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(54) Title: INFLATION HUB FOR A FLUID INFLATABLE APPARATUS

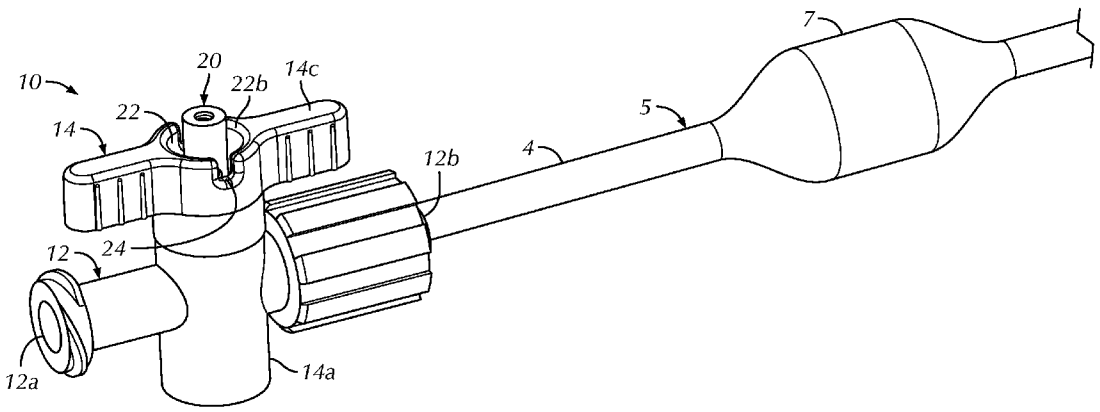

FIG. 3

(57) Abstract: An inflation hub includes a body having an internal lumen defining first and second lumen sections. A stopcock valve has a stem extending from the body between the first and second lumen sections, the stem being selectively rotatable between an open position, wherein an internal channel thereof fluidly connects the first and second lumen sections together, and a closed position, wherein the stopcock valve fluidly disconnects the first and second lumen sections from one another. A pressure-relief valve is integrated within the stem of the stopcock valve and in fluid communication with the internal channel thereof, and includes a loading member biasing the pressure-relief valve into a closed position. The pressure-relief valve moves into an open position when the stopcock valve is in the open position thereof and a pressure with the internal lumen of the body exceeds a threshold, opening pressure of the loading member.

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TITLE

[0001] Inflation Hub For A Fluid Inflatable Apparatus

CROSS-REFERENCE TO RELATED APPLICATION

[0002] This application claims priority from U.S. Provisional Patent Application No. 63/052,786, titled "Inflation Hub For A Fluid Inflatable Apparatus", filed on July 16, 2020, the entire contents of which are incorporated by reference herein.

BACKGROUND OF THE DISCLOSURE

[0003] The disclosure relates to an inflation hub for a fluid inflatable apparatus, such as, for example, for a medical catheter.

[0004] Conventional medical catheters 5 may include an inflatable balloon 7 configured to perform partial and full occlusion of a patient's vessel, such as, for example, at various locations in the patient's aorta, including the descending thoracic aorta and the abdominal aorta. Generally, as shown in Figs. 1 and 2, the inflatable occlusion balloon 7 is fluidly connected with an outlet of an inflation hub 2 via a catheter shaft 4 defining an internal lumen. The inflation hub 2 generally includes a valve 3, e.g., a stopcock, that is oriented in an open position (Figs. 1, 2) to permit the flow of fluid therethrough during balloon inflation, and oriented in the closed position (now shown) thereafter to maintain balloon inflation. The inflation hub 2 may further include a pressure-relief valve 6 fluidly connected to the catheter shaft 4. The pressure-relief valve 6 defines a cracking pressure set to prevent overinflation of the balloon. Often, as shown in Figs. 1 and 2, the pressure-relief valve 6 is positioned adjacent to, and in series with, the stopcock 3 via a molded pressure relief fitting, bonding or the like. One drawback of such a design is that the inflation hub 2 is long, thereby being increasingly susceptible to fracture from bending. Another drawback is that the inflation hub 2 is formed of two separate components requiring manufacture.

[0005] It would, therefore, be advantageous to manufacture a more compact inflation hub formed of a single component to improve reliability and ease of manufacture thereof.

BRIEF SUMMARY OF THE DISCLOSURE

[0006] Briefly stated, an aspect of the present disclosure is directed to an inflation hub for attachment to a fluid inflatable apparatus. The inflation hub includes a body having an internal lumen defining a first lumen section and a second lumen section, an inlet of the first lumen section being configured for connection to an inflation device, and an outlet of the second lumen section being configured for connection to the fluid inflatable apparatus. A stopcock valve has a stem angularly extending from a portion of the body between the first lumen section and the second lumen section of the internal lumen, the stem being selectively rotatable between an open position, wherein an internal channel of the stem fluidly connects the first lumen section with the second lumen section, and a closed position, wherein the stopcock valve fluidly disconnects the first lumen section from the second lumen section. A pressure-relief valve is integrated within the stem of the stopcock valve and in fluid communication with the internal channel thereof, the pressure-relief valve including a loading member biasing the pressure-relief valve into a closed position thereof. The pressure-relief valve is configured to move into an open position thereof when the stopcock valve is in the open position thereof and a pressure with the internal lumen of the body exceeds a threshold, opening pressure of the loading member.

[0007] In one configuration, the stopcock valve further includes a stopcock valve body angularly extending from the internal lumen of the body, and the stem is sealing and rotationally received within the valve body. In such a configuration, the stopcock valve body may be monolithic with the body.

[0008] In any of the previous configurations, the internal channel of the stem may have a generally lateral channel portion and a generally axial channel portion in fluid communication with and angularly extending therefrom. In such a configuration, the generally lateral channel portion of the stem may be interposed between, and in line with, the first lumen section and the second lumen section in the open position of the stopcock valve. In such a configuration. the generally lateral channel portion of the stem may additionally or alternatively be interposed between, and angularly offset from, the first lumen section and the second lumen section in the closed position of the stopcock valve.

[0009] In any of the previous configurations, the stem of the stopcock valve may be selectively rotatable between only two operative positions, the open position thereof being a first

of the two operative positions and the closed position thereof being a second of the two operative positions.

[0010] In any of the previous configurations, the stem of the stopcock valve may be rotatable substantially 90° between the open position thereof and the closed position thereof.

[0011] In any of the previous configurations, the pressure-relief valve may further include a valve body sealingly mounted to the stem, the valve body having an internal valve body channel in fluid communication with the internal channel of the stem; a valve seat within the internal valve body channel; and a movable valve member sealingly engaged with the valve seat by the loading member in the closed position of the pressure-relief valve. In such a configuration, the valve body of the pressure-relief valve may further include at least one vent port fluidly communicating the internal valve body channel with external atmosphere, the at least one vent port being fluidly disconnected from the internal channel of the stem by the engagement of the movable valve member with the valve seat in the closed position of the pressure-relief valve and the at least one vent port being fluidly communicated with the internal channel of the stem in the open position of the pressure-relief valve. Additionally, or alternatively, in such a configuration, the valve member may be a ball.

[0012] In any of the previous configurations, the loading member may be a spring.

[0013] In any of the previous configurations, wherein the threshold, opening pressure of the loading member may be approximately 6 psi.

[0014] In any of the previous configurations, the stopcock valve may further include a handle laterally extending from the stem, whereby rotation of the handle is configured rotate the stem.

[0015] In any of the previous configurations, an upper rim of the stopcock valve may include at least one recess permitting fluid travel therethrough.

[0016] In any of the previous configurations, the inflation hub may be combined with a medical catheter, wherein the fluid inflatable apparatus is the medical catheter, the medical catheter including an inflatable occlusion balloon fluidly connected with a catheter shaft, the catheter shaft being selectively connectable with the outlet of the second lumen section.

[0017] Another aspect of the present disclosure is directed to a method of using any of the previous configurations of the inflation hub. The method includes the steps of connecting the fluid inflatable apparatus with the outlet of the second lumen section; and inflating the fluid inflatable apparatus from the inlet of the first lumen section.

[0018] In one configuration, the method may further include the step of rotating the stem into the open position thereof before the inflating step, thereby fluidly connecting the first lumen section with the second lumen section through the internal channel of the stem.

[0019] In any of the previous configurations, the inflating step may include inflating the fluid inflatable apparatus to a pressure greater than the threshold, opening pressure of the loading member, thereby moving the pressure-relief valve into the open position thereof.

[0020] In any of the previous configurations, method may further include the step of rotating the stem into the closed position thereof.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0021] The following description of an embodiment of the disclosure will be better understood when read in conjunction with the appended drawings. It should be understood, however, that the disclosure is not limited to the precise arrangements and instrumentalities shown. In the drawings:

[0022] Fig. 1 is a perspective view of a prior art inflation hub connected to a fluid inflatable apparatus;

[0023] Fig. 2 is a cross-sectional perspective view of the prior art inflation hub of Fig. 1, taken along sectional line 2-2 of Fig. 1;

[0024] Fig. 3 is a perspective view of an inflation hub according to an embodiment of the present disclosure, with a stopcock valve thereof in an open position;

[0025] Fig. 4 is a cross-sectional elevational view of the inflation hub of Fig. 3, taken along sectional line 4-4 of Fig. 3;

[0026] Fig. 5 is a perspective view of the inflation hub of Fig. 1, with the stopcock valve thereof in a closed position;

[0027] Fig. 6 is a cross-sectional perspective view of the inflation hub of Fig. 5, taken along sectional line 6-6 of Fig. 5;

[0028] Fig. 7 is an enlarged, elevational partial view of the cross-sectional view of Fig. 6;

[0029] Fig. 8 is a perspective view of the inflation hub of Fig. 1 prior to use, with a release pin maintaining a pressure-relief valve thereof in an open configuration; and

[0030] Fig. 9 is a cross-sectional perspective view of the inflation hub of Fig. 8, taken along sectional line 9-9 of Fig. 8.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0031] Certain terminology is used in the following description for convenience only and is not limiting. The words "lower," "bottom," "upper" and "top" designate directions in the drawings to which reference is made. The words "inwardly," "outwardly," "upwardly" and "downwardly" refer to directions toward and away from, respectively, the geometric center of the stopcock, and designated parts thereof, in accordance with the present disclosure. Unless specifically set forth herein, the terms "a," "an" and "the" are not limited to one element, but instead should be read as meaning "at least one." The terminology includes the words noted above, derivatives thereof and words of similar import.

[0032] It should also be understood that the terms "about," "approximately," "generally," "substantially" and like terms, used herein when referring to a dimension or characteristic of a component of the disclosure, indicate that the described dimension/characteristic is not a strict boundary or parameter and does not exclude minor variations therefrom that are functionally similar. At a minimum, such references that include a numerical parameter would include variations that, using mathematical and industrial principles accepted in the art (e.g., rounding, measurement or other systematic errors, manufacturing tolerances, etc.), would not vary the least significant digit.

[0033] Referring to the drawings in detail, wherein like numerals indicate like elements throughout, there is shown in Figs. 3-9 an inflation hub, generally designated 10, for attachment to (and fluid communication with) a fluid, i.e., liquid or gas, inflatable apparatus, such as, for example, without limitation, a medical catheter 5, in accordance with an embodiment of the present disclosure. As shown, the inflation hub 10 includes a single body 12 having an inlet 12a, an outlet 12b and an internal lumen 12c extending therebetween. The inlet 12a is selectively connectable with an inflation device (not shown) and the outlet 12b is selectively connectable with the fluid inflatable apparatus. In the illustrated configuration, the inlet 12a takes the form of a female luer fitting and the outlet 12b takes the form of a male luer fitting, but the disclosure is not so limited. Rather, the inlet and outlet 12a, 12b may take the form of any leakproof connection fittings currently known or that later becomes known. As also should be understood by those of ordinary skill in the art, the body 12 of the inflation hub 10 may include more than one inlet and/or more than one outlet, selectively fluidly connectable with one another.

[0034] A stopcock type valve 14 extends angularly, e.g., transversely, from a portion of the body 12 between the inlet 12a and the outlet 12b thereof. The stopcock valve 14 defines a stopcock valve body 14a angularly extending, e.g., generally orthogonally, from the internal lumen 12c. In the illustrated embodiment, the stopcock valve body 14a is generally cylindrical, but the disclosure is not so limited. The stopcock valve body 14a is fixed, i.e., stationary, relative to the body 12 of the inflation hub 10. In one configuration, the stopcock valve body 14a may be monolithic with the body 12 of the inflation hub 10. A stopcock stem 14b extends into the valve body 14a in a substantially mating fit therewith. In one configuration, the stopcock stem 14b may form an interference fit with the valve body 14a. The stopcock stem 14b includes a stopcock handle 14c, e.g., a wing-like handle, proximate an upper end thereof for selectively rotating the stem 14b relative to the valve body 14a, as will be described in further detail.

[0035] As shown best in Figs. 4 and 6, the stopcock stem 14b defines an internal, inverted generally T-shaped channel 16, having a generally lateral channel 16a and a generally axial channel 16b in fluid communication therewith and extending therefrom. The generally axial channel 16b may extend substantially along a central axis of the stopcock stem 14b. The lateral channel 16a extends angularly, such as substantially orthogonally, relative to the axial channel 16b and is elevationally aligned with the internal lumen 12c of the inflation hub body 12.

[0036] The stopcock stem 14b is selectively movable (via the handle 14c) between two operative positions. In the illustrated configuration, the stopcock stem 14b is rotatable substantially 90° (quarter-turn), between the two operative positions, but the disclosure is not so limited. For example, without limitation, the stopcock stem 14b may be reciprocally translatable or the like between the two operative positions. In an open position (the first operative position), as shown in Figs. 3-4, the stem 14b is positioned such that the lateral channel 16a is in line, and in fluid communication, with the internal lumen 12c. That is, the lateral channel 16a is interposed between a first section 12c1 of the internal lumen 12c and a second section 12c2 of the internal lumen 12c and fluidly communicates the first and second sections 12c1, 12c2 of the internal lumen 12c with one another. Thus, fluid may flow completely through the internal lumen 12c, between the inlet 12a, the first section 12c1, the lateral channel 16a, the second section 12c2 and the outlet 12b (and ultimately to the fluid inflatable apparatus, such as the catheter shaft 4). In a closed position (the second operative position), as shown in Figs. 5-7 , the stem 14b is rotated about an axial axis thereof (compared to the position thereof in the first

operative position) such that the lateral channel 16a is offset/misaligned from the first and second sections 12c1, 12c2 of the internal lumen 12. For example, the lateral channel 16a may be oriented perpendicularly relative to the internal lumen 12c, and, therefore, relative to the direction of fluid flow. Thus, the stopcock type valve 14 fluidly disconnects the first and second sections 12c1, 12c2 of the internal lumen 12 from one another and substantially prevents fluid flow between the inlet 12a and the outlet 12b of the inflation hub 12 in the closed position, and fluidly connects the first and second sections 12c1, 12c2 with one another and permits fluid flow between the inlet 12a and the outlet 12b of the inflation hub 12 in the open position. As should be understood by those of ordinary skill in the art, however, the stopcock stem 14b may be selectively rotatable between more than two operative positions in a manner well understood, e.g., if the body 12 includes more than one outlet, selectively fluidly communicating the inlet 12a with a respective one or more of the outlets. Optionally, the stopcock valve 14 may further include a sealing member 18, e.g., an O-ring, positioned between the stopcock valve body 14a and stopcock stem 14b on an opposite side of the internal lumen 12c from the channel 16.

[0037] The stopcock type valve 14 further includes a pressure-relief valve 20 integrated within the stopcock stem 14b. In the illustrated configuration, and as shown best in Fig. 7, the pressure-relief valve 20 is seated proximate an upper end of the stem 14b, within a socket 22 in the stopcock handle 14c. Alternatively, the pressure-relieve valve 20 may be positioned entirely within the stem 14b. Advantageously, integrating the pressure-relief valve 20 within the stopcock valve 14 results in a more compact inflation hub 12, formed of less pieces, requiring less assembly/bonds, and thereby being more reliable and less prone to fracture.

[0038] In the illustrated embodiment, the pressure-relief valve 20 includes a valve body 20a mounted upon a base 22a of the socket 22. The valve body 20a includes an internal valve body channel 20b in fluid communication with the channel 16 of the stopcock stem 14b. The valve body 20a defines an internal valve seat 20c in the form of a radially inwardly projecting shoulder. Stated differently, the valve body channel 20b defines a step down in width/diameter between an upper portion and a lower portion, forming the inwardly projecting shoulder 20c therebetween. A movable valve member 20d, e.g., a disc or ball, is disposed within the valve body channel 20b, i.e., within the wider portion of the valve body channel 20b, and biased against the valve seat 20c by a loading member 20e, e.g., a spring, disposed with the valve body channel 20b to maintain the valve 20 in a closed position. That is, the loading member 20e may

be interposed between the valve member 20d and a terminal end of the valve body channel 20b. A sealing member 20g, e.g., an O-ring or other sealing seat ring, may form a component of the valve seat 20c or be interposed between the valve member 20d and the valve seat 20c to enhance sealing when the pressure-relief valve 20 is closed.

[0039] The load, i.e., force, applied by the loading member 20e upon the valve member 20d determines the pressure required to open the relief valve 20, i.e., to disengage the valve member 20d from the valve seat 20c. The cracking, i.e., opening, pressure of the pressure-relief valve 20 defines a threshold pressure for safe inflation of a fluid inflatable apparatus, e.g., without limitation, a medical catheter 5, thereby preventing dangerous overinflation or over-pressurization of a component, such as a balloon or occlusion balloon positioned downstream of the outlet 12b. In one configuration, the cracking, i.e., opening, pressure of the loading member 20e, and, thus, of the valve 20, may be approximately 0.5 atm (approximately 6 psi), but the disclosure is not so limited. As should be understood by those of ordinary skill in the art, the loading member may take the form of any member capable of storing and releasing energy. The valve body 20a further includes at least one side vent port 20f, fluidly communicating the valve body channel 20b with the external atmosphere. Generally, the vent port(s) 20f is positioned on an opposite side of the valve member 20d, and thereby sealingly disconnected, from the stopcock stem channel 16 when the pressure-relief valve 20 is in the closed position. When the pressure-relief valve 20 is opened, the side vent port(s) 20f becomes fluidly communicated with the stopcock stem channel 16. Thus, pressure within the inflation hub 12, and, therefore, within the line may be vented to the atmosphere, via the stopcock stem channel 16, the pressure-relief valve body channel 20b and out the side vent port(s) 20f. As should be understood by those of ordinary skill in the art, the pressure-relief valve 20 may alternatively take the form of any other safety valve, currently known, or that later becomes known, capable of integration with the stopcock valve 14 and functioning as described with respect to the pressure-relief valve 20 herein.

[0040] In operation, e.g., without limitation, with an occlusion balloon catheter 5, the outlet 12b of the inflation hub 12 is connected with the occlusion balloon catheter and the inlet 12a of the inflation hub is connected with an inflation device (not shown), e.g., a syringe or the like. The stopcock valve 14 is then rotated into the open position thereof (as previously described), to fluidly communicate the inflation device with the occlusion balloon catheter 5 via the internal

lumen 12c and the interposed, aligned lateral channel 16a. In the open position of the stopcock valve 14, the pressure-relief valve 20 is also fluidly communicated with the inflation hub lumen 12c, and, in turn, with the occlusion balloon catheter 5.

[0041] The occlusion balloon of the occlusion balloon catheter 5 is then inflated. Should the occlusion balloon be inadvertently overinflated by the user, e.g., to a pressure greater than the cracking pressure of the pressure-relief valve 20, the pressure within the inflation hub 12 will bias the pressure-relief valve 20 open to vent out the overpressure through the side vent port(s) 20f. After inflation of the occlusion balloon catheter 5 is completed, the stopcock valve 14 is rotated to the closed position thereof, thereby isolating, i.e., fluidly disconnecting, the pressure-relief valve 20 so that it is no longer in fluid communication with the occlusion balloon of the occlusion balloon catheter 5. Advantageously, isolating the pressure-relief valve 20 from the pressure within the occlusion balloon catheter during use prevents the potential for leaking from the valve 20 over extended use.

[0042] Optionally, the upper rim 22b of the socket 22, the stem 14b or the stopcock valve 14 generally may include at least one recess 24 to ensure that fluid may escape out of the socket 22 via the recess(es) 24, even if an object, e.g., a user's finger, obstructs the open upper end of the socket 22. Additionally, or alternatively, the upper rim 22b of the socket 22 or the stopcock valve 14 generally may also project further upwardly (from the stopcock handle 14c) than the pressure-relief valve 20. Such design minimizes the opportunity to override and/or damage the pressure-relief valve 20, which may otherwise result in harm to the patient.

[0043] In one configuration, as shown in Figs. 8 and 9, the upper rim 22b of the socket 22 may include at least two coaxial/diametrically opposed recesses 24, in registry/aligned with two coaxial/diametrically opposed side vent ports 20f. Prior to use, a release pin 26 may extend through the opposed and aligned recesses 24 and side vent ports 20f, and maintain the valve member 20d biased and spaced away from the sealing member 20g, against the bias of the loading member 20e. That is, the valve member 20d and the loading member 20e may be supported upon the release pin 26 in a compressed state. In the illustrated embodiment, the release pin 26 includes a tabbed proximal end for simplified handling, but the disclosure is not so limited as the release pin 26 may take alternative configurations capable of performing the function of the release pin 26 described herein.

[0044] Advantageously, the release pin 26 lifts the valve member 20d off of the sealing member 20g so that the two components do not contact one another during transport and storage prior to use. Advantageously, such spacing prevents formation of stiction between the valve member 20d and the sealing member 20g, which may otherwise occur if the valve member 20d is biased against the sealing member 20g for an extended prior of time prior to use. As should be understood by those of ordinary skill in the art, when a valve's moving component, e.g., the valve member 20d, does not move for an extended period of time, it tends to stick in that position. Initially, therefore, additional pressure, greater than the normal cracking pressure thereof, becomes required to overcome the stiction. After the first actuation of the valve, the stiction is generally eliminated. Nevertheless, an increased cracking pressure of the pressure-relief valve 20, even for the first actuation of the valve 20, may expose the fluid inflatable apparatus to excess pressure and result in damage to the apparatus as well as the surrounding environment, such as, for example to a catheter 5 and the vessel receiving the catheter, thereby harming the patient.

[0045] In operation, the release pin 26 is removed, i.e., withdrawn, from the opposed and aligned recesses 24 and side vent ports 20f by the user prior to use of the inflation hub 10. When the release pin 26 is removed just before use, the valve member 20d is biased into contact with the sealing member 20g under the bias of the loading member 20e and seals the pressure-relief valve 20 in the closed position thereof, but does not stick because the components have not been touching for enough time to stick.

[0046] It will be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the broad inventive concept thereof. For example, the inflation hub 10 is not limited to medical uses and may be designed and configured for operation with nearly any variety of valve in nearly any industry, wherein the combination of a shut-off valve and a pressure-relief valve to relieve pressure at a predetermined level is desirable, such as fluid transmission, fluid storage and related uses where pressure relief in potential over pressurization situations is desirable. It is understood, therefore, that this disclosure is not limited to the particular embodiments disclosed, but it is intended to cover modifications within the spirit and scope of the present disclosure, as set forth in the appended claims.

CLAIMS

I/We claim:

1. An inflation hub for attachment to a fluid inflatable apparatus, the inflation hub comprising:

a body having an internal lumen defining a first lumen section and a second lumen section, an inlet of the first lumen section being configured for connection to an inflation device, and an outlet of the second lumen section being configured for connection to the fluid inflatable apparatus;

a stopcock valve having a stem angularly extending from a portion of the body between the first lumen section and the second lumen section of the internal lumen, the stem being selectively rotatable between an open position, wherein an internal channel of the stem fluidly connects the first lumen section with the second lumen section, and a closed position, wherein the stopcock valve fluidly disconnects the first lumen section from the second lumen section; and

a pressure-relief valve integrated within the stem of the stopcock valve and in fluid communication with the internal channel thereof, the pressure-relief valve including a loading member biasing the pressure-relief valve into a closed position thereof, the pressure-relief valve being configured to move into an open position thereof when the stopcock valve is in the open position thereof and a pressure with the internal lumen of the body exceeds a threshold, opening pressure of the loading member.

2. The inflation hub of claim 1, wherein the stopcock valve further comprises a stopcock valve body angularly extending from the internal lumen of the body, and the stem is sealing and rotationally received within the valve body.

3. The inflation hub of claim 2, wherein the stopcock valve body is monolithic with the body.

4. The inflation hub of claim 1, wherein the internal channel of the stem has a generally lateral channel portion and a generally axial channel portion in fluid communication with and angularly extending therefrom.

5. The inflation hub of claim 4, wherein the generally lateral channel portion of the stem is interposed between, and in line with, the first lumen section and the second lumen section in the open position of the stopcock valve.

6. The inflation hub of claim 4, wherein the generally lateral channel portion of the stem is interposed between, and angularly offset from, the first lumen section and the second lumen section in the closed position of the stopcock valve.

7. The inflation hub of claim 1, wherein the stem of the stopcock valve is selectively rotatable between only two operative positions, the open position thereof being a first of the two operative positions and the closed position thereof being a second of the two operative positions.

8. The inflation hub of claim 1, wherein the stem of the stopcock valve is rotatable substantially 90° between the open position thereof and the closed position thereof.

9. The inflation hub of claim 1, wherein the pressure-relief valve further comprises:

a valve body sealingly mounted to the stem, the valve body having an internal valve body channel in fluid communication with the internal channel of the stem;

a valve seat within the internal valve body channel; and

a movable valve member sealingly engaged with the valve seat by the loading member in the closed position of the pressure-relief valve.

10. The inflation hub of claim 9, wherein the valve body of the pressure-relief valve further includes at least one vent port fluidly communicating the internal valve body channel with external atmosphere, the at least one vent port being fluidly disconnected from the internal channel of the stem by the engagement of the movable valve member with the valve seat in the closed position of the pressure-relief valve and the at least one vent port being fluidly communicated with the internal channel of the stem in the open position of the pressure-relief valve.

11. The inflation hub of claim 9, wherein the valve member is a ball.

12. The inflation hub of claim 1, wherein the loading member is a spring.

13. The inflation hub of claim 1, wherein the threshold, opening pressure of the loading member is approximately 6 psi.

14. The inflation hub of claim 1, wherein the stopcock valve further includes a handle laterally extending from the stem, whereby rotation of the handle is configured rotate the stem.

15. The inflation hub of claim 1, wherein an upper rim of the stopcock valve includes at least one recess permitting fluid travel therethrough.

16. The inflation hub of claim 1 in combination with a medical catheter, wherein the fluid inflatable apparatus is the medical catheter, the medical catheter including an inflatable occlusion balloon fluidly connected with a catheter shaft, the catheter shaft being selectively connectable with the outlet of the second lumen section.

17. A method of using the inflation hub of any one of the previous claims, the method comprising the steps of:

connecting the fluid inflatable apparatus with the outlet of the second lumen section; and

inflating the fluid inflatable apparatus from the inlet of the first lumen section.

18. The method of claim 17, further comprising the step of:

rotating the stem into the open position thereof before the inflating step, thereby fluidly connecting the first lumen section with the second lumen section through the internal channel of the stem.

19. The method of claim 17, wherein the inflating step comprises inflating the fluid inflatable apparatus to a pressure greater than the threshold, opening pressure of the loading member, thereby moving the pressure-relief valve into the open position thereof.

20. The method of claim 17, further comprising the step of:

rotating the stem into the closed position thereof.

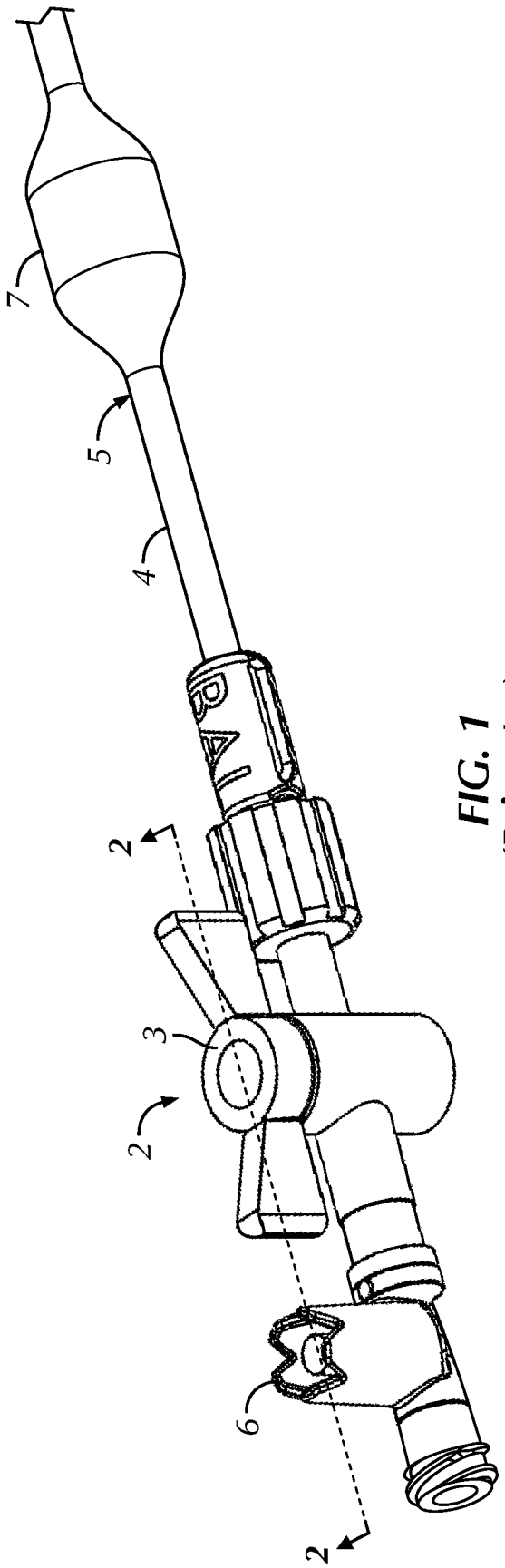

FIG. 1
(Prior Art)

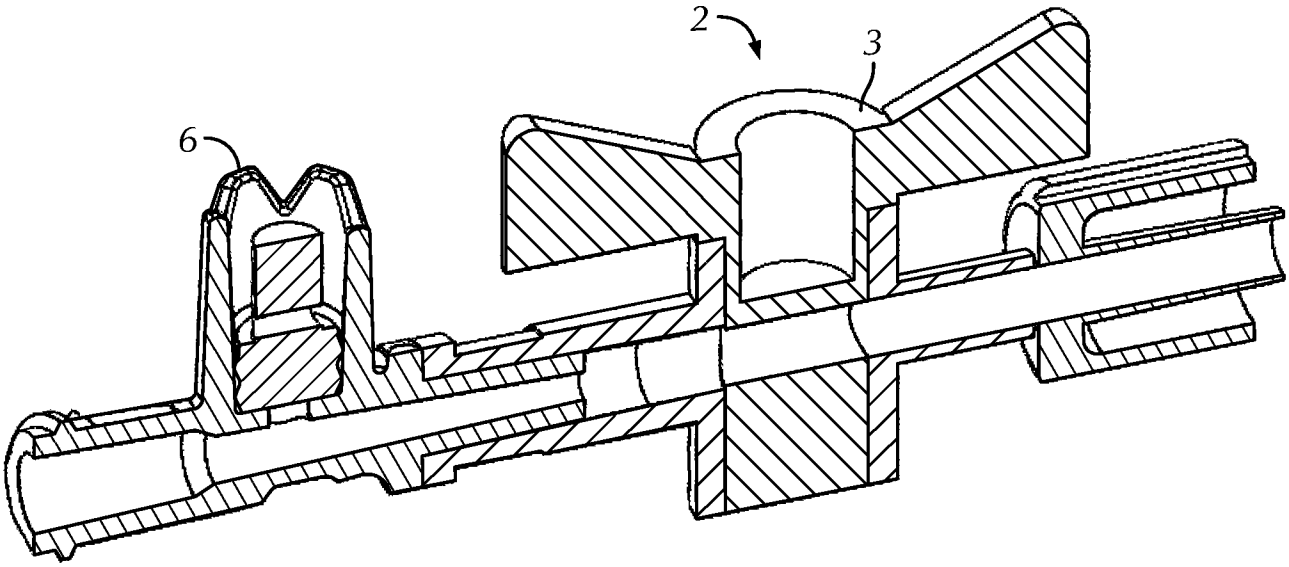

FIG. 2
(Prior Art)

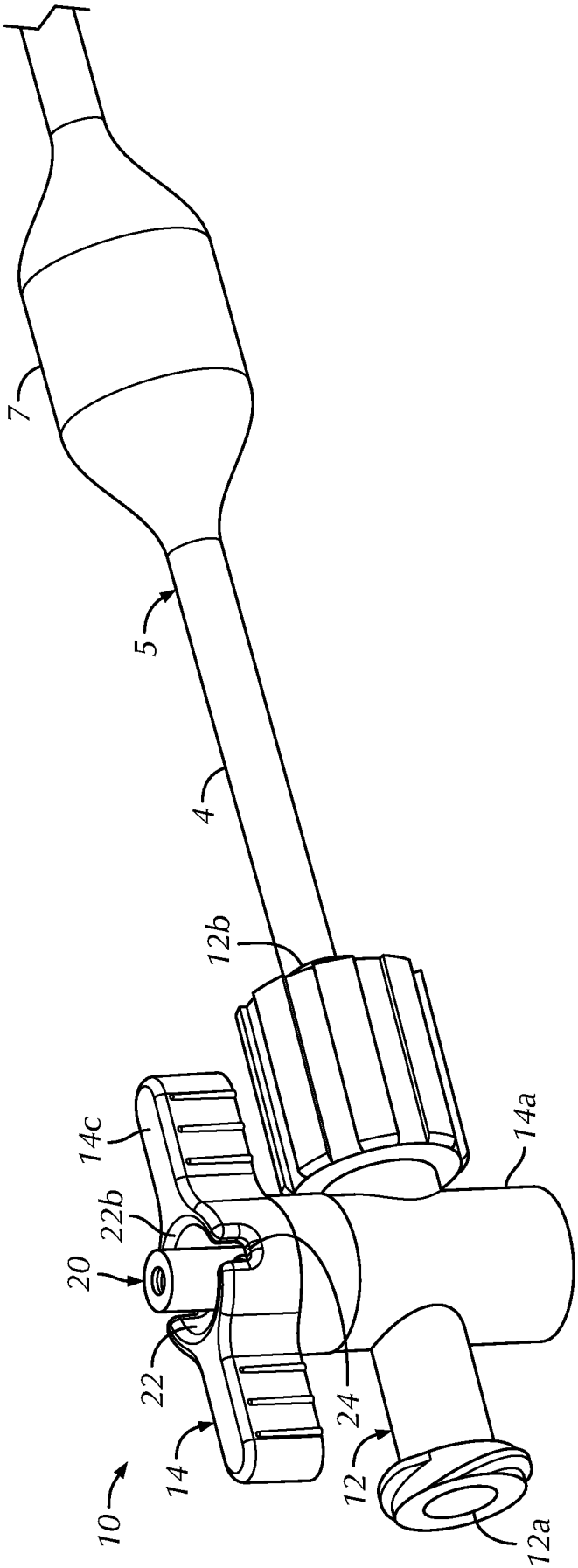

FIG. 3

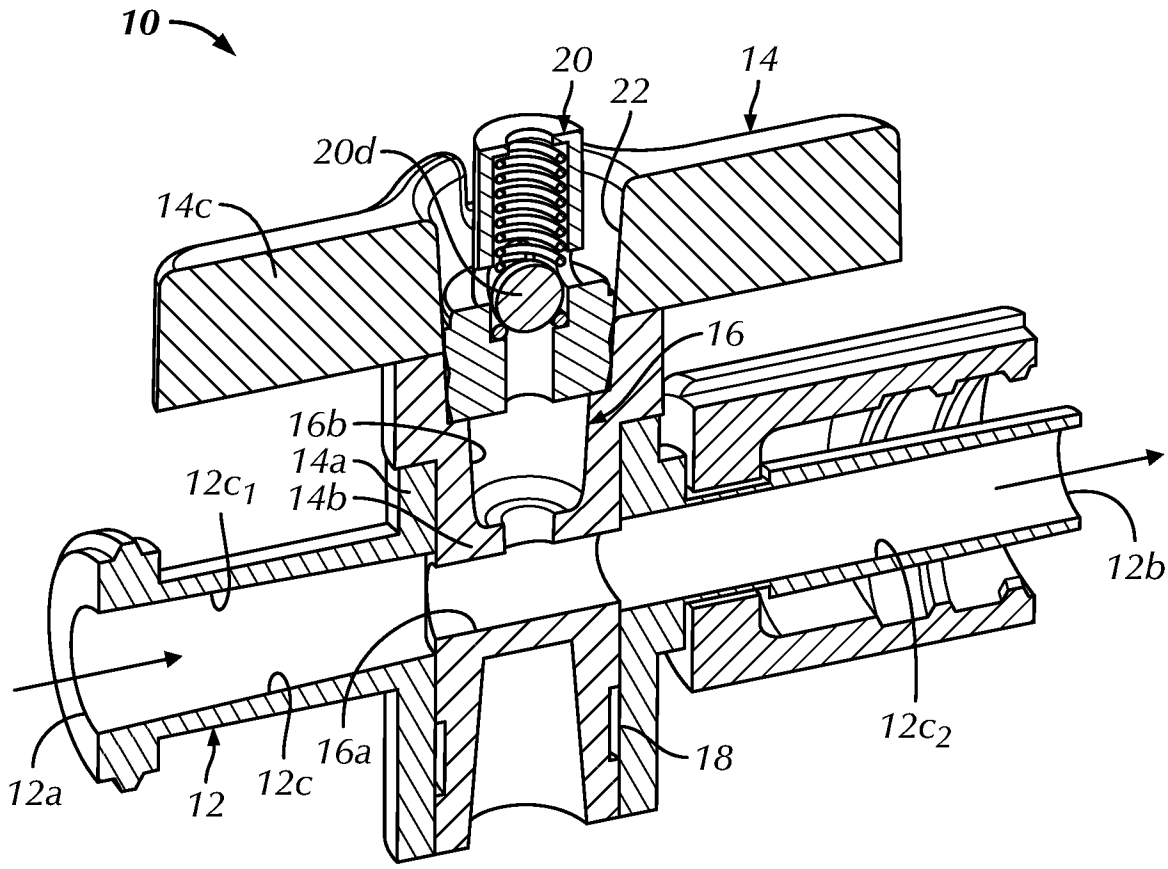

FIG. 4

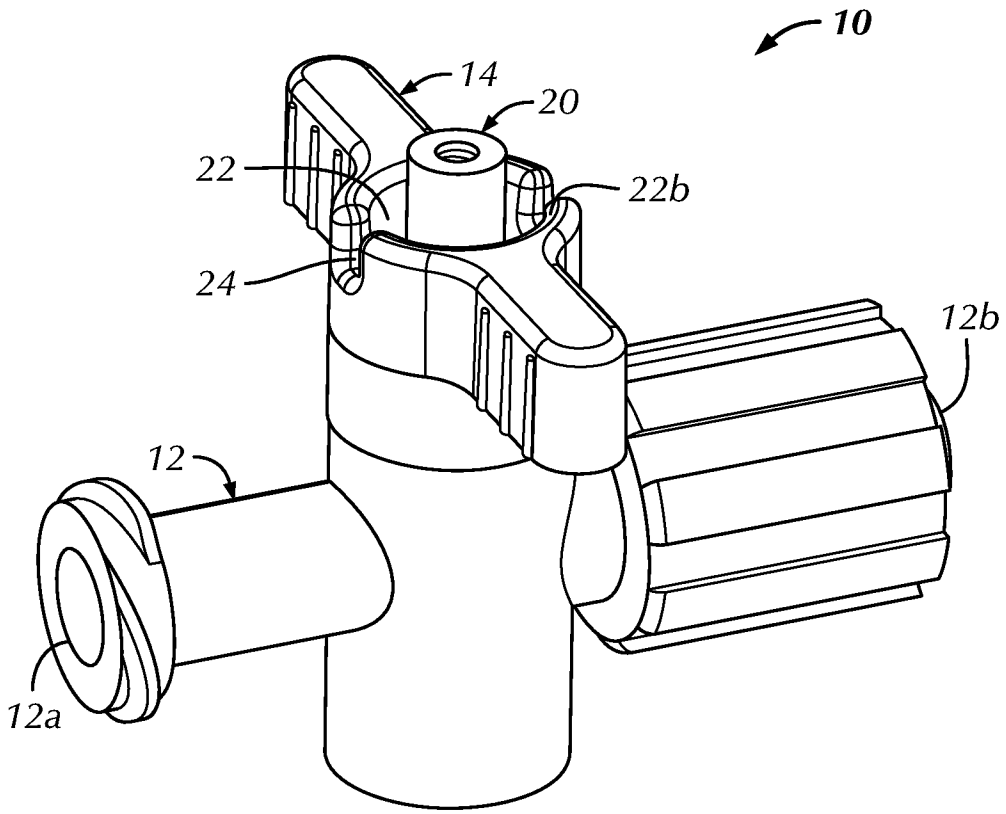

FIG. 5

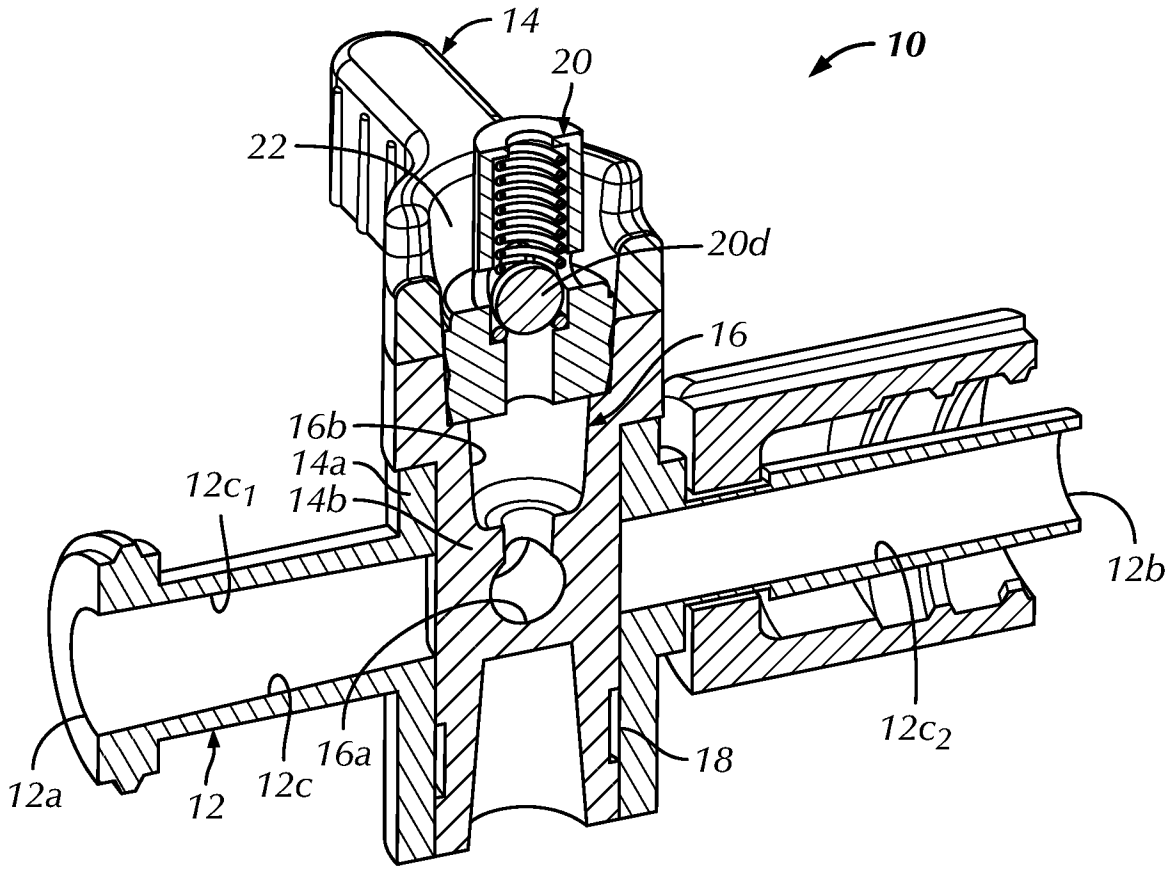

FIG. 6

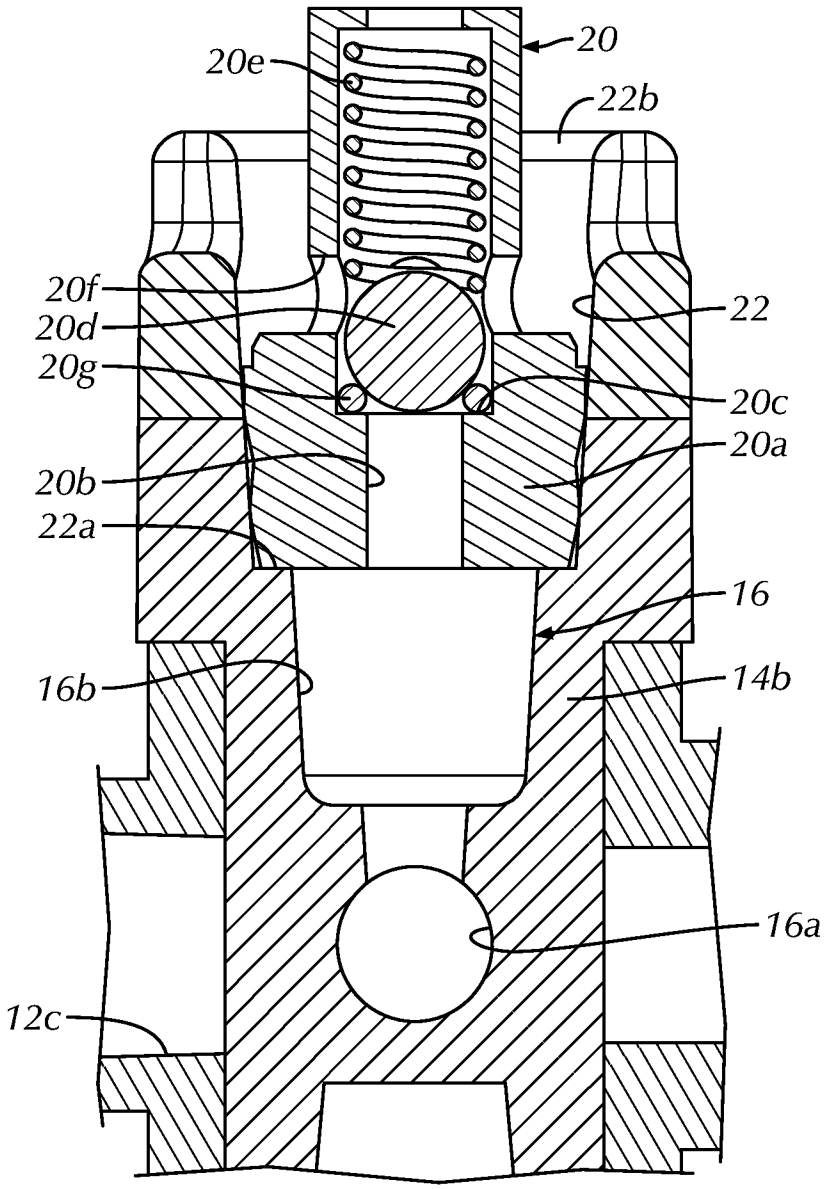

FIG. 7

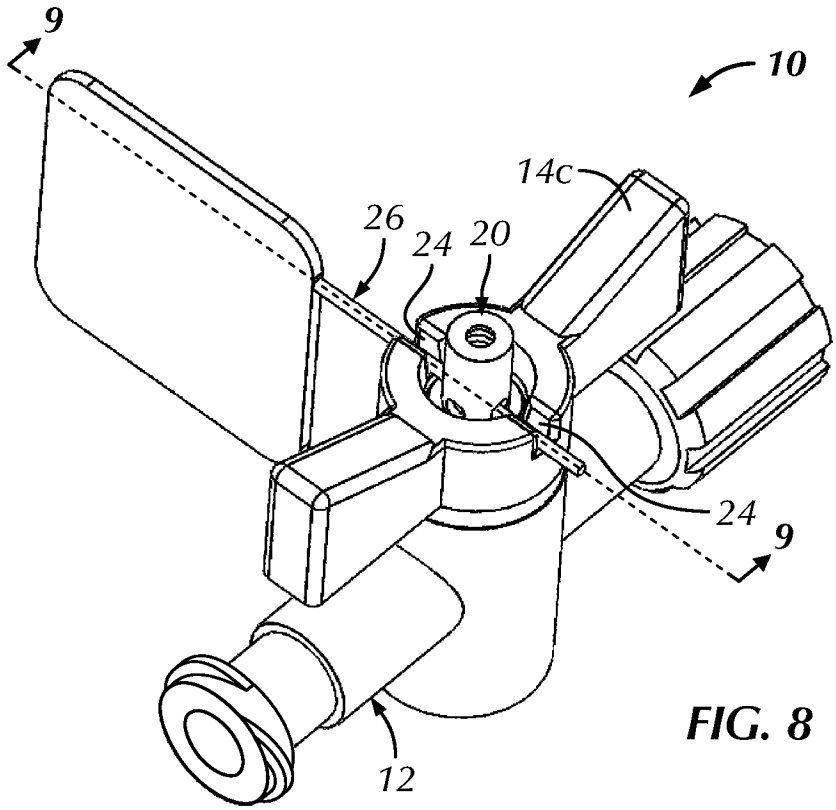

FIG. 8

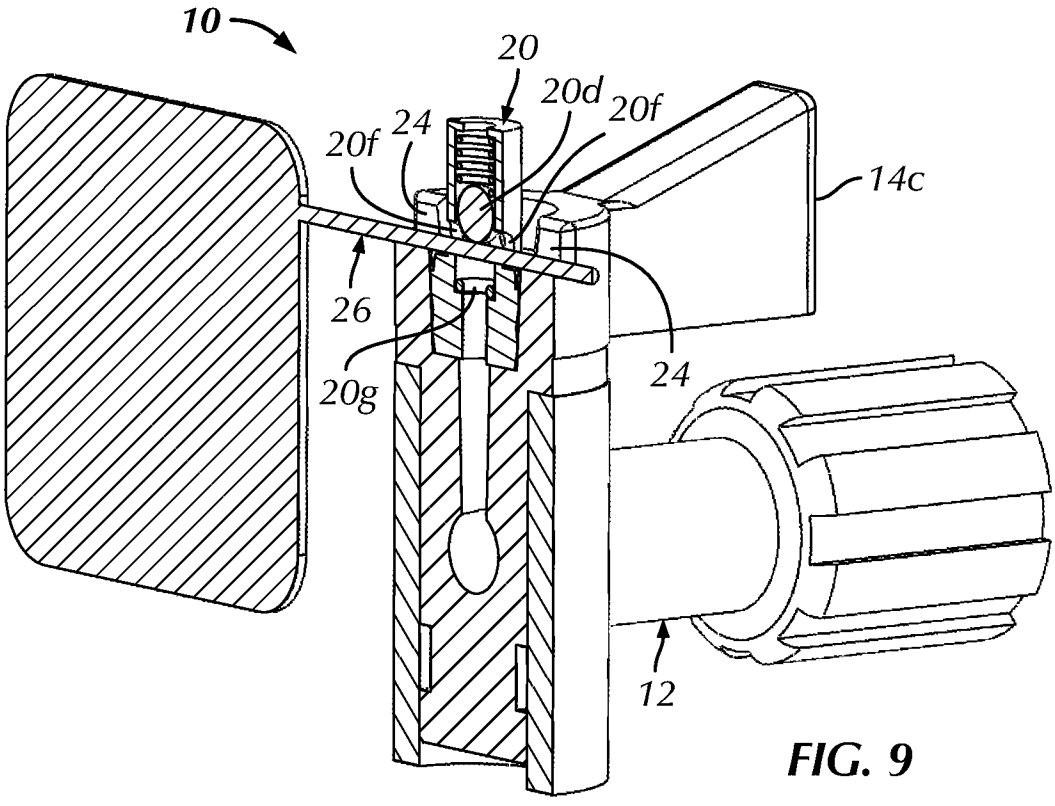

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 21/42067

A. CLASSIFICATION OF SUBJECT MATTER

IPC - F16K 5/00 (2021.01)

CPC - F16K 5/00

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)
See Search History document

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/0312609 A1 (MILLER et al.); 18 December 2008 (18.12.2008); entire document, especially Fig. 3C-3H, para. [0117], [0124]-[0126].	1-20
A	US 2015/0112312 A1 (UNIVERSITY OF LIMERICK); 23 April 2015 (23.04.2015); entire document.	1-20
A	US 4,623,335 A (JACKSON); 18 November 1986 (18.11.1986); entire document.	1-20
A	US 2005/0038421 A1 (JOYE et al.); 17 February 2005 (17.02.2005); entire document.	1-20
A	WO 1994/002195 A1 (JORGENSEN); 3 February 1994 (03.02.1994); entire document.	1-20
A	US 2004/0138615 A1 (LOMBARDI); 15 July 2004 (15.07.2004); entire document.	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"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	Date of mailing of the international search report
17 September 2021	OCT 26 2021
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Kari Rodriquez Telephone No. PCT Helpdesk: 571-272-4300