustment knob.

19. The syringe of claim **15**, wherein the sidewalls of the camming portions and the plunger rod define a slot having a radial width increasing from the second end of each camming portion to the first end of the camming portion.

20. The syringe of claim **15**, wherein distal ends of the adjustment plates are received in the slot such that each adjustment plate is associated with a corresponding camming portion.

21.-**30**. (canceled)

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