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(54) Title: SYRINGE ADAPTER WITH CONCENTRIC RINGS

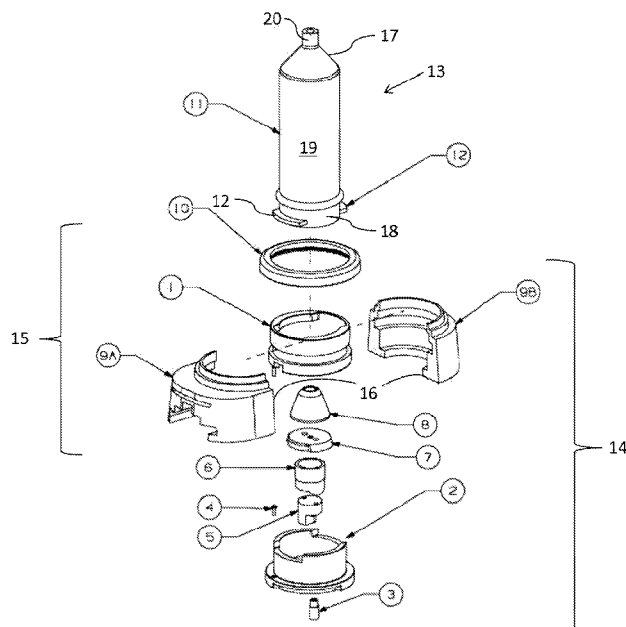


FIG. 1

(57) Abstract: An adapter (14) for use with a syringe and a power injector includes an outer ring (1) having a first end configured for passage of an end of a syringe (19) having at least one flange (12). An inner ring (2) is disposed coaxially within the outer ring. The inner ring has a first end including at least one flange slot. A magnet (3) fixed relative to the inner ring such that when the syringe end is disposed in the outer ring and the at least one flange engages the at least one flange slot, rotation of the syringe causes rotation of the inner ring and magnet relative to the outer ring.



SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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SYRINGE ADAPTER WITH CONCENTRIC RINGS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of and priority to United States Provisional Application No. 61/940,550, filed February 17, 2014.

BACKGROUND

[0002] This invention relates in general to syringes and syringe adapters used in conjunction with power injectors.

[0003] Injectors are devices that expel fluid, such as contrast fluid, into a circulatory system, which is used to enhance medical imaging like, for example, x-ray or magnetic imaging. The contrast fluid or contrast media is injected from a syringe, through a tube, and into an animal subject or human patient. Injectors are well known for use with a powered injector unit that is frequently fixed to a stand or support. Injectors typically include a plunger drive that couples to the plunger of the syringe and moves the plunger forward to expel fluid into the tube thereby injecting the contrast media in the subject.

[0004] Powered injectors or motorized injectors often include circuitry that controls the plunger drive unit for setting the rate of injection and/or the amount of fluid injected. Typically, the control circuitry includes switches which allow a user to manually actuate the drive unit to move the plunger within the syringe. The injector may cycle the plunger through the syringe one or more times to fill the syringe with fluid and expel any air bubbles trapped inside. Other syringes come pre-filled, which reduces the number of plunger drive movements needed to prepare the injector for a new injection. After the procedure has ended, the syringe plunger, typically positioned at the forward end of the syringe barrel, is retracted so that the syringe may be removed from the injector. In some injectors, the syringe can only be removed or replaced while the plunger drive is fully retracted.

[0005] Excess contrast media remaining in a syringe after an injection must be discarded as is well known in medical procedures to prevent cross contamination

and/or infection. However, contrast media can be expensive. For this reason, when preparing for an injection, an empty syringe is filled with only as much media as will be needed for the next procedure. Similarly, pre-filled syringes are sold in a number of sizes, for example ranging from 60 to 200 milliliters, allowing the operator preparing for an injection to select a syringe containing only as much media as is needed for that procedure. Accordingly, the syringes may have one or more characteristic properties or parameters that if communicated to the power injector would assist the operator in the procedure and provide safeguards for ensuring proper use of the contrast media. Examples of such parameters may include syringe diameter or length, syringe material, contrast fluid composition and concentration of the contrast media. These parameters may affect certain procedures like the delivery rate or pressure.

[0006] In some situations, customized syringes are intended to be used with certain specific power injectors.

SUMMARY

[0007] This invention relates more specifically to a syringe adapter that allows for the safe and effective use of non OEM syringes on power injectors that are used to deliver contrast and other diagnostic fluids during imaging procedures; in particular, an adapter utilizing two concentric rings.

[0008] In at least one embodiment, a magnet fixed to an inner rotating ring may be driven to a position that may make certain indications to an injector, such the load or lock state of a syringe. In further embodiments, it may be that the magnet that is fixed to the inner rotating ring interacts with a hall effect sensor of the injector to signal that the syringe is loaded/unloaded and/or locked/unlocked, thus indicating that the syringe is in a certain position and ready for subsequent phases of an injection procedure

[0009] Various aspects will become apparent to those skilled in the art from the following detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is an exploded view of a portion of an injector assembly including an adapter and a syringe.

[0011] Fig. 2A is a top view of the outer ring of Fig. 1.

[0012] Fig. 2B is a side cross-sectional view of the outer ring of Fig. 2A taken along line 2B.

[0013] Fig. 2C is a bottom view of the outer ring of Fig. 2A.

[0014] Fig. 2D is a side view of the outer ring of Fig. 2A.

[0015] Fig. 2E is a partial cross-sectional view of the outer ring of Fig. 2C taken along line 2E.

[0016] Fig. 2F is a perspective view of the outer ring of Fig 2A.

[0017] Fig. 3A is top view of the inner ring of Fig. 1.

[0018] Fig. 3B is a side cross-sectional view of the inner ring of Fig. 3A taken along line 3B.

[0019] Fig. 3C is a bottom view of the inner ring of Fig. 3A.

[0020] Fig. 3D is a side view of the inner ring of Fig. 3A.

[0021] Fig. 3E is an enlarged portion of the inner ring of Fig. 3B at 3E.

[0022] Fig. 3F is a perspective view of the inner ring of Fig. 3A.

[0023] Fig. 4A is an end view of the magnet holder of Fig. 1.

[0024] Fig. 4B is a side cross-sectional view of the magnet holder of Fig 4A taken along line 4B.

[0025] Fig. 5A is a top view of the ram extension of Fig. 1.

- [0026] Fig. 5B is a side view of the ram extension of Fig 5A.
- [0027] Fig. 5C is a bottom view of the ram extension of Fig. 5A.
- [0028] Fig. 5D is a front cross-sectional view of the ram extension of Fig 5A taken along line 5D.
- [0029] Fig. 5E is a bottom perspective view of the ram extension of Fig. 5A.
- [0030] Fig. 5F is a top perspective view of the ram extension of Fig. 5A.
- [0031] Fig. 6A is a top view of the ram sleeve of Fig. 1.
- [0032] Fig. 6B is a cross-sectional view of the ram sleeve of Fig. 6A taken along line 6B.
- [0033] Fig. 6C is a perspective view of the ram sleeve of Fig. 6A.
- [0034] Fig. 7A is a top view of the ram tip of Fig. 1.
- [0035] Fig. 7B is a side view of the ram tip of Fig. 7A.
- [0036] Fig. 7C is a bottom view of the ram tip of Fig. 7A.
- [0037] Fig. 7D is a cross-sectional view of the ram tip of Fig. 7A taken along line 7D.
- [0038] Fig. 7E is a bottom perspective view of the ram tip of Fig. 7A.
- [0039] Fig. 7F is a top perspective view of the ram tip of Fig. 7A.
- [0040] Fig. 8A is a side view of the cone of Fig. 1.
- [0041] Fig. 8B is a cross-sectional view of the cone of Fig. 8A taken along line 8B.

DETAILED DESCRIPTION

[0042] Referring now to the drawings collectively, there is illustrated a portion of an power injector assembly 15 with an adapter 14 and a syringe 13, together forming part of a medical system for injecting a fluid.

[0043] The adapter 14 includes an outer ring 1 and a concentric inner ring 2 which is coaxially disposed with the outer ring 1.

[0044] The outer ring 1 has a first end 201 configured for passage of an end of a syringe having at least one flange. As illustrated the first end 201 includes one or more ring flanges 202 that define recesses 203 for passage of syringe flanges, as will be further discussed below. The outer ring 1 includes a second end 204 having a slot 205 for engagement of a protrusion on the faceplate 16 of the injector 15. For example, the injector 15 may include a spring plunger 4 for engaging the slot 205 in the outer ring 1 for biasing the position of the inner ring 1 relative to the faceplate 16.

[0045] Further an annular groove 206 may be disposed between the first end 201 and the 204 for cooperative engagement with the faceplate 16.

[0046] The inner ring 2 is disposed coaxially within the outer ring 1. The inner ring 2 has a first end 301 including one or more flange slots 302.

[0047] The inner ring 2 may include a partially circumscribed radial slot 303 for interaction with a protrusion on a head (not shown) of the injector 15 to limit rotation of the inner ring 2 relative to the injector head.

[0048] A magnet 401 is fixed relative to the inner ring 2 by a magnet holder 3, the operation of which will be further described below.

[0049] The injector assembly 15 includes a faceplate 16 having an upper faceplate portion 9B and a lower faceplate portion 9A that together are disposed about the outer ring 1 and retain the adapter 14 to the injector assembly 15. The injector 15 further includes a faceplate ring 10 that cooperates with the upper faceplate portion 9B and the lower faceplate portion 9A to retain the outer ring 1 within the faceplate 16.

[0050] The illustrated syringe 13 has a barrel 11 having a distal end 17 and a proximal end 18 an interior volume 19 is defined therebetween. There are one or more syringe flanges 12 extending from the proximal end 18. A delivery tip 20 extends from the distal end 17.

[0051] The power injector assembly 15 includes a ram (not shown) for pushing fluid from the syringe 13.

[0052] In operation, a plunger (not shown) is disposed within the barrel 11 and may be driven by the ram of the injector assembly 15. The ram may drive the plunger to push fluid from the syringe 13.

[0053] The injector assembly may also optionally include a ram extension 5 connected to the end of the ram to accommodate a variety of syringe designs and/or use of an adapter to thus account for any difference in ram stroke length/position due to use of syringes of differing designs and/or the use of an adapter. A ram tip 7 may be connected to the end of the ram extension 5 opposite the ram, and a cone 8, for supporting the plunger, may be connected to the ram tip 8 opposite the ram extension 7. An optional ram sleeve 6 may be disposed about the ram extension 5, as desired.

[0054] In operation of the illustrated example, the inner ring 2 has two flange slots 302 in opposed position about the circumference of the first end 301 and the syringe 13 has two flanges 12 extending in opposed directions from the circumference of the proximal end 18 of the barrel 11. During placement of the syringe 13, the proximal end 18 is moved through the first end 201 of the outer ring 1 with the syringe flanges 12 passing through the recess 203. The two syringe flanges 12 are placed in the flange slots 302 of the inner ring 2.

[0055] Once the proximal end 18 of the syringe 13 is disposed in the outer ring 1 and the syringe flanges 12 engage the flange slots 302 on the inner ring 2, the syringe 13 may be rotated and thus cause rotation of the inner ring 2 and the magnet 401 relative to the outer ring 1.

[0056] In the case where the injector 15 has a magnetic sensor to determine the load or lock state of the syringe 13, the associated movement of the magnet 401 may make such indication to such a sensor.

[0057] In one exemplary method for operating a medical injector system in accordance with this disclosure, a power injector is provided with a ram. The power injector has a faceplate. An adapter is provided. The adapter includes an outer ring having a first end and an inner ring disposed coaxially within the outer ring. The inner ring has a first end including at least one flange slot. A magnet is fixed relative to the inner ring. A syringe is provided having a barrel with a distal end and a proximal end and an interior volume defined therebetween. At least one flange extends from proximal end, and a delivery tip extends from the distal end. The syringe is loaded on the power injector by passing the proximal end of the syringe through the first end of the outer ring, and the at least one flange engages the at least one flange slot. The syringe is rotated to cause rotation of the inner ring and magnet relative to the outer ring.

[0058] Prior to loading the syringe on the power injector, the method may include filling the syringe with a fluid for injection.

[0059] After loading the syringe on the power injector, the method may include filling the syringe with a fluid for injection.

[0060] In the method, the loading may include loading the syringe on the power injector with a plunger engaging the ram. The method may further include driving the ram to push fluid from the syringe.

[0061] Engaging the ram may include the use of a ram extension connected to the end of the ram, a ram tip connected to the end of the ram extension opposite the ram, and a cone for supporting the plunger connected to the ram tip opposite the ram extension.

[0062] For further example, a syringe load/ unload procedure in accordance with this disclosure includes having an outer ring in fixed in position relative to an Original

Equipment Manufacture (OEM) faceplate. Orientation for the outer ring is maintained by engagement of a slot in the outer ring with one or more protrusions on the faceplate. An inner ring is moveably coaxially disposed within the outer ring. The inner ring includes the flange slots for accepting flanges on a syringe. The alignment of the outer ring and/or inner ring may be biased with engagement of a spring plunger cooperating with the faceplate or an injector head and a corresponding slot in the outer ring or inner ring. Additionally, rotation of the outer ring or inner ring may be limited a circumferentially extending the radial slot on outer ring or inner ring that interacts with a protrusion, such as a fixed protruding pin, on the faceplate or on the injector head.

[0063] For additional example, a magnet positioning procedure in accordance with this disclosure includes having a magnet fixed relative to the inner ring. Movement of the inner ring between a load and an unload position also causes corresponding movement of the magnet. As the magnet is rotated away in such movement, for example from a hall effect sensor associated with the injector, movement of the magnet relative to the sensor may signal to the injector that a syringe is in a particular place or state.

[0064] In more example, a syringe retention or lock procedure in accordance with this disclosure includes that the syringe is placed into the syringe adapter, the syringe flanges are placed into the flange slots on the inner ring. The syringe is then rotated, for example 90 degrees clockwise, and the syringe is locked into position with the syringe flanges biased between the flange slots of the inner ring and the ring flanges of the outer ring. This relative positioning of the inner and outer ring may be maintained by an engagement of a spring plunger with the corresponding slot in the outer ring. Additionally, rotation may be limited by the a radial slot formed in the inner ring that interacts with a fixed protruding pin on the injector head.

[0065] While principles and modes of operation have been explained and illustrated with regard to particular embodiments, it must be understood, however, that this may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope.

What is claimed is:

1. A medical system for injecting a fluid comprising:
a power injector with a ram for pushing fluid from a syringe, the injector including:
a faceplate, and
an adapter for use with a syringe, the adapter engaging the faceplate, the adapter including:
an outer ring having a first end configured for passage of an end of a syringe having at least one flange,
an inner ring disposed coaxially within the outer ring, the inner ring having a first end including at least one flange slot, and
a magnet fixed relative to the inner ring,
where when the syringe end is disposed in the outer ring and the at least one flange engages the at least one flange slot, rotation of the syringe causes rotation of the inner ring and magnet relative to the outer ring.
2. The system of Claim 1 further comprising:
a syringe having:
a barrel having a distal end and a proximal end and defining an interior volume therebetween,
at least one flange extending from the proximal end, and
a delivery tip extending from the distal end,
where the ram drives a plunger disposed within the barrel to push fluid from the syringe.
3. The system of Claim 2 further comprising:
a ram extension connected to the end of the ram,
a ram tip connected to the end of the ram extension opposite the ram, and
a cone for supporting the plunger connected to the ram tip opposite the ram extension.

4. The system of Claim 2 where the inner ring has two flange slots and where the syringe has two flanges extending in opposed directions from the circumference of the barrel, the two flanges disposed in the flange slots.
5. The system of Claim 1 where the faceplate includes an upper faceplate portion and a lower faceplate portion that about one another and are disposed about the outer ring.
6. The system of Claim 5 where the injector further comprises a faceplate ring that cooperates with the upper faceplate portion and the lower faceplate portion to retain the outer ring within the faceplate.
7. The system of Claim 1 where the magnet is fixed relative to the inner ring by a magnet holder.
8. A method for operating a medical injector system comprising:
 - providing a power injector with a ram and having a faceplate,
 - providing an adapter including
 - an outer ring having a first end,
 - an inner ring disposed coaxially within the outer ring, the inner ring having a first end including at least one flange slot, and
 - a magnet fixed relative to the inner ring,
 - providing a syringe having:
 - a barrel having a distal end and a proximal end and a defining an interior volume therebetween,
 - at least one flange extending from proximal end, and
 - a delivery tip extending from the distal end,
 - loading the syringe on the power injector by passing the proximal end of the syringe through the first end of the outer ring, engaging the at least one flange slot with the at least one flange, and
 - rotating the syringe to causes rotation of the inner ring and magnet relative to the outer ring.

9. The method of Claim 8 further comprising, prior to loading the syringe on the power injector, filling the syringe with a fluid for injection.
10. The method of Claim 8 further comprising, after loading the syringe on the power injector, filling the syringe with a fluid for injection.
11. The method of Claim 8 wherein the loading includes loading the syringe on the power injector with a plunger engaging the ram.
12. The method of Claim 11 further comprising :
driving the ram to push fluid from the syringe.
13. The method of Claim 11 wherein engaging the ram includes the use of a ram extension connected to the end of the ram, a ram tip connected to the end of the ram extension opposite the ram, and a cone for supporting the plunger connected to the ram tip opposite the ram extension.
14. An adapter for use with a syringe and a power injector, the adapter comprising:
an outer ring having a first end configured for passage of an end of a syringe having at least one flange,
an inner ring disposed coaxially within the outer ring, the inner ring having a first end including at least one flange slot, and
a magnet fixed relative to the inner ring,
where when the syringe end is disposed in the outer ring and the at least one flange engages the at least one flange slot, rotation of the syringe causes rotation of the inner ring and magnet relative to the outer ring.
15. The adapter of Claim 14 where the outer ring includes a second end having a slot for engagement of a protrusion on a faceplate of an injector.

16. The adapter of Claim 14 where the magnet is fixed relative to the inner ring by a magnet holder.

17. The adapter of Claim 14 further comprising a spring plunger engaging a slot in the outer ring for biasing the position of the inner ring.

18. The adapter of Claim 14 where the inner ring includes a radial slot for interaction with a protrusion on an injector head to limit rotation of the inner ring.

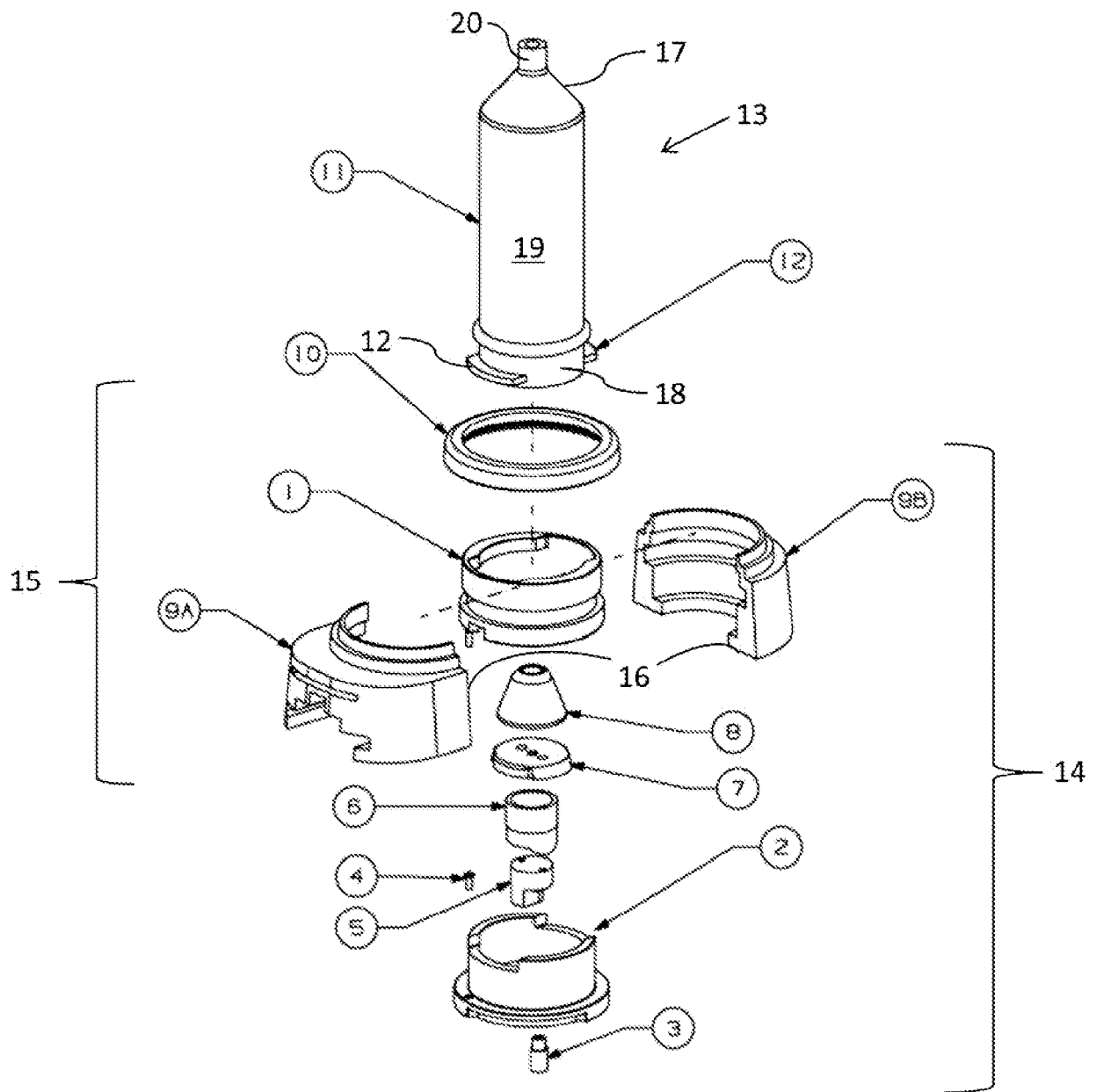


FIG. 1

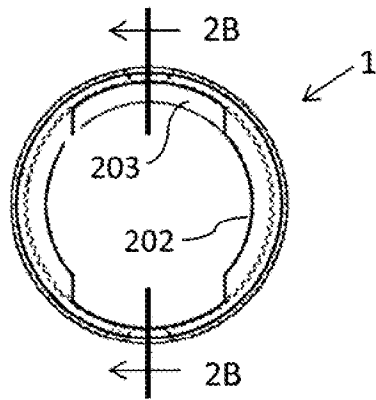


FIG. 2A

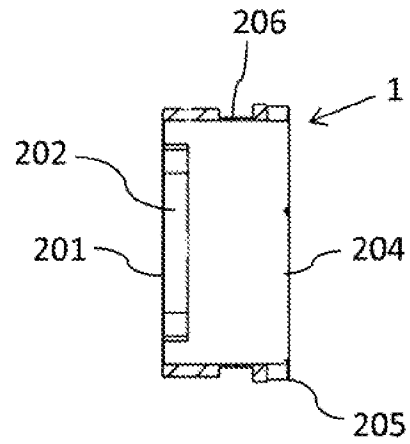


FIG. 2B

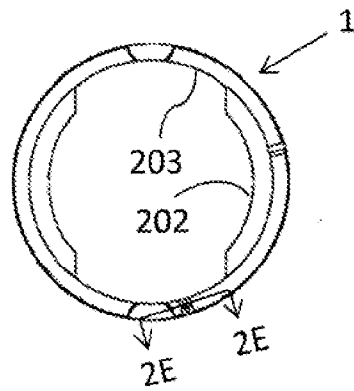


FIG. 2C

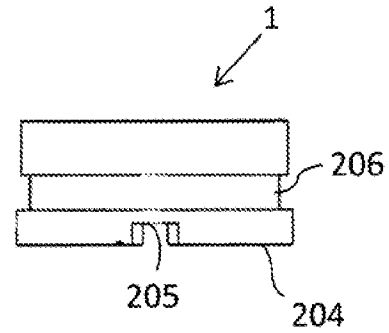


FIG. 2D



FIG. 2E

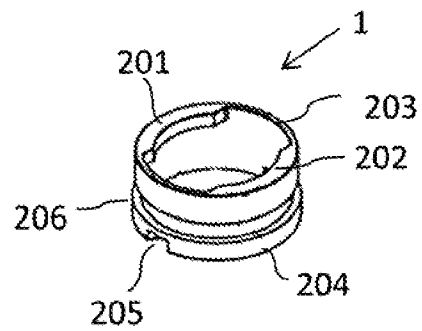


FIG. 2F

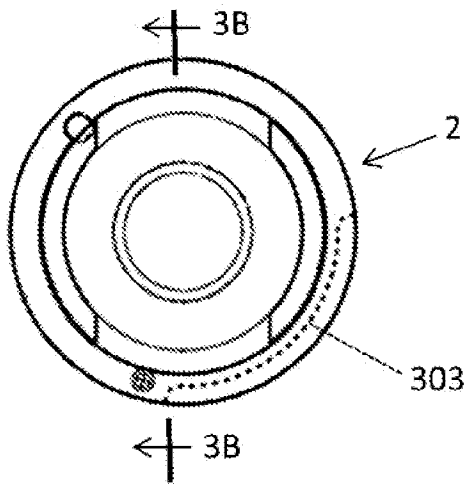


FIG. 3A

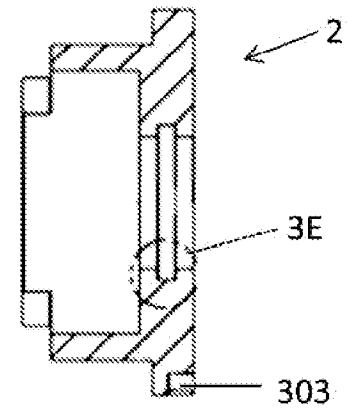


FIG. 3B

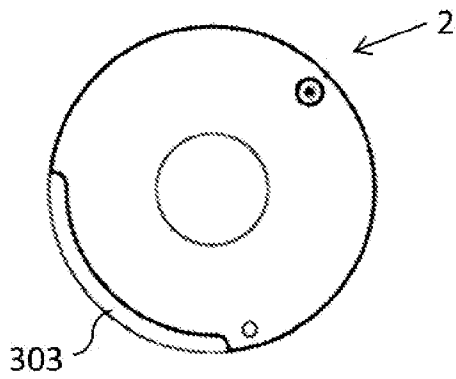


FIG. 3C

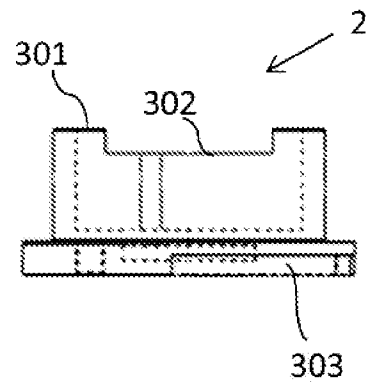


FIG. 3D

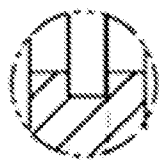


FIG. 3E

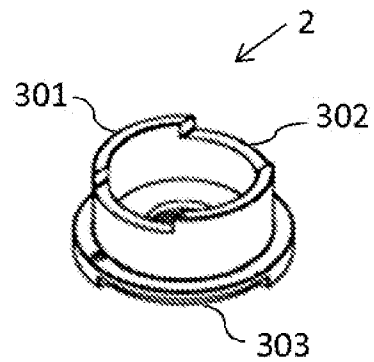


FIG. 3F

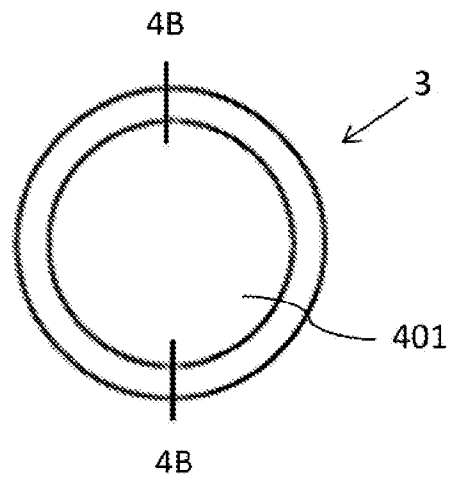


FIG. 4A

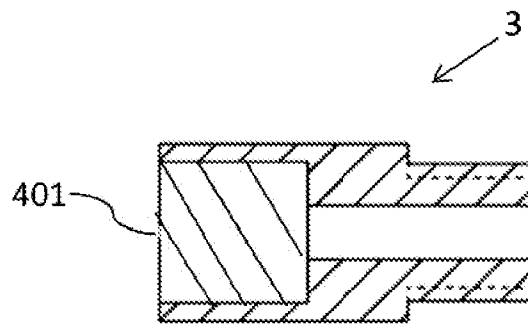


FIG. 4B

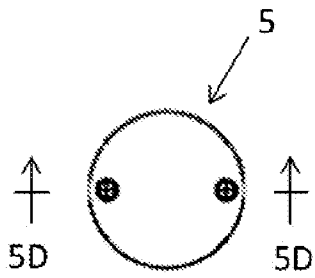


FIG. 5A

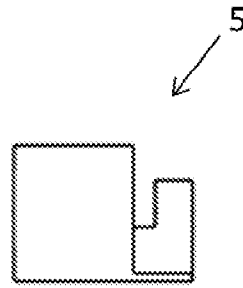


FIG. 5B

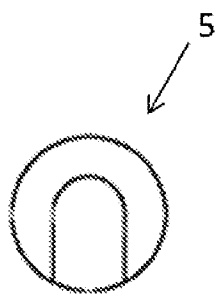


FIG. 5C

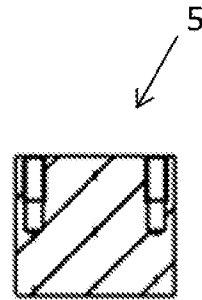


FIG. 5D

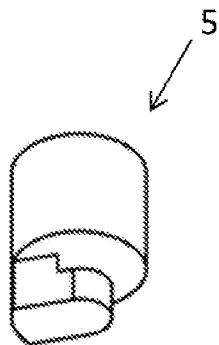


FIG. 5E

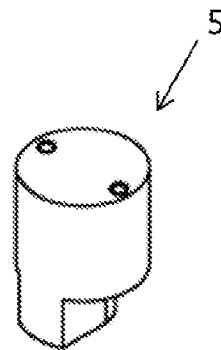


FIG. 5F

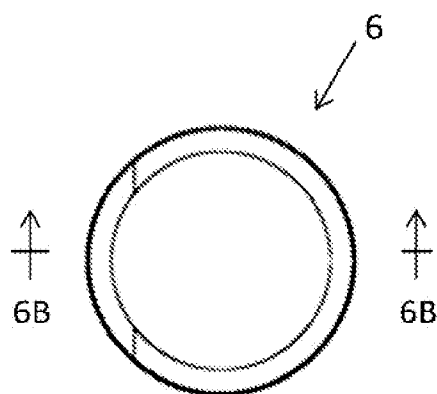


FIG. 6A

FIG. 6B

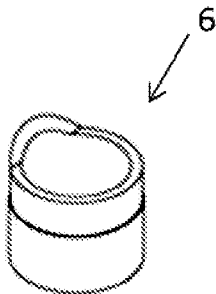
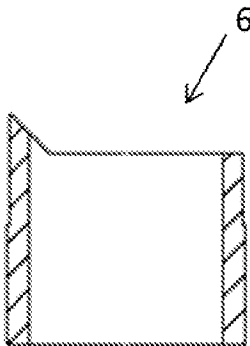


FIG. 6C

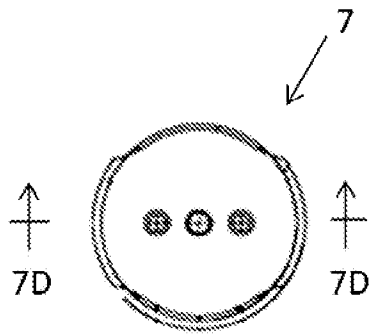


FIG. 7A

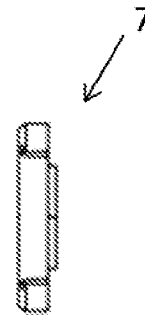


FIG. 7B

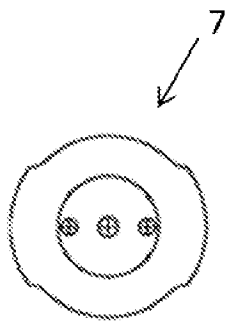


FIG. 7C

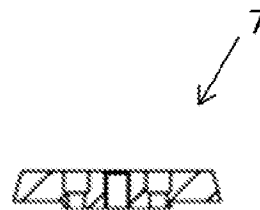


FIG. 7D

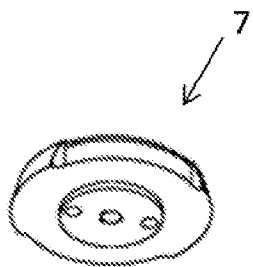


FIG. 7E

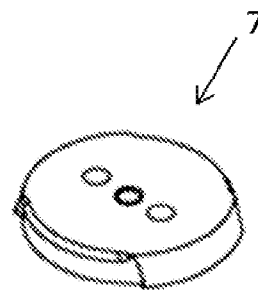


FIG. 7F

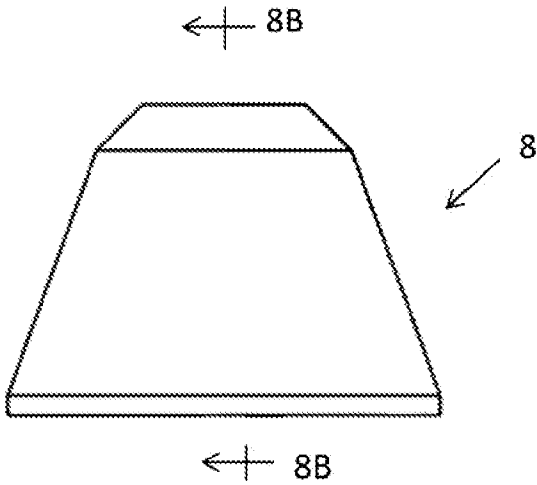


FIG. 8A

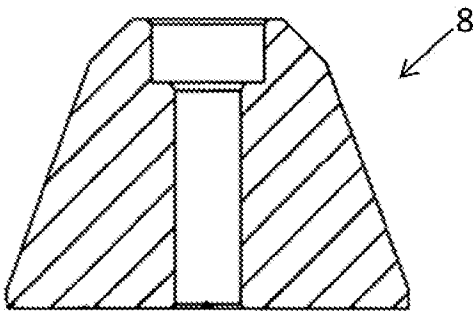


FIG. 8B

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/015912

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M5/315 A61M5/145
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2009/045714 A1 (MALLINCKRODT INC [US]; FAGO FRANK M [US]; GIBBS JONATHAN D [US]) 9 April 2009 (2009-04-09) page 19, line 16 - line 37; figure 7 -----	1-7, 14-18
Y	WO 2010/021953 A2 (MALLINCKRODT INC [US]; BRUCE JOHN K [US]; GIBSON CHAD M [US]; STROBL G) 25 February 2010 (2010-02-25) page 1, line 1 - page 5, line 34; figures 1A-2B, 4B page 14, line 23 - page 15, line 9 page 23, line 16 - page 25, line 16 ----- -/-	1-7, 14-18



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

24 April 2015

Date of mailing of the international search report

07/05/2015

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Knychalla, Verena

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/015912

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97/36635 A1 (MEDRAD INC [US]; SPOHN MICHAEL A [US]; ASHCRAFT ROBERT J JR [US]; BOWS) 9 October 1997 (1997-10-09) abstract; figures 3, 5 column 4, line 27 - line 40 column 5, line 23 - line 39 -----	1-7, 14-18
A	JP 2011 224273 A (MEDRAD INC) 10 November 2011 (2011-11-10) figures 2G, 4A -----	1-7, 14-18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/015912

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 8-13
because they relate to subject matter not required to be searched by this Authority, namely:
see FURTHER INFORMATION sheet PCT/ISA/210
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.1

Claims Nos.: 8-13

Claim 8 defines a method of operating a medical injection system. Claim 12 defines that a ram is driven to push fluid, and it is implicit that the fluid is injected into a patient. Thus, the subject-matter of claims 8-13 is regarded as a method for treatment of the human or animal body by therapy (R. 39.1 (iv) PCT).

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2015/015912

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