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(72) Inventor(s):
ANTHONY BUTTITTA
GRANT ANTHONY BOMGAARS
NICOLE MARIE MASCHERI

(73) Proprietor(s):
BAXTER INTERNATIONAL INC.
DF2-2E, Deerfield 1L 60015
United States of America

BAXTER HEALTHCARE SA
8152 Glattpark (Opfikon)
Switzerland

(74) Agent and/or Address for Service:
FRKelly
27 Clyde Road
Ballsbridge
Dublin 4
Ireland

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STORAGE CONTAINER FOR LIQUID ANESTHETIC EVAPORATOR

BACKGROUND

[0001] This patent is directed to an anesthetic storage container and, in particular, to an anesthetic storage container and a container adapter to be used with a halogenated anesthetic.

[0002] Liquid anesthetic is conventionally shipped from the manufacturer to the user (medical professional, hospital, etc.) in a container. While the design of the container may vary, it is often the case that the container will include an adapter with a valve assembly disposed in the neck of the container. The valve assembly controls the flow of liquid anesthetic from the container into a vaporizer, where the liquid anesthetic vaporizes typically in the presence of a carrier gas. The valve assembly may also control the return flow of vapor from the vaporizer into the container as the liquid is displaced from the container.

[0003] U.S. Patent No. 7,287,561 illustrates one example of such an adapter. As disclosed in that document, one conventional adapter includes a valve assembly disposed within a hollow conduit or neck portion. The valve assembly includes a shut-off valve biased against a sealing surface (or valve seat) with a spring such as to remain closed until properly mated with an filling device for an evaporator. The shut off-valve and sealing surface each include radiused (or curved) surfaces for creating a fluid tight seal. Such radiused surfaces however must be manufactured within specific tolerances in order to provide sufficient operating reliability, especially under pressure. This disadvantageously increases the inherent possibility of leaks in valves that are not manufactured to the highest standards. Moreover, over time, the reliability of these sealing surfaces depend on the alignment of the various components of the valve assembly. Any misalignment can compromise the integrity of the seal. This is often the case when using such designs with anesthetics.

[0004] As set forth in more detail below, the present disclosure sets forth a container with an improved valve assembly embodying advantageous alternatives to the valve assemblies of prior art devices.

SUMMARY

[0005] One aspect of the present disclosure provides a storage container for liquid anesthetic. The storage container includes a receptacle, an adapter neck, a first anesthetic specific coding, an outlet pipe, a valve seat, and a valve assembly. The receptacle can have a neck defining an opening and a passage between the opening and an interior of the receptacle. The adapter neck includes a generally tubular structure with a hollow interior, a proximal end, and a distal end, the proximal end connected to the neck of the receptacle. The first anesthetic specific coding is defined on an outer surface of the adapter neck between the proximal and distal ends. The outlet pipe is defined by the distal end of the adapter neck, and includes at least one slot disposed in a top side of the pipe. The at least one slot being adapted to be in fluid communication with the hollow interior of the adapter neck. The valve seat is defined at the proximal end of the adapted neck, and the valve seat having a first sloped surface. The valve assembly is adapted to control the flow of liquid anesthetic from the receptacle. The valve assembly includes a valve member with a second sloped surface, wherein the first sloped surface and the second sloped surface having different slopes. The first and second sloped surfaces abut each other to form a gasketless, fluid-tight seal therebetween when the valve assembly is in a closed configuration to limit the flow of anesthetic from the receptacle. And, the first and second sloped surfaces are spaced from each other when the valve assembly is in an open configuration to permit the flow of the anesthetic from the receptacle.

[0006] In some aspects, the second sloped surface has a slope that is steeper than a slope of the first sloped surface.

[0007] In some aspects, the valve seat is a frusto-conical surface comprising the first sloped surface, and the valve member comprises a poppet valve with the second sloped surface.

[0008] In some aspects, the poppet valve includes a third sloped surface, the third sloped surface having a slope that is different than the slope of the second sloped surface.

[0009] In some aspects, the valve assembly of the storage container further includes a conduit disposed in the adapter neck and having a wall defining a conduit passage with a first end adjacent the distal end of the adapter neck and a second end adjacent the proximal end of the

adapter neck. The valve seat is disposed at the proximal end of the adapter neck, and an actuation surface of the valve assembly is disposed at the first end of the conduit.

[0010] In some aspects, the adapter neck includes a neck flange at the proximal end, and the valve assembly includes a cage having a cage flange disposed between the neck flange and the neck of the receptacle.

[0011] In some aspects, the storage container further includes a biasing member disposed between the valve member and the cage, biasing the valve assembly into the closed configuration.

[0012] In some aspects, said first anesthetic-specific coding is designed as a polygon.

[0013] In some aspects, the at least one slot is a radially extending slot.

[0014] In some aspects, the at least one slot is a wedge shaped slot.

[0015] In some aspects, the outlet pipe includes a plurality of slots in the top side of the pipe.

[0016] In some aspects, the plurality of slots are designed as a star.

[0017] In some aspects, the storage container further includes a ferrule securing the adapter neck and valve assembly to the container.

[0018] In some aspects, the storage container further includes a cap threadably coupled over the outside of the adapted neck.

[0019] In some aspects, the storage container further includes a halogenated inhalation anesthetic disposed in the receptacle, the anesthetic selected from the group of halogenated anesthetics consisting of sevoflurane, desflurane, isoflurane, enflurane, methoxyflurane and halothane.

[0020] In some aspects, a wall of the receptacle has an exterior surface and comprises a layer of low-density polyethylene that defines at least in part the exterior surface of the wall.

[0021] In some aspects, the valve assembly and adapter neck are permanently coupled to the container.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Fig. 1 is a perspective view of a storage container for liquid anesthetic in accordance with the teachings of the present disclosure.

[0023] Fig. 1A is a detail view of Fig. 1 take from circle 1A, showing a container adapter of the storage container.

[0024] Fig. 2 is a longitudinal cross-sectional view of Fig. 1A showing an adapter neck and valve assembly of the storage container.

[0025] Fig. 2A is a detail view of Fig. 2 taken from circle 2A, showing a valve seating arrangement of the container adapter.

[0026] Fig. 3 is a partial cross-sectional view of Fig. 2, showing a receptacle and a ferrule removed, and also showing the valve assembly in an open configuration.

[0027] Fig. 4 is the same longitudinal cross-sectional view as Fig. 2, but also including a cap disposed over the adapter neck.

[0028] Fig. 5 is a perspective view of a filling device in accordance with the teachings of the present disclosure.

[0029] Fig. 6 is a longitudinal cross-sectional view of the filling device of Fig. 5.

DESCRIPTION

[0030] Referring to the drawings in particular, Figs. 1 and 1A show a perspective view of a storage container 10 including a receptacle 12 and a container adapter 14. FIG. 2 illustrates a longitudinal cross-sectional view of the container adapter 14 according to Figs. 1 and 1A. In some embodiments, the storage container 10 stores, or is adapted to store, a halogenated inhalation anesthetic including, for example, sevoflurane, desflurane, isoflurane, enflurane, methoxyflurane or halothane.

[0031] As depicted in Fig. 2, the receptacle 12 can include a storage bottle or other container, for example, and includes a neck 26, an opening 28, an interior 30, and a passage 32 through the neck 26 providing communication between the opening 28 and the interior 30. The container

adapter 14 of the present disclosure is attached to the neck 26 of the receptacle 12 at the opening 28 for controlling the flow of a fluid (e.g., a liquid anesthetic) relative to the receptacle 12, as will be described. In some versions, the container adapter 14 can be removably attached to the receptacle 12. In other versions, the container adapter 14 can be permanently attached to the receptacle 12.

[0032] Still referring to Fig. 2, the container adapter 14 is attachable or is attached to the receptacle 12 to control flow of fluids (e.g., anesthetic) through the passage 32 out of (and in to) the receptacle 12 to (and from) a vaporizer. In the depicted version, the container adapter 14 is attached to the neck 26 of the receptacle 12 with a crimped ferrule 46, but other fixation methods could be used including threads, welding, heat sealing, an adhesive, etc. The container adapter 14 includes an adapter neck 16, an outlet pipe 18, and a valve assembly 42. The adapter neck 16 is a generally tubular structure with a hollow interior 34, a proximal end 36, and a distal end 38. The proximal end 36 is shown connected to the receptacle 12 and defines a valve seat 52. Referring to Fig. 1, an outer surface of the adapter neck 16 includes a first anesthetic specific coding 40 disposed between the proximal and distal ends 36, 38. In the depicted version, the first anesthetic specific coding 40 includes an outer polygon 20. Still with reference to Fig. 1, the outlet pipe 18 is located at the distal end 38 of the adapter neck 16 and includes at least one slot 22 (shown in Figs. 1 and 1A) disposed in a top side 24 of the outlet pipe 18. The at least one slot 22 is adapted to be in fluid communication with the hollow interior 34 of the adapter neck 16 when the valve assembly 42 occupies an open configuration, as will be described. In some versions the at least one slot 22 includes a plurality of radially extending slots and, in the version of Figs. 1 and 1A, the at least one slot 22 includes five (5) radially extending slots. Moreover, in Figs. 1 and 1A, each slot 22 is a wedge shaped slot and the plurality of slots 22 are designed and arranged as a star. In this version, the outlet pipe 18 and adapter neck 16 are constructed as a single component, but other versions could be constructed differently.

[0033] Referring again to Fig. 2, the valve assembly 42 includes a valve member 44, a conduit 48, a cage (or basket) 50, and a resilient or biasing member 54. Other elements may be included as well, but as explained in greater detail below, the valve assembly 42 is designed to be gasketless in regard to the interface between the valve member 44 and the valve seat 52.

[0034] As seen in Figs. 2 and 2A, the adapter neck 16 is a tubular structure including a cylindrical wall 64 that defines the interior 34. As shown in Fig. 2A, the tubular wall 64 at the proximal end 36 of the adapter neck 16 defines a frusto-conical surface 148. The surface 148 defines the valve seat 132. The adapter neck 16 also includes a flange 66 (see Fig. 2) that depends radially outwardly from the wall 64 at the proximal end 36. The flange 66 has opposing first and second surfaces 152, 154.

[0035] The cage 50 (which may be made of nylon (e.g., nylon)) has a cage flange 160 that is disposed between the flange 66 of the adapter neck 16 and the neck 26 of the receptacle 12, as shown in Fig. 2. In particular, the cage flange 160 has opposing first and second surfaces 162, 164, and the first surface 162 of the cage flange 160 abuts the second surface 154 of the flange 66 on the adapter neck 16, while the second surface 164 of cage flange 160 abuts a gasket 166 (which may be made of low density polyethylene (LDPE)) disposed on a rim 120 of the receptacle 12 (i.e., between the flange 66 of the adapter neck 16 and/or cage flange 160 and the neck 26 of the receptacle 12, or more particularly, the rim 120 of the receptacle 12). A fluid-tight seal may be formed as a consequence.

[0036] Even though a fluid-tight seal may be formed, a layer of resilient polymer may define an exterior surface 118 of the receptacle 12, at least in the region of the neck 26. For example, a layer of low-density polyethylene may be disposed on a layer of aluminum or aluminum alloy in the region of the neck 26 of the receptacle 12. According to certain embodiments, the low-density polyethylene may be applied using powder coating techniques, in particular where the wall of the receptacle 12 is includes a layer of aluminum or an aluminum alloy. Other methods of including or applying the low-density polyethylene may also be used.

[0037] It should be noted that the entirety of the receptacle 12 need not include the layer of low-density polyethylene. For example, it may be that other regions of the receptacle 12 include other polymers, as discussed above. According to an exemplary embodiment, the receptacle 12 may include a wall 108 with a layer of a lacquer or an enamel disposed on a layer of aluminum or aluminum alloy, the layer of lacquer or enamel defining, at least in part, the interior surface 124 of the wall 108 of the receptacle 12. According to certain embodiments, the lacquer or enamel may include an epoxyphenolic resin.

[0038] As illustrated in Fig. 2, the ferrule 46 is disposed over at least a portion of the flange 66 of the adapter neck 16 and the cage flange 160 and about at least a portion of the neck 26 of the receptacle 12 to attach the adapter neck 16 and valve assembly 42 to the receptacle 12. The ferrule 46 has a cylindrical shape, with a first end 170 having an opening 172 with a rim 174 disposed about the opening 172 and defining the opening 172. The adapter neck 16 depends through the opening 172 in the first end 170 of the ferrule 46. A second end 176 of the ferrule 46 may be crimped about the flange neck 26 of the receptacle 12 to attach the components to the receptacle 12. The ferrule 46 may be made of aluminum.

[0039] While the illustrated embodiment of the present disclosure has been illustrated with the adapter neck 16 and valve assembly 42 attached to the receptacle 12 with a ferrule 46, it will be recognized that the container 10 need not be only defined as such. For example, the adapter neck 16 and valve assembly 42 may be in the form of an adapter that is mated with the receptacle 12 only just prior to use, and held with a cap that may be threaded on to the receptacle 12 or held in place by a "snap-off" fit. According to such an embodiment, the cap is removed from the receptacle 12 prior to use, and the valve assembly 42 inserted into the passage 32 of the receptacle 12 to attach the adapter neck 16 and valve assembly 42 to the receptacle 12. As such, the embodiment of the container 10 thus defined does not require the ferrule 46 illustrated in FIG. 1.

[0040] With reference to Figs. 2, 2A and 3, it will be recognized that the valve member 44 is disposed between the adapter neck 16 and the cage 50, or more particularly between the valve seat 52 and the cage 50. The valve member 44 has a first end 180 that abuts the valve seat 52 when the valve member 44 is in the closed position (as seen in Fig. 2). This may coincide with a closed configuration of the valve assembly 42. The valve member 44 is spaced from the valve seat 52 with the valve member 44 is in the open position (Fig. 3). This may coincide with an open configuration of the valve assembly 42 that permits the flow of the anesthetic to/from the receptacle 12.

[0041] As illustrated in Fig. 2A, the valve member 44 may have a head 182 formed at the first end 180. The head 182 may include at least one sloped surface 184, as illustrated. The sloped surface 184 faces the sloped surface 148 that defines the valve seat 52, and abuts the surface 148

to form a gasketless, fluid-tight seal therebetween with the valve assembly 42 in the closed configuration so as to limit the flow of the anesthetic from the receptacle 12. As illustrated, neither surface 148, 184 exhibits any curvature, such that the cross-section of the surfaces 148, 184 appears linear instead of exhibiting any arcuate section.

[0042] Elimination of a gasket between the surfaces 148, 184 is advantageous in that it eliminates the gasket material that comes into contact with the fluid, thereby eliminating a potential source of extractables or leachables that may impact the shelf life or other characteristic of the fluid. As observed by Schulte and Ellis, in Anesthesia and Analgesia, vol. 2, no. 2, pp. 644-645 (February 2010), a yellow discoloration may result from use of conventional anesthetic containers, which containers include the use of gaskets between valve members and valve seats. While they report that no patient harm is likely to result, the limitation or elimination of the compounds reported by Schulte and Ellis is believed to be possible through the elimination of gaskets in the anesthetic container.

[0043] As illustrated in Fig. 2A, the first sloped surface 148 of the valve seat 52 has a slope that is different than a slope of the second sloped surface 184 of the valve member 44. In Fig. 2A, a first line S1 has been extended from the sloped surface 148 and a second line S2 has been extended from the sloped surface 184 for ease of visualization. The first line S1 represents the slope of the surface 148, and the second line S2 represents the slope of the surface 184. With the valve seat 52 and valve member 44 oriented as illustrated in Figs. 2-3, it will be recognized that the slope of line S2 is steeper than the slope of line S1; that is, the rise of the line S2 in the vertical direction is larger than the rise of the line S1 for a comparable run in the horizontal direction.

[0044] In addition, it will be recognized that the slopes of the first and second surfaces 148, 150 are not horizontal, nor are they vertical. Instead, the slopes are such that the angle formed between the surface and the horizontal is between 0° and 90°. For example, the slope of the surface 148 may be described as 45°, while the slope of the surface 184 may be described as 60°, with reference to Fig. 2A.

[0045] It is believed that the valve seat 52 and the valve member 44, or more particularly the surfaces 148, 184, abut along a line of contact that runs about the circumference of the surface

184. It is also believed that the difference in the slopes of the surfaces 148, 184 permits a gap to be defined between sections of the facing surfaces 148, 184 disposed radially outward (relative to a longitudinal axis of the valve assembly 42) of the line of contact between the surfaces 148, 184. The gap between the sections of the facing surfaces 148, 184 may accommodate manufacturing tolerances in the surfaces 148, 184.

[0046] As also best illustrated in Fig. 2A, the valve member 44 may have a third sloped surface 186. The third sloped surface may be disposed radially inward (again relative to the longitudinal axis of the valve assembly 42) of the second sloped surface 184, and the second and third sloped surfaces 184, 186 may meet at an interface 188 along adjoining edges. The interface 188 may be disposed radially inward (relative to the afore-mentioned longitudinal axis) of the line of contact between the first and second sloped surfaces 148, 184. The third sloped surface 186 may have a slope (represented by the line S3) that is not as steep as the slope of the second sloped surface 184.

[0047] With reference to Figs. 2 and 3, it will be recognized that the valve member 44 includes a plate (or core seat) 190 attached to the conduit 48. It will be recognized that other valve members may be designed wherein the plate 190 and conduit 48 are formed as a single unit (i.e., integrally with each other). Thus, the illustrated embodiment is not intended to be limiting in this regard. The plate 190 may be made of low density polyethylene (LDPE), for example, while the conduit 48 may be made of nylon (e.g., nylon 66).

[0048] The plate 190 defines the first end 180 of the valve member 44 with the surface 184, and occludes the second end 62 of the interior 34 of the adapter neck 16 with the valve member 44 in the closed position. The plate 190 may be referred to as a poppet valve. The valve member 44 is biased towards a closed position, illustrated in Fig. 2, through the action of the resilient member 54, which may be a spring, as illustrated. The spring 54 may be made of stainless steel. The resilient member 54 is disposed between the valve member 44 and the cage 50, and specifically the plate 190 of the valve member 44 and a surface 194 of the cage 50.

[0049] The conduit 48 is an exemplary structure or partition that may be included in the valve member 44 to guide the flow of more than one fluid at a time. In particular, the conduit 48 has an opening 196 at a first end 60 (see Fig. 2) and at least one opening 200 at the second end 62 (see

Figs. 2 and 3). As illustrated, a plurality of openings 200 can be provided in the second end 62. While the conduit 48 is illustrated as coaxial with the adapter neck 16, this need not be the case according to all embodiments of the present disclosure.

[0050] The conduit 48 depends from the plate 190. The conduit 48 is configured with an interior surface which is preferably generally cylindrical to define the passage 58 through the conduit 48 (see Fig. 1). A series of ribs may extend along a portion of the length and outwardly from an outer surface 212 of the conduit 48 to close proximity to the cylindrical wall 64 of the adapter neck 16 to define annular gaps or passageways between the conduit 48 and the adapter neck 16. In an embodiment, there may be four ribs spaced equally around the outer circumference of the conduit 48 that define four annular passageways.

[0051] Fig. 4 is a further cross-section of the container 10 including adapter neck 16 and valve assembly 42 of Figs. 2-3, but also including a cap 70 attached outside of the adapter neck 16 with a plurality of threads 72. The disclosed version further includes an o-ring 74 disposed between the cap 70 and the adapter neck 16 for providing a fluid tight seal. The cap 70 in this instance can provide protection to the adapter neck 16, and particularly, the outlet pipe 18. Moreover, the o-ring 74 can provide a fluid tight seal between the cap 70 and the adapter neck 16 to help maintain the cleanliness of the outlet pipe 18.

[0052] Fig. 5 shows a perspective view of a filling device 220 for anesthetics and an anesthetic evaporator 221. The filling device 220 has a filler neck 222 with a cylindrical sealing surface 223, an inner lead-in bevel 224 on the upper part of the filler neck 222, a spoked wheel 225 with radially inwardly pointing bars 226, an inner polygon 227, and a filling valve 228. The inner polygon 227 constitutes a second anesthetic specific coding having a design corresponding to the first anesthetic specific coding 40 on the container adapter 14 described above.

[0053] Fig. 6 shows the longitudinal section of the filling device 220. Identical components are designated by the same reference numbers as in Fig. 5. The filling valve 228 comprises a valve plate 229 at a valve guide bar 230, which is accommodated in a hole 231 of the evaporator housing 232 in such a way that it can perform lifting movements. The top side 233 of the valve plate 229 is pressed by means of a valve spring 234 against a sealing crater 235 of the filling

valve 228. A guide ring 236 is connected with the valve plate 229 and is displaceable together with the valve plate 229.

[0054] The filling system according to the present invention operates as follows:

[0055] When the container adapter 14 is plugged into the filling device 220, the outer polygon 20, 40 will engage the inner polygon 227, resulting in the container adapter 10 being centered in relation to the filling device 220. The bars 226 will then be located in the slots 22 of the outlet pipe 18 and the outlet pipe 18 will enter the area of the guide ring 236.

[0056] By pressing down the container adapter 14, the top side 24 of the outlet pipe 18 comes into contact with the top side 237 of the guide ring 236 and the filling valve 228 will open. The valve assembly 42 in the container adapter 14 is still closed. If the downward force on the container adapter 14 is increased further, the valve plate 229 is displaced farther downward against the force of the valve spring 234 and the bars 226 will touch an actuation surface 250 of the conduit 48 of the valve assembly 42 (see, Fig. 3), which is located at the first end 60 of the conduit 48, as a result of which the valve member 44 will move away from the valve seat 52 carried by the proximal end 36 of the adapter neck 16 and open. Anesthetic will now flow from the receptacle 12 via holes (not shown) in the cage 50, through the interior 34 of the adapter neck 16, and out the slots 22 in the outlet pipe 18, and finally into the tank of the anesthetic evaporator 221. As in communicating vessels, gas will flow back from the tank into the receptacle 12 via the conduit 48 and cage 50.

[0057] When the filling operation is finished, the valve assembly 42 in the container adapter 14 will close first, so that residual quantities of anesthetic that may be present within the filler neck 222 can flow off into the tank of the anesthetic evaporator 221. The filling valve 228 is then closed and the container adapter 14 can be removed from the filler neck 222.

[0058] While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

Claims

1. A storage container for liquid anesthetic, comprising:

a receptacle having a neck defining an opening and a passage between the opening and an interior of the receptacle;

an adapter neck comprising a generally tubular structure with a hollow interior, a proximal end, and a distal end, the proximal end connected to the neck of the receptacle;

a first anesthetic specific coding defined on an outer surface of the adapter neck between the proximal and distal ends;

an outlet pipe defined by the distal end of the adapter neck, the outlet pipe including at least one slot disposed in a top side of the pipe, the at least one slot adapted to be in fluid communication with the hollow interior of the adapter neck;

a valve seat defined at the proximal end of the adapted neck, the valve seat having a first sloped surface; and

a valve assembly adapted to control the flow of liquid anesthetic from the receptacle, the valve assembly comprising a valve member with a second sloped surface, the first sloped surface and the second sloped surface having different slopes, wherein optionally the second sloped surface has a slope that is steeper than a slope of the first sloped surface.

the first and second sloped surfaces abutting each other to form a gasketless, fluid-tight seal therebetween when the valve assembly is in a closed configuration to limit the flow of anesthetic from the receptacle,

the first and second sloped surfaces spaced from each other when the valve assembly is in an open configuration to permit the flow of the anesthetic from the receptacle.

2. The storage container of claim 1, wherein the valve seat is a frusto-conical surface comprising the first sloped surface, and the valve member comprises a poppet valve with the second sloped surface,

wherein optionally the poppet valve includes a third sloped surface, the third sloped surface having a slope that is different than the slope of the second sloped surface, and

optionally the adapter neck comprises a neck flange at the proximal end, the valve assembly comprises a cage having a cage flange disposed between the neck flange and the neck of the receptacle, and the storage container further optionally comprising a biasing member disposed between the valve member and the cage, biasing the valve assembly into the closed configuration.

3. The storage container of any one of claims 1 to 2, wherein the valve assembly further comprises a conduit disposed in the adapter neck and having a wall defining a conduit passage with a first end adjacent the distal end of the adapter neck and a second end adjacent the proximal end of the adapter neck, the valve seat disposed at the proximal end of the adapter neck, and an actuation surface of the valve assembly disposed at the first end of the conduit.

4. The storage container of any one of claims 1 to 3, wherein at least one of:

(a) the first anesthetic-specific coding is designed as a polygon,

(b) the at least one slot is a radially extending slot,

(c) the at least one slot is a wedge shaped slot,

(d) the outlet pipe includes a plurality of slots in the top side of the pipe the plurality of slots optionally designed as a star.

5. The storage container of any one of claims 1 to 4, further comprising at least one of:

(a) a ferrule securing the adapter neck and valve assembly to the container,

(b) a cap threadably coupled over the outside of the adapter neck, and

(c) a halogenated inhalation anesthetic disposed in the receptacle, the anesthetic selected from the group of halogenated anesthetics consisting of sevoflurane, desflurane, isoflurane, enflurane, methoxyflurane and halothane,

(d) a wall of the receptacle has an exterior surface comprising a layer of low-density polyethylene that defines at least in part the exterior surface of the wall,

(e) the valve assembly and adapter neck are permanently coupled to the container.

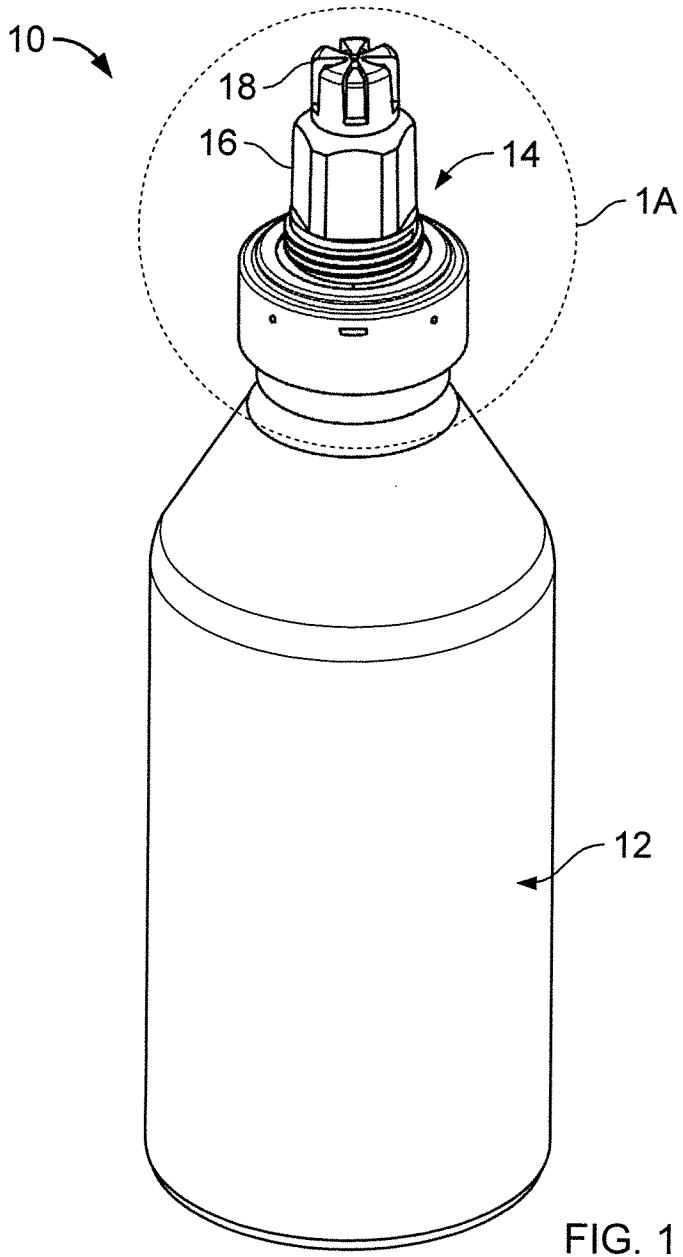

FIG. 1

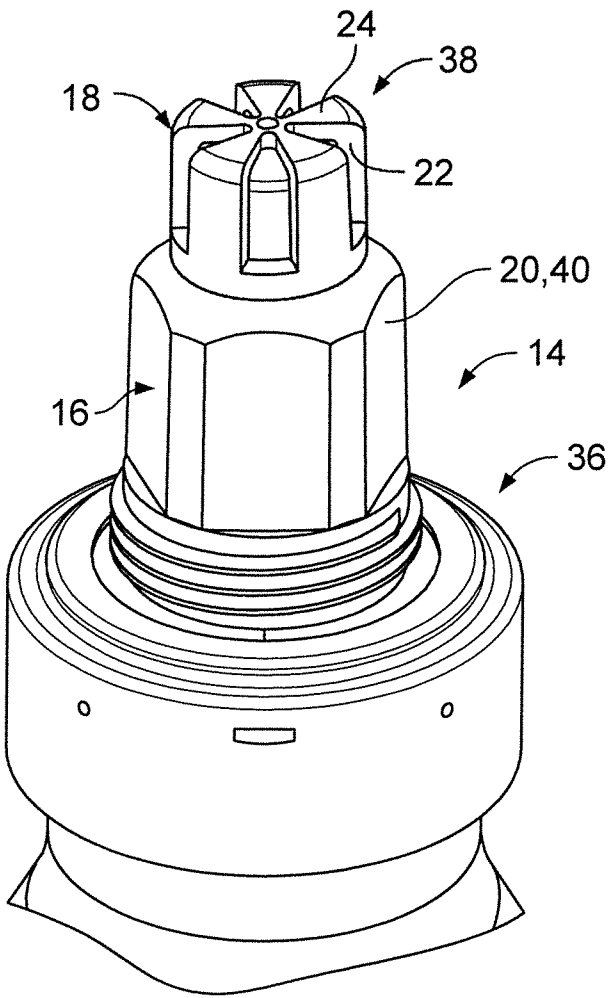

FIG. 1A

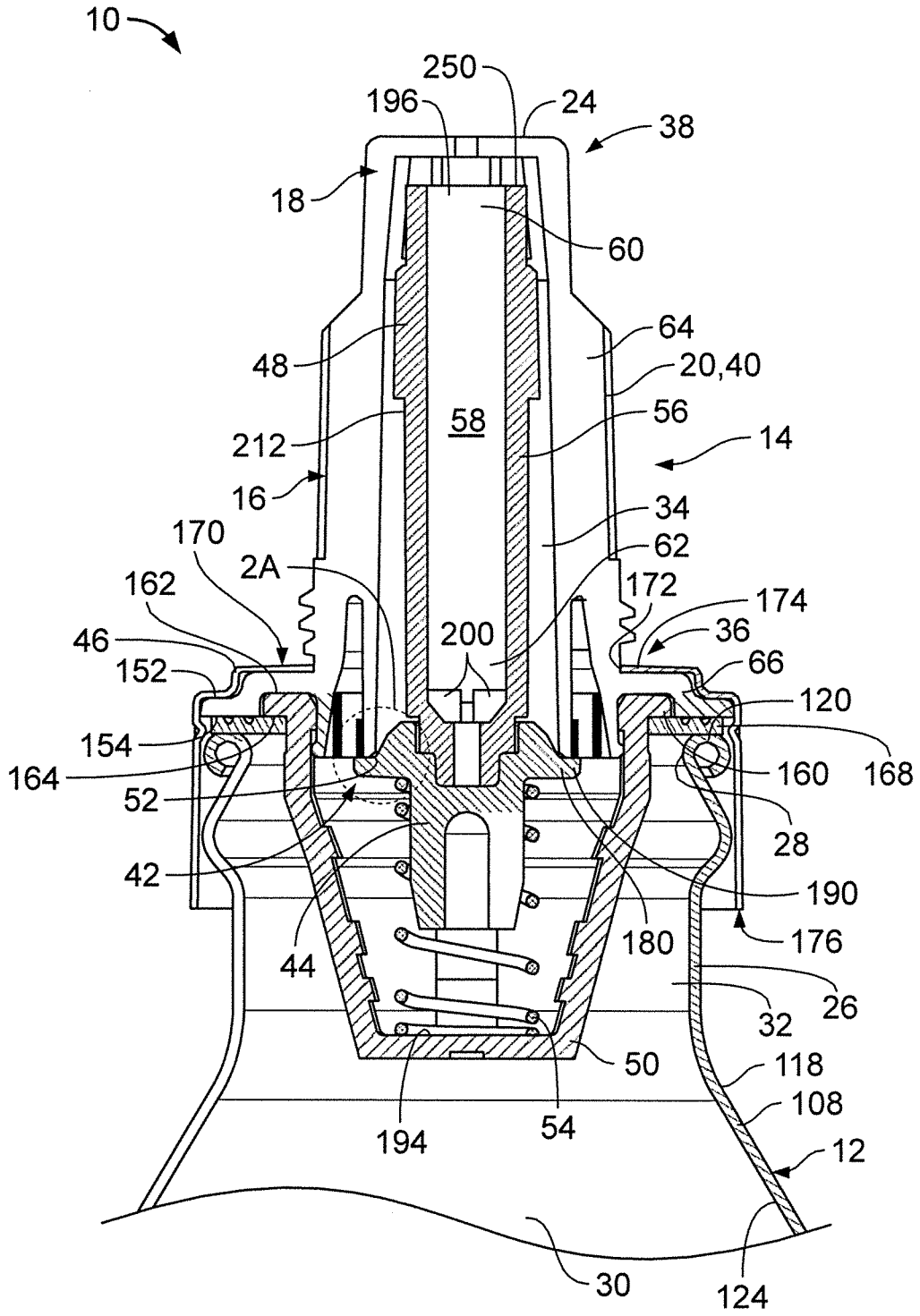
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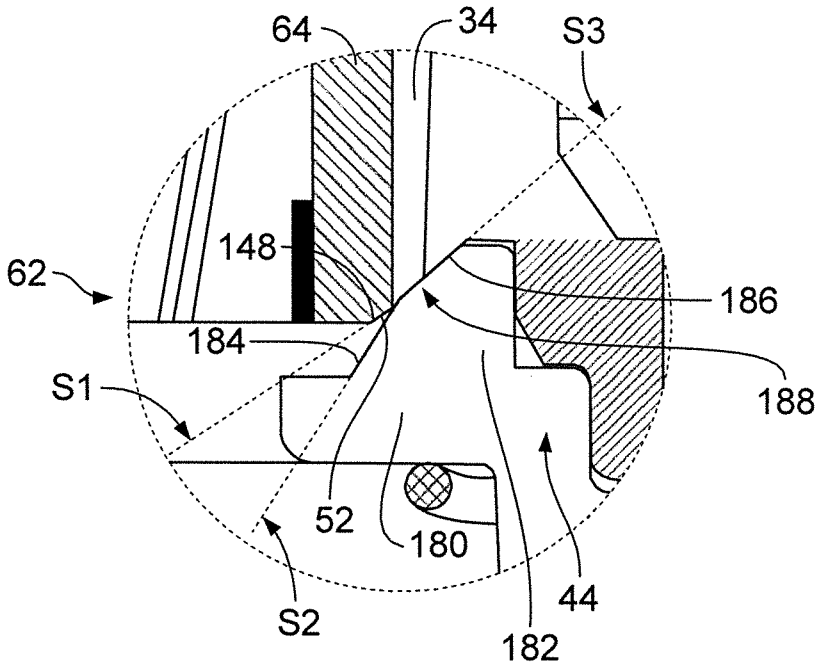
FIG. 2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S3
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62
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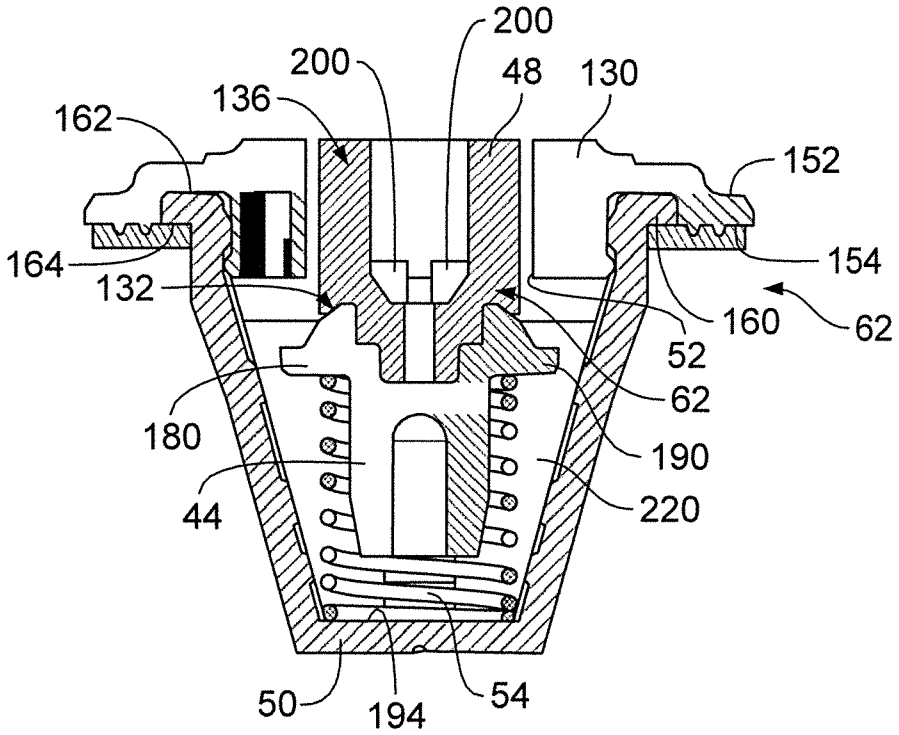
184
188
S1
52
180
44
S2
182

FIG. 2A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54

FIG. 3

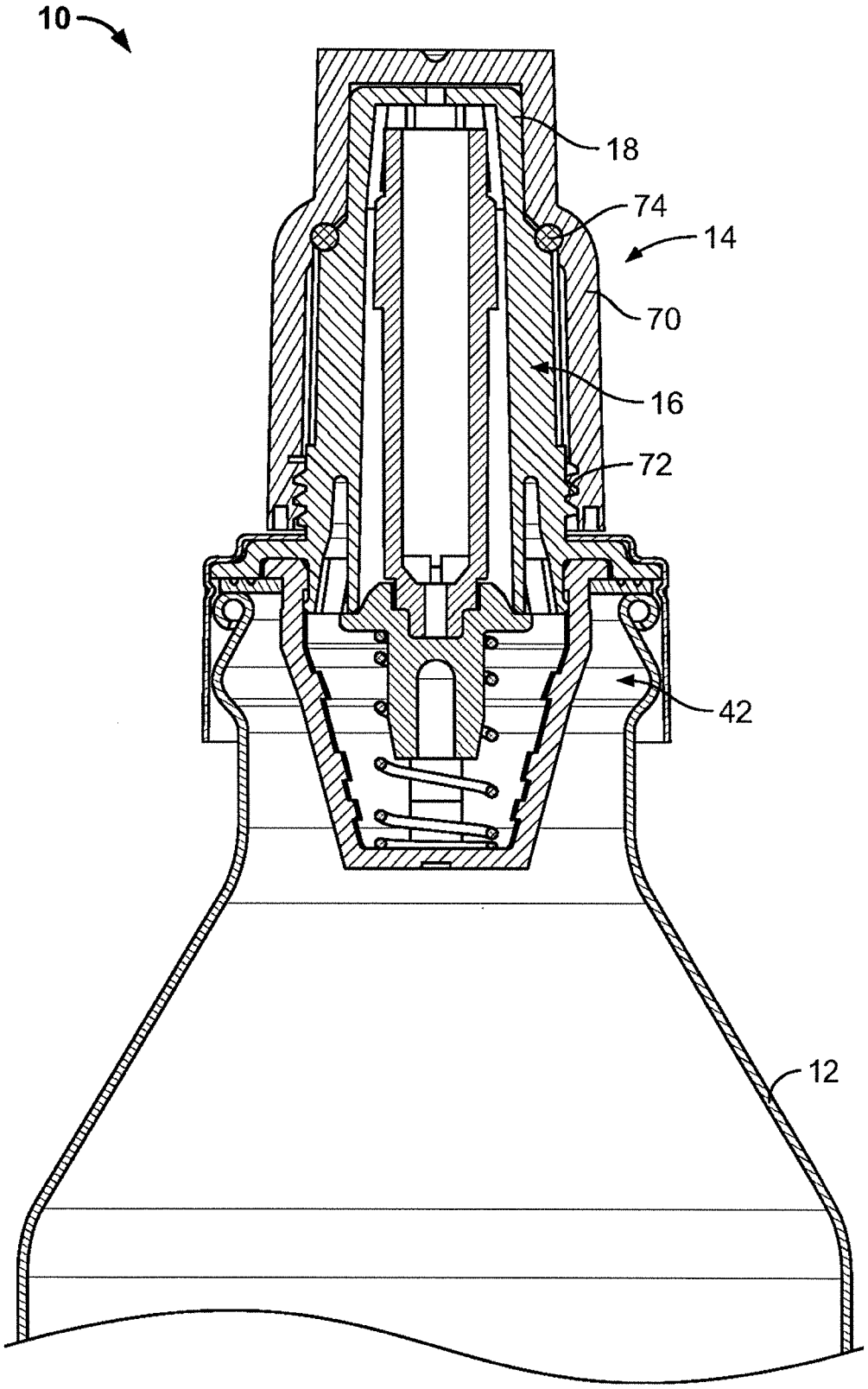

FIG. 4

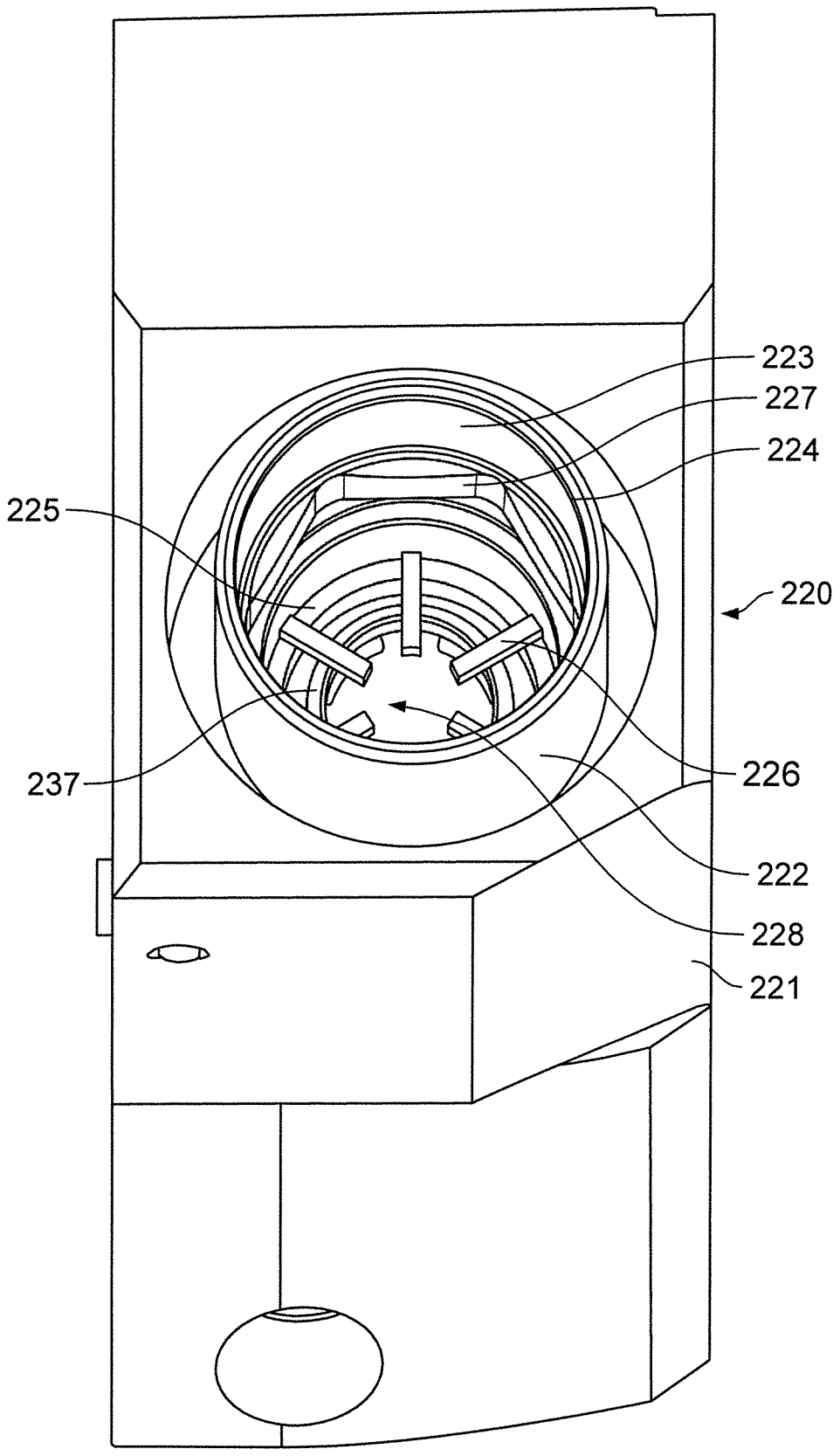

FIG. 5

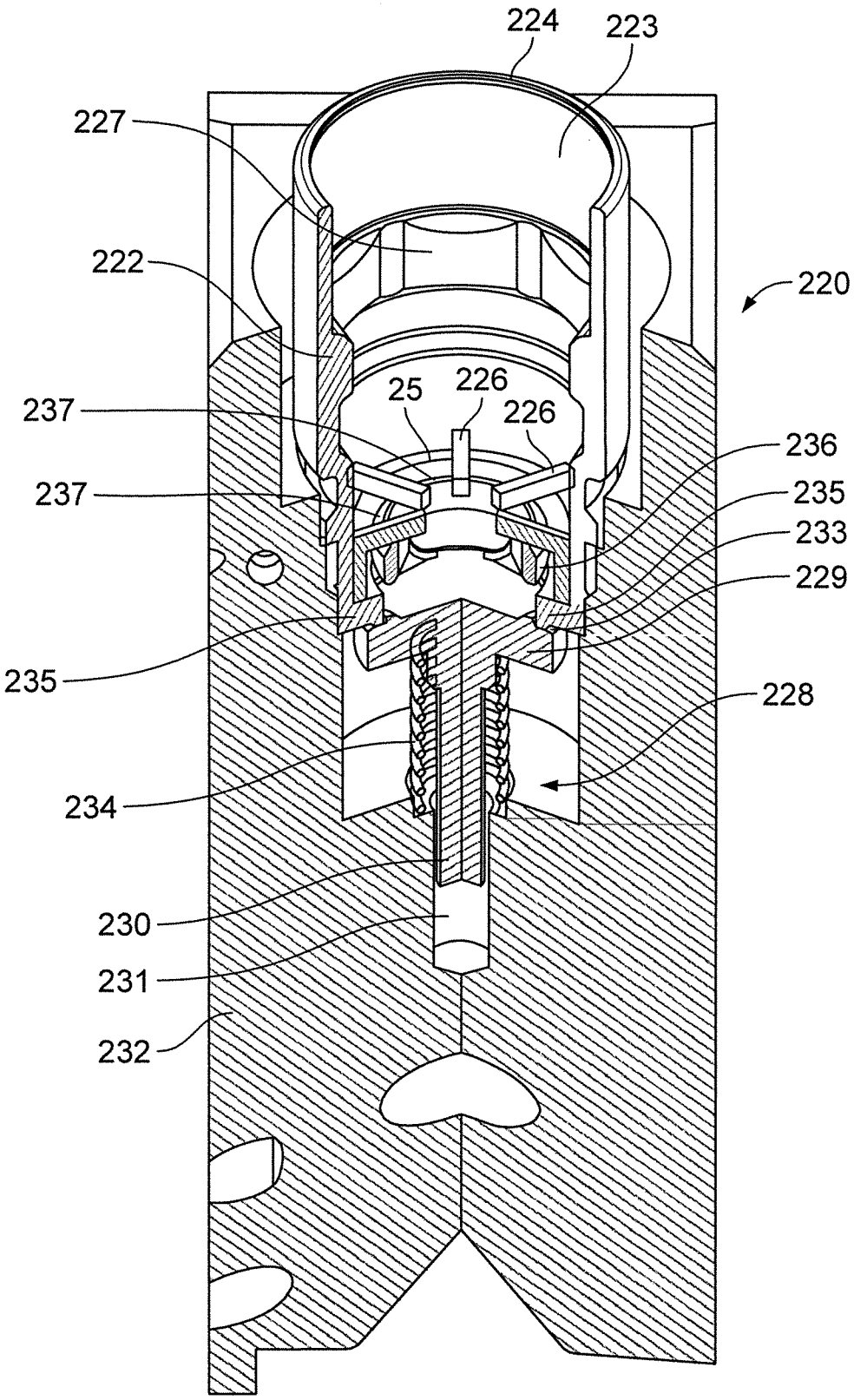
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FIG. 6