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(54) **MEDICAL CONNECTOR WITH INTERNAL VALVE MEMBER MOVABLE WITHIN MALE LUER PROJECTION**

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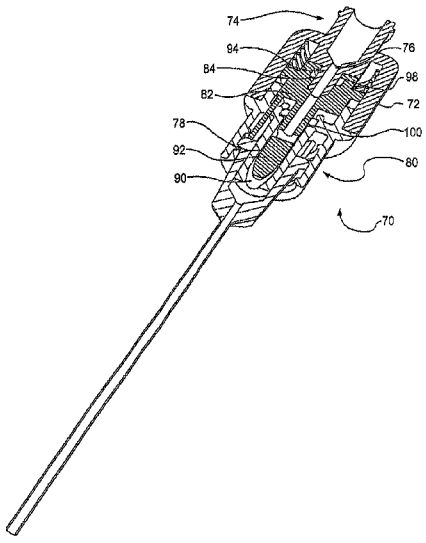
(57) **ABSTRACT**

Disclosed herein is a valve assembly comprising a male luer end portion and a female luer end portion and a passage for the transfer of fluids extending between the male and female luer end portions, valve means movable between a first position, in which the passage is closed, and a second position, in which the passage is open, biasing means for biasing the valve means toward the first position, and actuating means extending into the male luer end portion and coupled to the valve means to actuate the valve means when a female luer end portion of a medical accessory is engaged with the male luer end portion.

29 Claims, 15 Drawing Sheets



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continuation of application No. 14/052,592, filed on Oct. 11, 2013, now Pat. No. 9,707,346, which is a continuation of application No. 13/305,663, filed on Nov. 28, 2011, now Pat. No. 8,556,868, which is a continuation of application No. 12/789,255, filed on May 27, 2010, now Pat. No. 8,066,692, which is a continuation of application No. 10/584,920, filed as application No. PCT/US2004/042723 on Dec. 21, 2004, now Pat. No. 7,758,566.

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See application file for complete search history.

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ICU Medical, Inc. U.S. Appl. No. 11/417,671, filed May 3, 2006.

ICU Medical, Inc. U.S. Appl. No. 11/417,882, filed May 3, 2006.

ICU Medical, Inc. U.S. Appl. No. 11/417,909, filed May 3, 2006.

ICU Medical, Inc. U.S. Appl. No. 11/417,923, filed May 3, 2006.

ICU Medical, Inc. U.S. Appl. No. 15/789,242, filed Oct. 20, 2016.

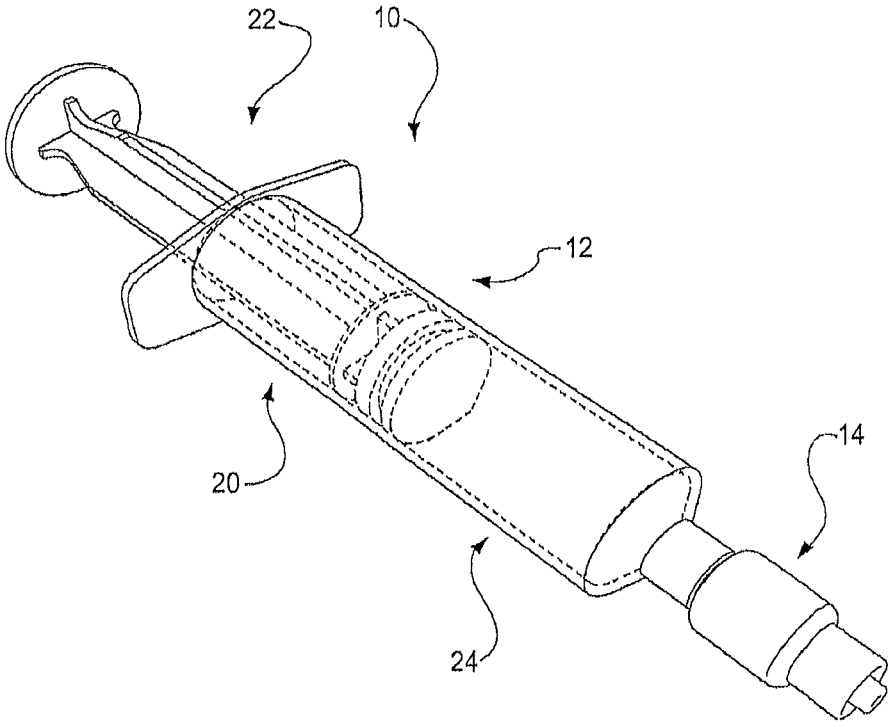


FIG. 1

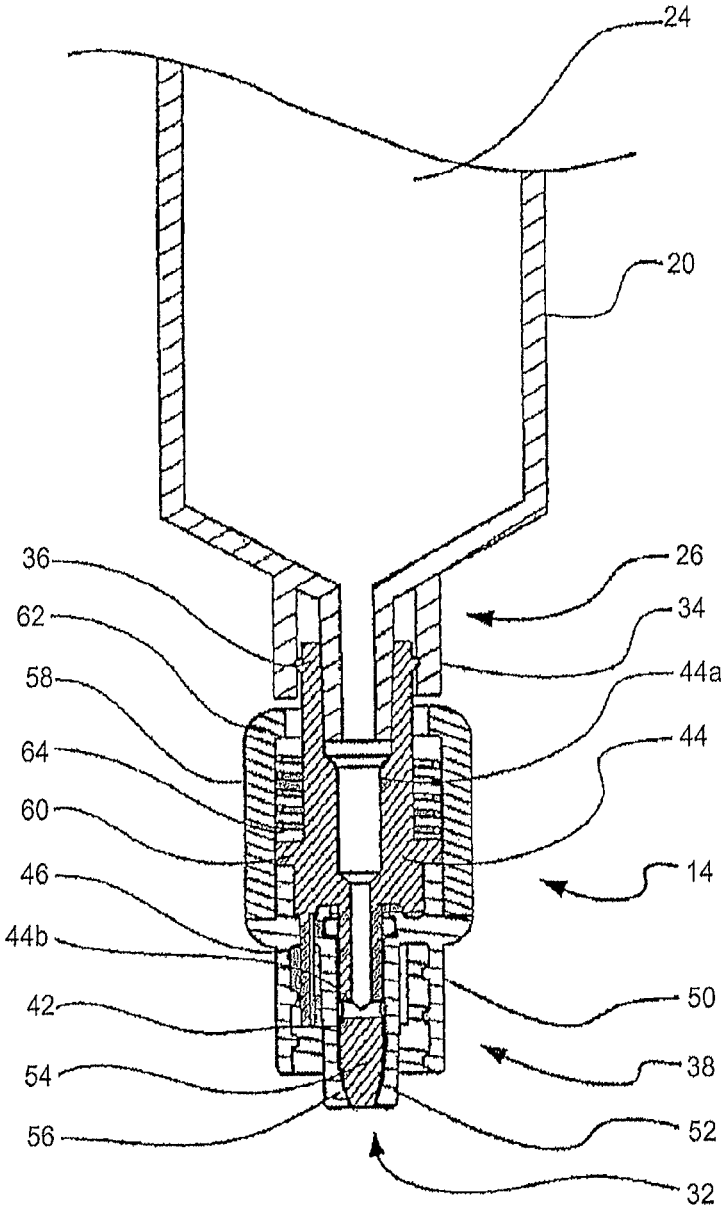


FIG. 2

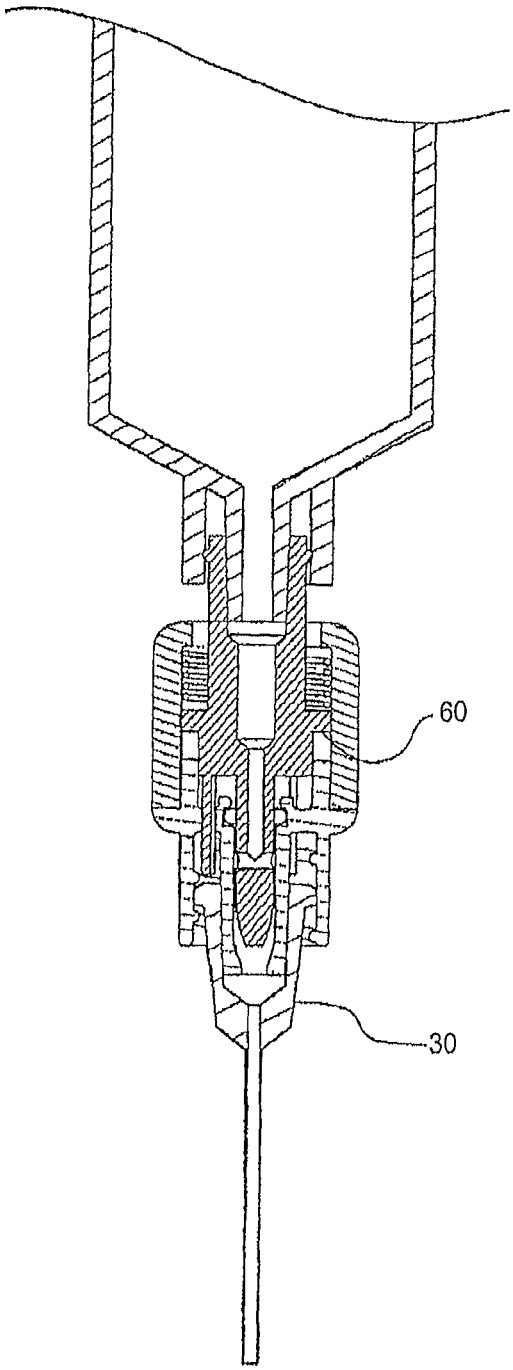


FIG. 3

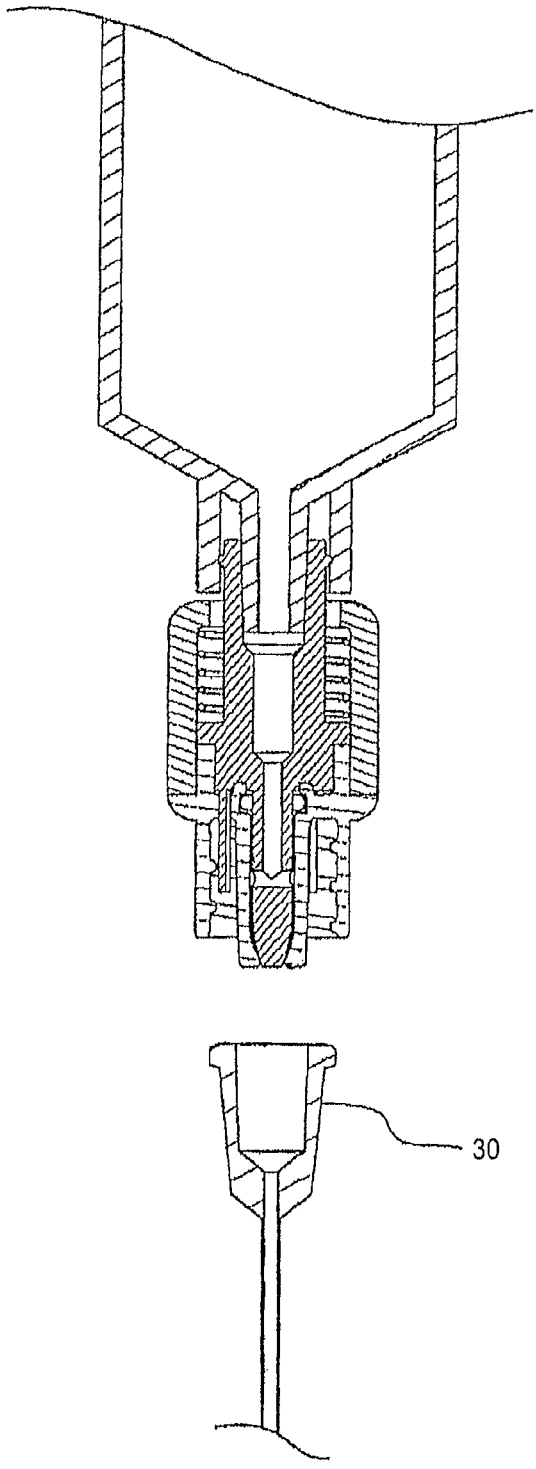


FIG. 4

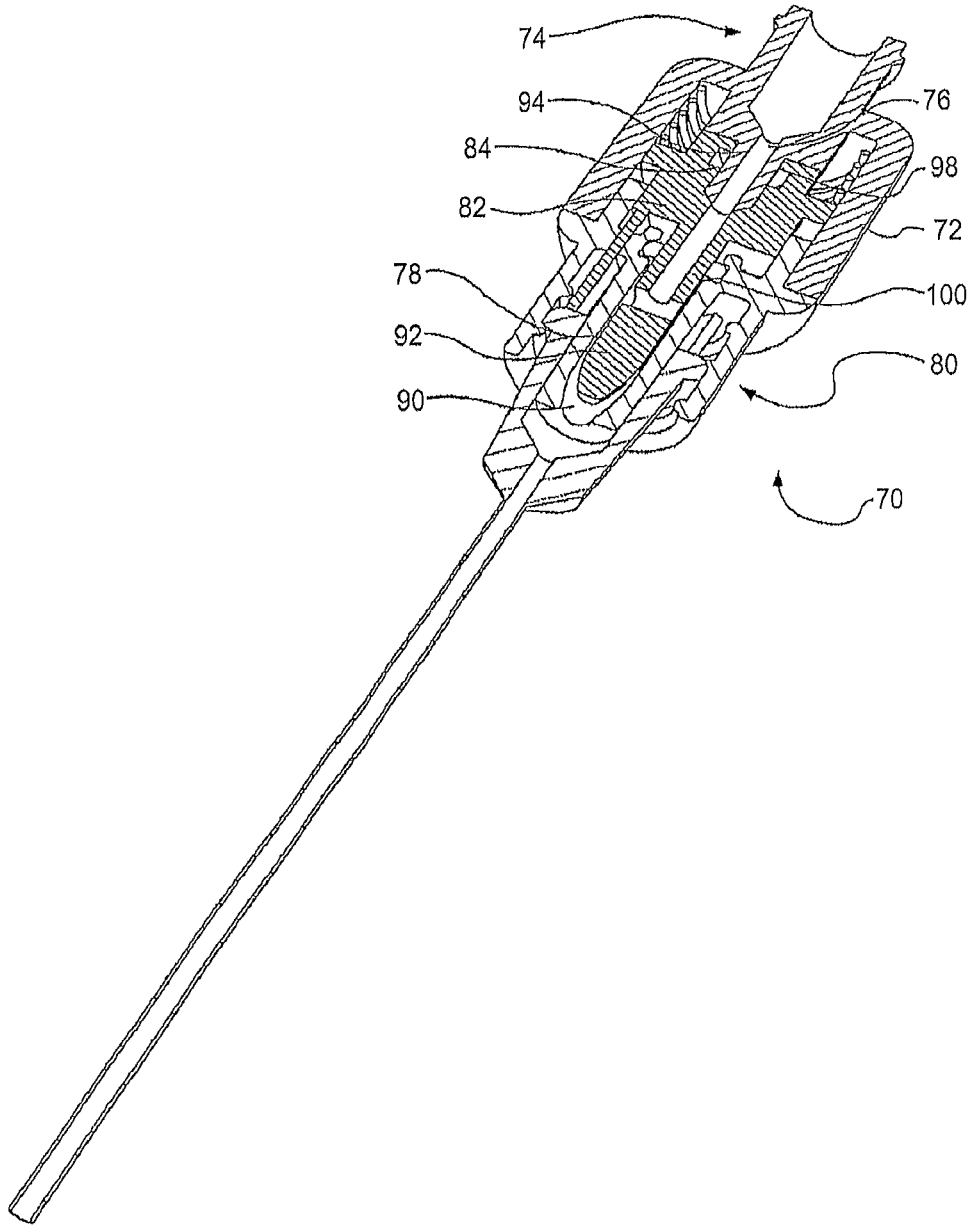


FIG. 5

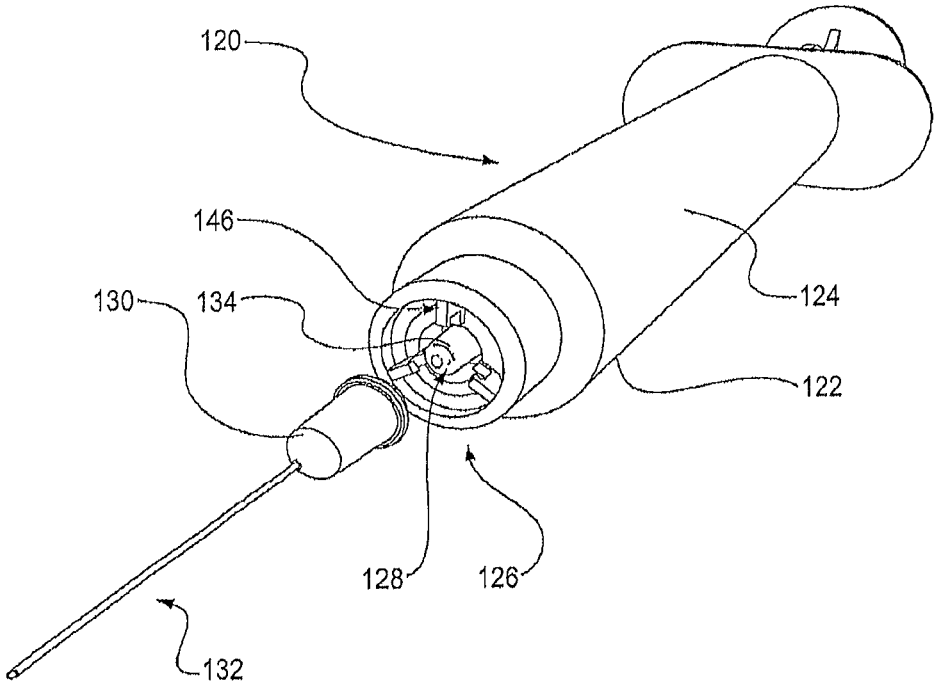


FIG. 6

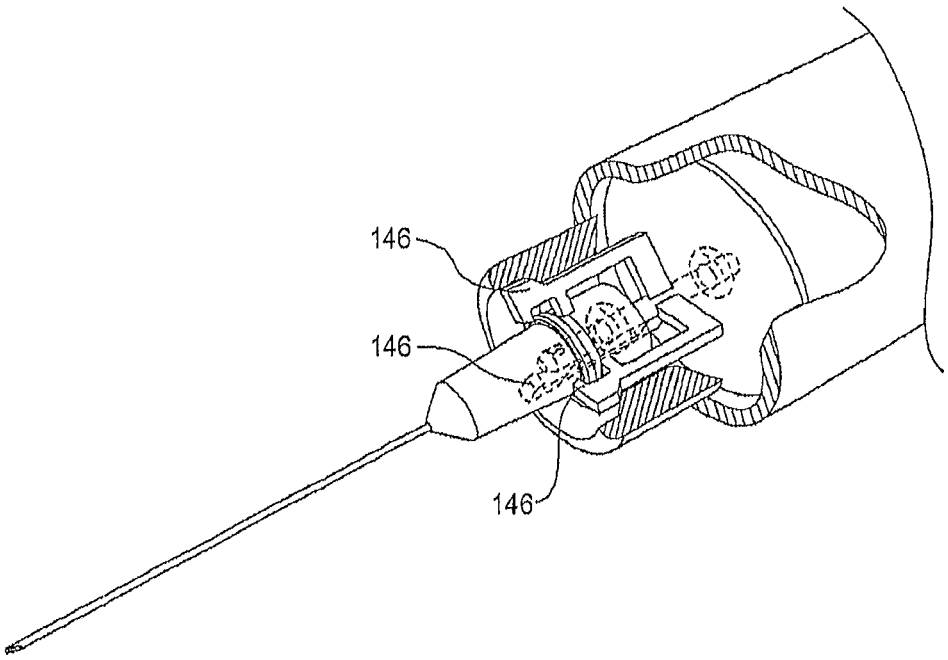
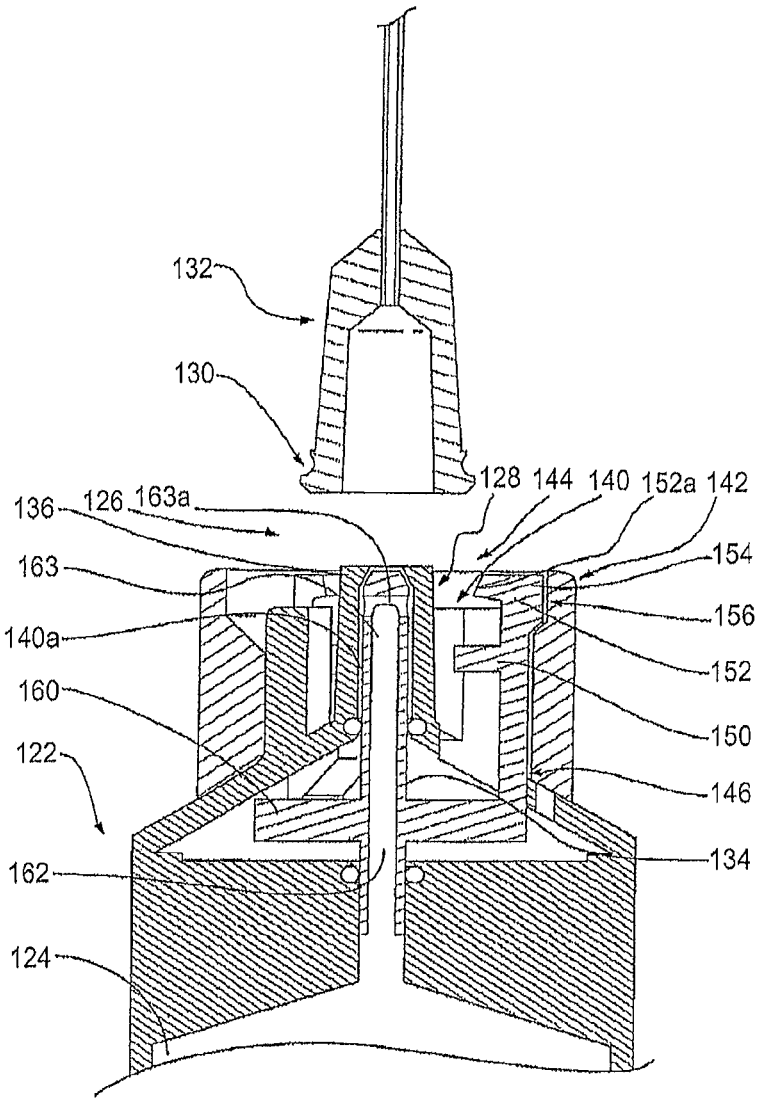


FIG. 7


132
130
128 144 140 152a 142
136 126 163a
154
163
156
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160
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122
146
134
162
124

FIG. 8

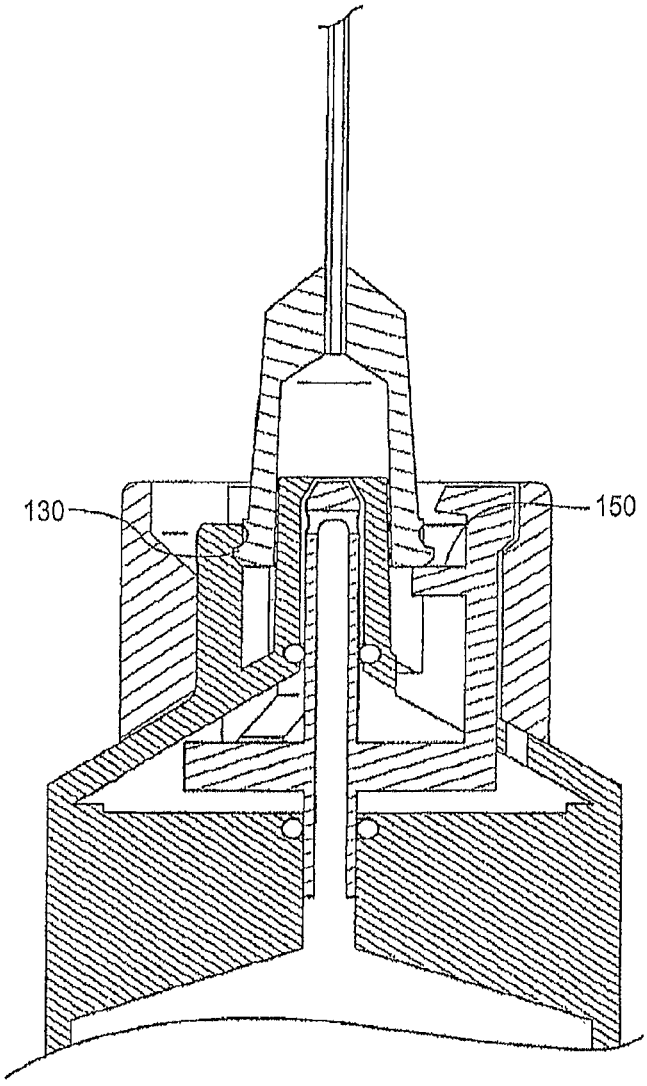

FIG. 9

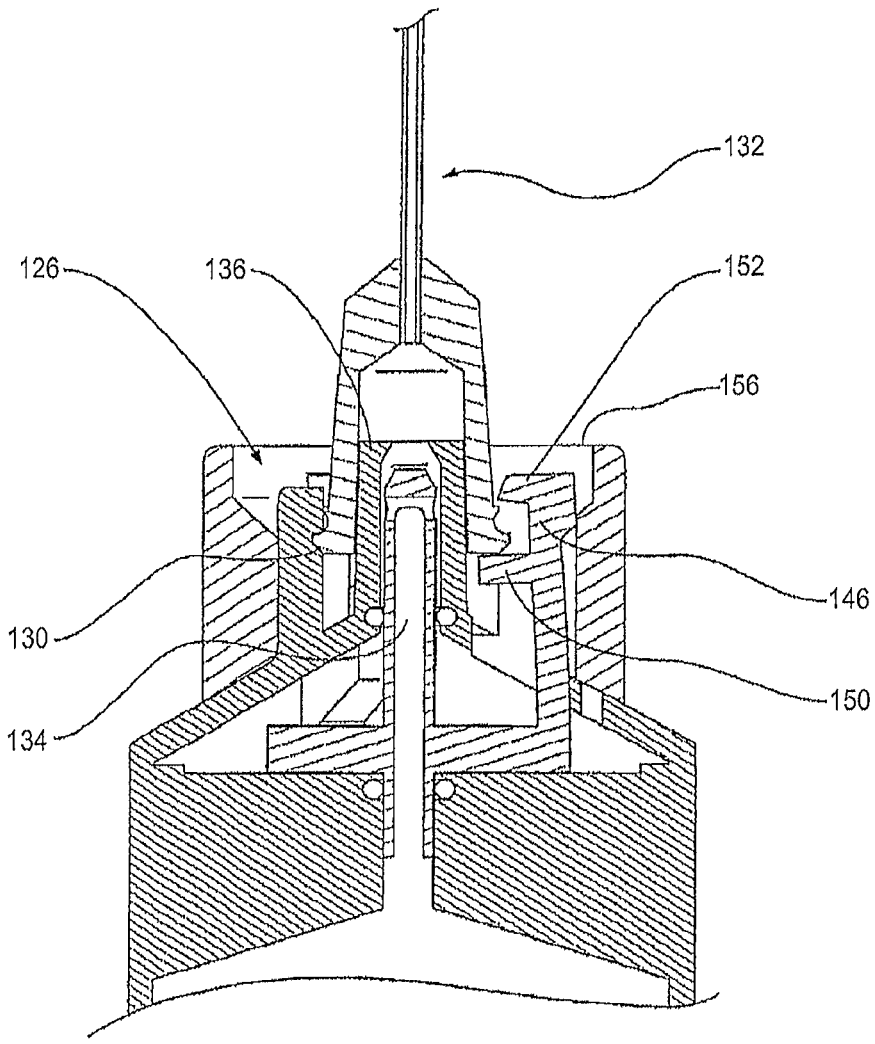

FIG. 10

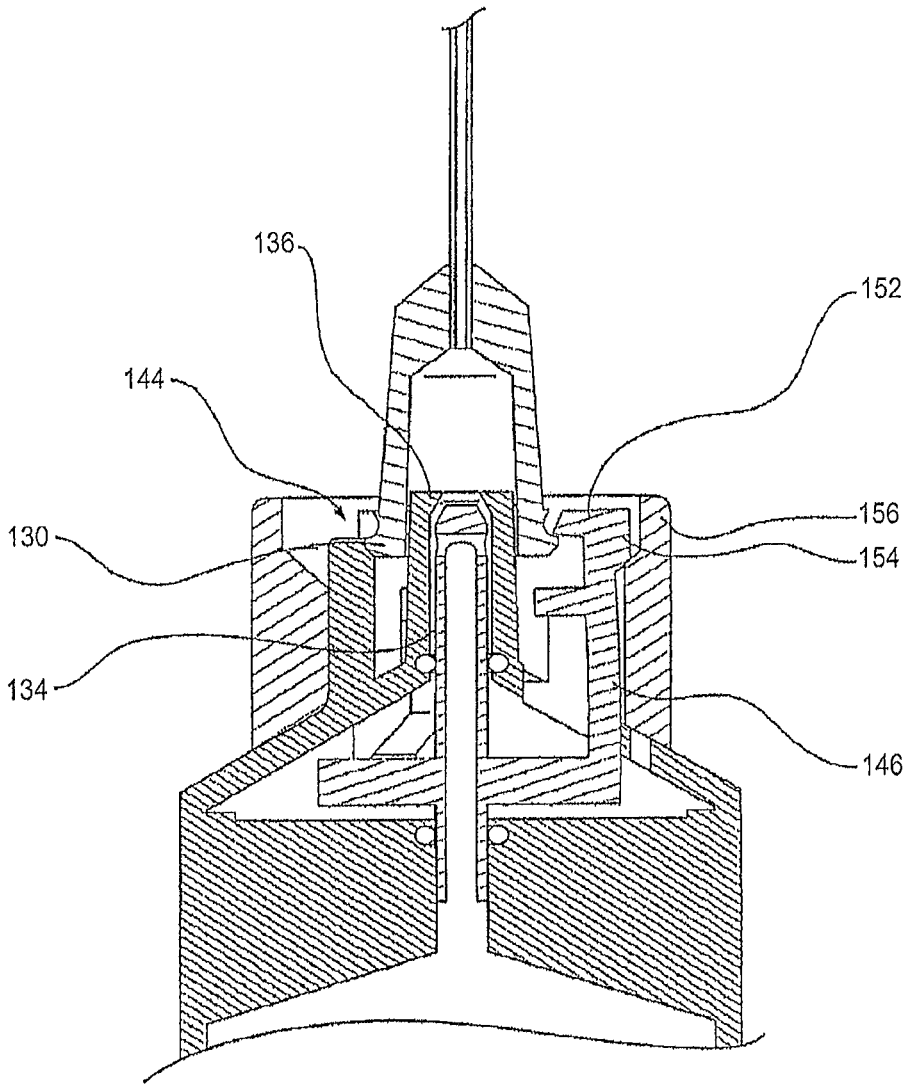

FIG. 11

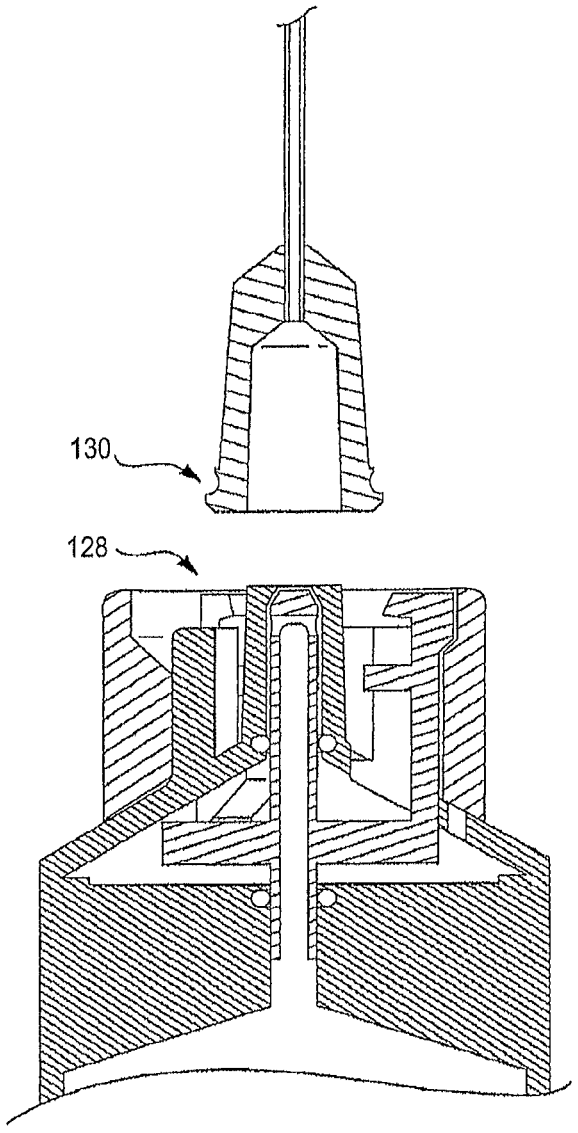

FIG. 12

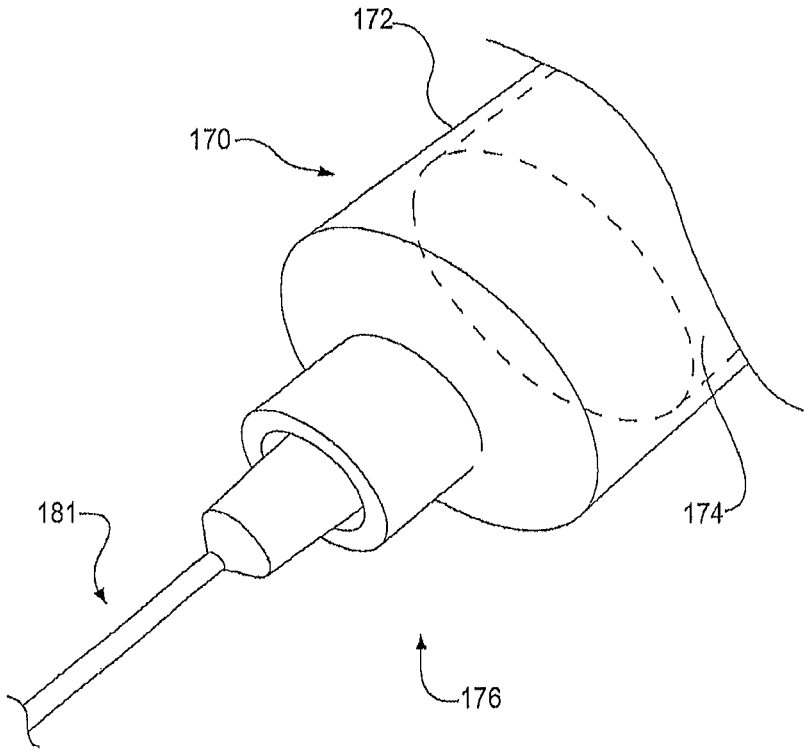

FIG. 13

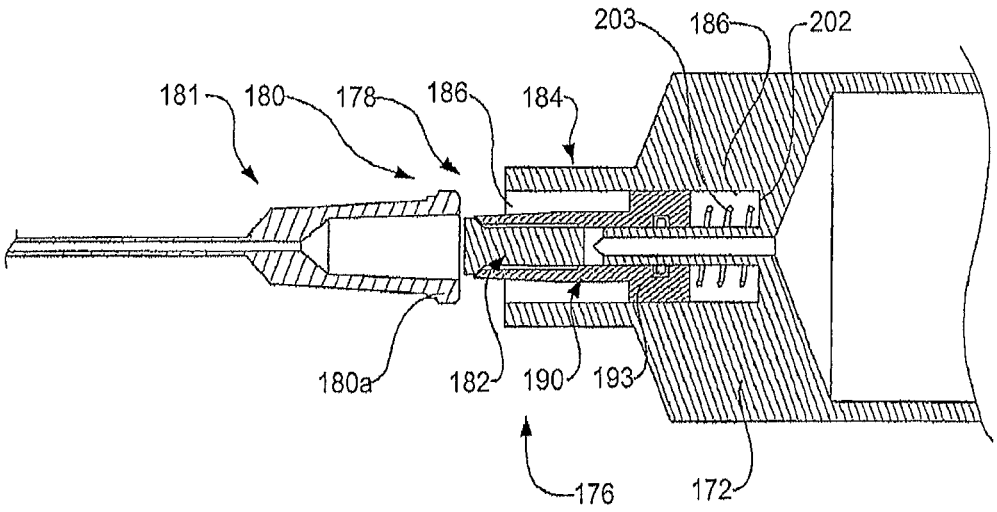

FIG. 14

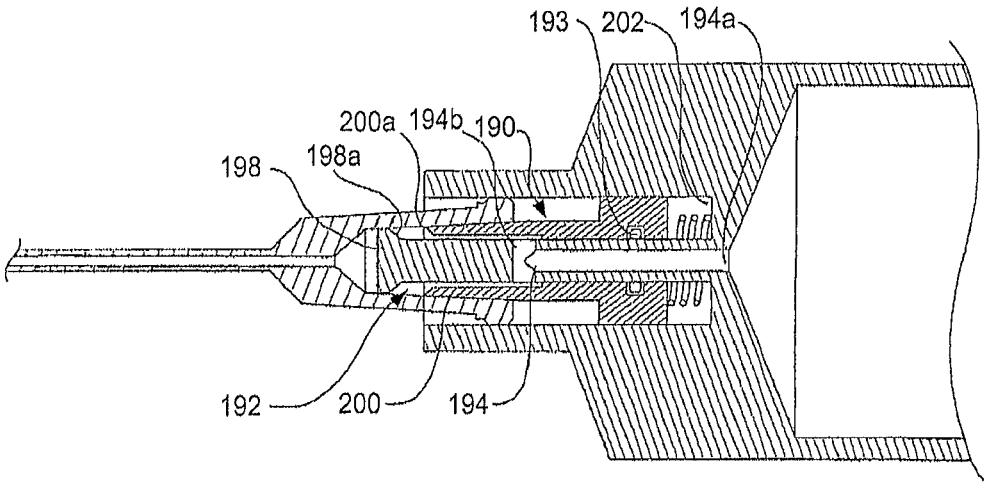

FIG. 15

MEDICAL CONNECTOR WITH INTERNAL VALVE MEMBER MOVABLE WITHIN MALE LUER PROJECTION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 15/648,147, filed Jul. 12, 2017, now U.S. Pat. No. 9,913,945, which is a continuation of U.S. patent application Ser. No. 14/052,592, filed Oct. 11, 2013, now U.S. Pat. No. 9,707,346, which is a continuation of U.S. patent application Ser. No. 13/305,663, filed Nov. 28, 2011, now U.S. Pat. No. 8,556,868, which is a continuation of U.S. patent application Ser. No. 12/789,255, filed May 27, 2010, now U.S. Pat. No. 8,066,692, which is a continuation of U.S. patent application Ser. No. 10/584,920, filed Dec. 28, 2006, now U.S. Pat. No. 7,758,566, which is the National Stage Entry of International Application No. PCT/US04/42723, filed Dec. 21, 2004, which claims the benefit of U.S. Provisional Application No. 60/532,916, filed Dec. 30, 2003; the entire contents of all of which are hereby incorporated by reference herein and made a part of this specification. Any and all priority claims identified in the Application Data Sheet, or any correction thereto, are hereby incorporated by reference under 37 CFR 1.57.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to medical fluid delivery valves and more particularly to valve assemblies for use with syringes or other medical dispensing devices.

Description of the Related Art

Syringes are commonly used to deliver medications and other biological fluids to a patient. The syringe typically has a plunger which is sealingly engaged with an outer cylindrical chamber to form an inner fluid-receiving chamber. A 'male' luer fitting is usually provided at a delivery end of the chamber which receives a female luer fitting with a needle assembly or the like. The fluid channel joining the cavity to the luer fitting is usually open, so that when the needle is removed, the cavity is open to the environment. This is problematic since many medications and biological fluids are sensitive (or can degrade when exposed) to the environment.

It is therefore an object of the present invention to provide a novel valve assembly for use with a syringe or other medical dispensing devices, enabling the latter to be closed to the environment when in an unattached condition.

SUMMARY OF THE INVENTION

In one of its aspects, the present invention provides a valve assembly comprising a male luer end portion, a female luer end portion and a channel for the transfer of fluids between the male and female luer end portions, valve means movable between a closed position and an open position, biasing means for biasing the valve means toward the closed position, and actuating means extending into the male luer end portion and coupled to the valve means to actuate the valve means when a female luer end portion of a medical accessory is coupled with the male luer end portion.

In an embodiment the male luer end portion has an inner projection and outer threaded sheath which is spaced therefrom to receive the female luer end portion therebetween. The actuating means includes an actuating member positioned between the outer threaded sheath and the inner projection.

In an embodiment, the valve means includes a valve seat and a valve member moveable relative thereto. The channel includes a first channel portion adjacent the female luer end portion and the inner projection includes a second channel portion. The valve member has a valve channel portion in fluid communication with the first and second channel portions. The valve seat is formed in the second channel portion and the valve member is integrally formed with the female luer end portion.

In one embodiment, the valve member includes an anchor flange extending outwardly toward an inner surface of the housing portion. In this case, the housing portion is coupled to the male luer end portion for movement therewith relative to the valve member. The male luer end portion engages the anchor flange when the valve means is in the closed position and the male luer end portion is spaced from said anchor flange when the valve means is in the open position. The housing portion terminates at an end region adjacent the female luer end portion, the biasing means includes a compression spring located within the housing between the end region and the outer anchor flange.

In another of its aspects, the present invention provides a medical dispensing device comprising a body having a chamber therein to contain a fluid material, a valve assembly in fluid communication with the chamber, the valve assembly having a male coupling member for engaging a female coupling member on a medical accessory to form a fluid coupling between the medical dispensing device and the medical accessory, the valve assembly further comprising flow control means operable to control fluid flow through the male coupling member, the flow control means being operable to be displaced by the female coupling member to open the male coupling member when female coupling member is operatively connected therewith, the flow control means being operable to be displaced by the female coupling member to close the male coupling member when the female coupling member is disconnected therefrom.

In one embodiment, the male coupling member includes an inner male portion and an outer sheath portion spaced therefrom to form a passage there between for receiving the female coupling member, the flow control means including at least one valve actuating portion positioned in the passage to abut the female coupling member and to displace the valve member during the travel of the female coupling member along the passage. The valve assembly includes a valve member and a valve seat, wherein the valve member is positioned against the seat to close the male coupling member. The valve actuating portion includes a pair of abutment elements which are spaced from one another along the passage to receive the female coupling member there between, wherein the pair of abutment elements are operable to travel with the female coupling member along the passage.

In one embodiment, the actuating portion is longitudinally oriented relative to the passage and the abutment elements are positioned along the actuating portion.

The valve member includes a back plate and a plurality of actuating portions equally spaced on the back plate, each of the actuating portions having first and second abutment elements.

In one embodiment, the valve actuating portion includes a locking flange which is adjacent one of the abutment elements. The valve assembly includes a locking seat to receive the locking flange when the male coupling member is in the closed position. The actuating portion has a distal end region, the locking flange being located adjacent the distal end region and the locking seat is formed in the outer sheath portion. The actuating portion is thus arranged to flex in order to displace the locking flange from the locking seat.

In yet another aspect, the present invention provides a medical dispensing device comprising a body having a chamber therein to contain a fluid material, a valve assembly in fluid communication with the chamber, the valve assembly having a male coupling member for engaging a female coupling member on a medical accessory to form a fluid coupling between the medical dispensing device and the medical accessory, the male coupling member including a projection and an outer valve member movable relative to the projection, the projection and the outer valve member forming a fluid channel there between, a sheath portion encircling the projection and spaced therefrom to form a passage to receive the female coupling member, the valve member being engageable with the female coupling member and movable relative to the projection to open the fluid channel when the female coupling member is connected with the male coupling member.

In one embodiment, the valve member forms an outer surface of the male coupling portion.

In an embodiment, biasing means is provided to bias the valve member toward an engaged position with the projection to close the fluid channel. In this particular case, the passage ends at an inner wall and the biasing means includes a spring located between the inner wall and the valve member.

In one embodiment, the projection is fixed to the body and includes an inner passage, the inner passage having one end which is open to the chamber and another end which is open to the fluid channel. The projection also includes an enlarged end portion, the valve member including an outer portion arranged to engage the enlarged end portion to close the fluid channel. In this case the enlarged end portion and the outer end portion on the valve member have mating bevelled surfaces.

In one embodiment, the female coupling member has a leading segment, the valve member being dimensioned to fit within the leading segment.

Preferably, the medical dispensing device includes such items as a syringe, an IV bottle, an IV line, a powder and/or atomized fluid and/or gas inhalant dispenser, an implant delivery dispenser, a ventilator, a syringe pump, an intubation tube, a gastrointestinal feeding tube or a plurality and/or a combination thereof.

Preferably, the medical material is in solid, liquid or gaseous form or a combination thereof and has beneficial properties to enhance life, to promote health, to cure and/or treat a disease, condition or ailment, to monitor and/or indicate a bodily function or a combination thereof. For example, the medical material may be useful for, among others, IV therapy, implantation, stem cell therapy, oncology therapy, blood transfusion and/or organ transplantation.

BRIEF DESCRIPTION OF THE DRAWINGS

Several preferred embodiments of the present invention will now be described, by way of example only, with reference to the appended drawings in which:

FIG. **1** is a perspective view of a syringe assembly;

FIG. **2** is a sectional view of a portion of the assembly of FIG. **1**;

FIGS. **3** and **4** are sectional views of the assembly of FIG. **1** in two alternate operative positions;

FIG. **5** is a fragmentary sectional perspective view of a portion of another syringe assembly;

FIGS. **6** and **7** are fragmentary perspective views of another syringe assembly;

FIGS. **8** to **12** are fragmentary sectional views of the syringe assembly of FIG. **6**;

FIG. **13** is a fragmentary perspective view of yet another syringe assembly; and

FIGS. **14** and **15** are fragmentary sectional views of the syringe assembly of FIG. **13** or portions thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the figures, and in particular FIG. **1**, there is provided a syringe assembly **10** comprising a syringe **12** and a valve unit **14**. The syringe **12** has a chamber **20** containing a plunger **22** to form a cavity **24**. Referring to FIG. **2**, the cavity has an outlet **26** and the valve unit **14** is located downstream of the outlet **26** for coupling the cavity **24** with a medical accessory such as a needle **30** (as shown in FIGS. **3** and **4**). The valve unit **14** has an outlet **32** and flow control means, as will be described, to control fluid flow through the outlet, the flow control means being operable to open the outlet when the coupling section is operatively connected with the medical accessory, the flow control means being operable to close the outlet when the valve unit is disconnected from the medical accessory and to remain closed until connected once again with a medical accessory.

In this case, the chamber **20** includes a first male luer end portion **34** adjacent the outlet **26** and the valve unit **14** includes a first female luer end portion **36** which is engageable with the male luer end portion **34**. The valve unit **14** also includes a second male luer end portion **38** for coupling with the medical accessory **30**.

Although the chamber **20** and the valve unit **14** are separate from one another in this case, it will be understood that they may, alternatively, be integrally formed, for example by combining the first male luer end portion **34** with the female luer end portion **36**.

The valve unit **14** has a channel **42** for the transfer of fluids between the female and male luer end portions **36**, **38**. A valve means, in the form of a valve member **44** is located in the valve unit **14** and is movable between a first position (as shown in FIG. **2**), in which the channel is closed, and a second position (as shown in FIG. **3**), in which the channel is open. An actuating means, in the form of an actuating member **46** (shown in FIG. **2**), extends outwardly from the valve member **44** and into the male luer end portion **38**. The actuating member **46** is coupled to the valve member **44** to actuate it when a female luer end portion of the medical accessory **30** is engaged with the male luer end portion **38**.

In the embodiment of FIGS. **1** to **4**, the male luer end portion **38** has an outer threaded sheath **50** which is spaced from an inner projection **52**. In this case, the actuating member **46** is positioned between the outer threaded sheath **50** and the inner projection **52**. The valve member **44** includes a valve plug portion **54** moveable relative to a valve seat portion **56**. The valve member **44** has an upper end which is integrally formed with the female luer end portion **36**. An outer housing member **58** is slidably mounted on the valve member **44**. In this case, the outer housing member **58** is joined to the male luer end portion **38**. The valve member

44 also has a valve channel 44*a* extending from the female luer end portion 36 to the valve plug portion 42 where it terminates at one or more transverse flow openings 44*b* to join with the channel 42.

The valve member 44 includes an anchor flange 60, and the male luer end portion 38 seats, directly or indirectly, against the anchor flange 60 when the valve is in the closed position as viewed in FIG. 2. Conversely, the male luer end portion 38 is spaced from said anchor flange when the valve is in the open position as shown in FIG. 3.

The outer housing 58 terminates at a radially inwardly directed end region 62 adjacent the female luer end portion 34 and a biasing means in the form of a compression spring 64 is located within the outer housing between the end region 62 and the anchor flange 60 to bias the valve member toward the first position to close the valve unit.

An alternative arrangement is shown in FIG. 5. In this case, the valve unit 70 has a housing 72 which is integrally formed with the female luer end portion 74. A first channel portion 76 is adjacent the female luer end portion 74 and a second channel portion 78 is adjacent a male luer end portion 80. In this case, the valve means includes a valve member 82 having a valve channel 84 in fluid communication with the first and second channel portions 76 and 78. In this case, the valve seat portion is formed at 90 in the second channel portion 78.

The valve member 82 includes a plug portion 92 which is movable relative to and within the second channel portion 78 for engaging the seat portion 90 to close the second channel portion 78. The first channel portion 76 includes a tubular projection 94 extending from the female luer end portion 74. In this case, the valve channel 84 in the valve member 82 is coextensive with the first and second channel portions 76, 78. In this case, the tubular projection 94 is slidably engaged with the valve member 82 within the valve channel 84 and sealed therein by way of seal 98. Likewise, the valve member 84 is sealed within the second channel portion 78 by way of seal 100.

The syringe assembly 10 is used as follows. First, the valve unit 14 is joined to the syringe 12 by engaging the corresponding first male luer end portion 34 with the female luer end portion 36. In this condition, the second male luer end portion 38 is unattached with a medical accessory such as the needle 30 and the actuator 46 is fully extended into the second male luer end portion 38 as shown in FIG. 2. Consequently, the valve member 44 is biased to its closed position, thereby engaging the valve plug portion 54 against the valve seat 56.

The needle 30 is then attached to the syringe by engaging the female luer end portion on the needle 30 with the second male luer end portion 38. Doing so causes the female luer end portion on the needle 30 to abut and displace the actuating member 46, thereby causing the valve member 44 to be displaced upwardly (as viewed in FIG. 2) thereby releasing the valve plug portion 54 from its sealed abutment with the valve seat 56 to open the valve channel. The plunger 22 may then be displaced outwardly to cause fluids in the proximity of the pointed end of the needle 30 to be drawn into the cavity 24, by a path starting at the valve seat 56 through the channel 42 to the transverse flow openings 44*b*, to the valve channel 44*a* and on through the female luer end portion and into the cavity 24. The needle 30 may then be removed causing the actuating member 46 to be displaced downwardly (as viewed in FIG. 2) causing the immediate displacement of the valve plug portion to abut the seat 56 and thereby close the valve.

Another device is shown at 120 FIGS. 6 to 12, having a body 122 forming an inner chamber 124 therein to contain a fluid material. A valve assembly 126 is in fluid communication with the chamber 124 and has a male coupling member 128 for engaging a female coupling member 130 on a medical accessory (in this case a needle 132) to form a fluid coupling between the device 120 and the needle 132.

The valve assembly 126 is operable to control fluid flow through the male coupling member 128 and more particularly to be in an open position when the male coupling member 128 is operatively connected with the female coupling member 130 and, conversely, to be in a closed position when the male coupling member 128 is disconnected from the female coupling member 130.

In this case, the body 122 and the valve assembly 126 are integrally formed and, as seen in FIG. 8, the latter includes a valve member 134 and a valve seat 136. The valve member 134 is shown in its position against the valve seat 136 to close the male coupling member 128, but for a very minor gap there between for illustrative purposes only.

The male coupling member 128 includes an inner male portion 140 having an inner fluid channel 140*a* and an outer sheath portion 142 spaced from the inner male portion 140 to form a passage 144 there between for receiving the female coupling member 130. At least one, in this case three, valve actuating portions 146 (two being shown in FIG. 7) are positioned in the passage 144 to abut the female coupling member 130 and to displace the valve member during the travel of the female coupling member 130 along the passage 144. In this case, each valve actuating portion 146 is integrally formed with the valve member 134.

Each valve actuating portion 146 includes a pair of abutment elements 150, 152 which are spaced from one another along the passage 144 to receive the female coupling member 130 there between and to travel with the female coupling member along the passage 144. The abutment element 152 has a bevelled outer surface 152*a* for reasons to be described. Each actuating portion 146 is longitudinally oriented relative to the passage 144 and the abutment elements 150, 152 are positioned along the actuating portion 146.

Each valve actuating portion 146 includes a locking flange 154 and the valve assembly includes a locking seat 156 to receive the locking flange 154 when the valve member 134 is in the closed position. In this case, the valve actuating portion 146 has a distal end region and the locking flange 154 is located in the distal end region, while the locking seat 156 is formed in the outer sheath portion 142.

It will be seen in FIG. 10 that each valve actuating portion 146 is arranged to flex in order to displace the locking flange 154 out of the locking seat 156.

Referring to FIG. 8, the valve member 134 includes a back plate 160 and the actuating portions 146 are equally spaced on the back plate 160. The back plate 160 has a central fluid channel 162 which is in fluid communication with the chamber 124 and the valve member 134 has a fluid channel 163 therein in fluid communication with the central fluid channel 162 and hence the chamber 124. In addition, the fluid channel 163 has a lateral portion 163*a* which establishes fluid communication between the fluid channel 163 and an inner fluid channel 140*a* in the inner male portion.

The device 120 is thus used as follows. The valve assembly is set with the valve member in its closed position, that is with the valve member 134 in its position against the valve seat 136 as shown in FIG. 8. The female coupling member 130 on the needle 132 is aligned with the passage

144 and brought toward the male coupling member 128. The bevelled leading surface 152*a* on the abutment member 152 aids to centre the female coupling member on the mouth of the passage 144. With the locking flange 154 in the locking seat 156, the female coupling member 130 is able to pass the lowermost edge of the abutment element 152 and continue into the passage 144 until the female coupling member makes contact with the abutment element 150 as seen in FIG. 9. As seen in FIG. 10, continued inward force on the female coupling member is transferred to the abutment element 150 causing the abutment portion 146 to move inwardly along the passage and thus to draw the locking flange 154 from this locked position in the locking seat 156, causing the abutment portion 146 to flex, until the locking flange 154 is removed from the locking seat 156. At this position, it can be seen that the valve member 134 has moved from the valve seat 136 to open the fluid channel 163 to the needle 132.

Referring to FIG. 11, as the female coupling member 130 is removed from the passage 144, it makes contact with the abutment element 152 and causes the abutment portion 146 to move outwardly along the passage 144 and thus cause the valve member 134 to move toward the valve seat 136. The locking flange 154 approaches, and finally enters, the locking seat 156 to coincide with the closure of the valve assembly.

Thus, the device 120 does not make use of a valve member which is biased to its closed position as with the earlier embodiment, but rather relies on the displacement of the female coupling member 130 to draw the valve assembly to its closed position when it is removed from the male coupling member 128.

Another device is shown at 170 in FIGS. 13 to 15, having a body 172 providing a chamber 174 therein to contain a fluid material. A valve assembly 176 is in fluid communication with the chamber 174 and has a male coupling member 178 for engaging a female coupling member 180, again on a needle 181, to form a fluid coupling between the medical dispensing device 170 and the needle 181.

The valve assembly 176 is operable to control fluid flow through the male coupling member and more particularly to actuate or open the male coupling member 178 when operatively connected with the female coupling member 180 and, conversely, to close the male coupling member 178 when disconnected from the female coupling member 180.

In this case, the male coupling member 178 includes a projection 182 which is fixed to the body 172. A sheath portion 184 encircles the projection 182 and is also fixed to the body 172. The sheath portion 184 and is spaced from the projection 182 to form a passage 186 to receive the female coupling member 180.

A valve member 190 is movable relative to the projection 182 and forms a fluid channel 192 there between and sealed by an inner seal 193. The projection 182 includes an inner passage 194 which has one end 194*a* open to the chamber 174 and another end 194*b* which is open to the fluid channel 192.

Referring to FIGS. 14 and 15, the projection includes an enlarged end portion 198 and the valve member 190 has an outer portion 200 arranged to engage the enlarged end portion 198 to close the fluid channel 192. In this case, the passage 186 ends at an inner wall 202 and the valve member 190 is movable relative to the inner wall 202 under the action of a spring 203 which is positioned in the passage 186 between the valve member 190 and the inner wall 202 to bias the outer end portion 200 of the valve member 190 toward an engaged position with the enlarged end portion 198.

As can be seen in FIG. 15, the enlarged end portion 198 and the outer end portion 200 on the valve member 190 have mating bevelled surfaces 198*a* and 200*a* respectively.

The valve member 190 is operable to engage the female coupling member 180 and to travel with the female coupling member 180 along the passage 186. In this case, the female coupling member 180 has a leading segment 180*a* and the outer end portion 200 of the valve member 190 is dimensioned to fit within the leading segment 180*a*.

In contrast to the device 120 of FIG. 6, the device 170 has a valve member 190 which is biased to the closed position. As the female coupling member 180 passes over the projection 182, the leading segment 180*a* of the female coupling member 180 rides over the outer end portion 200 of the valve element 190. Continued inward displacement of the female coupling member 180 into the passage 186 thus causes the valve member to move relative to the projection 182 until the mating bevelled surfaces 198*a*, 202*a* separate to open the fluid channel 192 to the needle. The fluid coupling is thus fully operational when the female and male coupling members are tightly engaged. When the female coupling member 180 is removed from the male coupling member 178, the valve member 190 is returned to its closed position against the projection 198 under the biasing action of the spring 203, to close the male coupling member.

While the present invention has been described for what are presently considered the preferred embodiments, the invention is not so limited. To the contrary, the invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

The valve unit may be used with other medical fluid delivery devices, such as IV lines, catheters, infusion pumps and the like. The valve unit may also be used on syringes and other medical devices which do not employ the ubiquitous luer coupling arrangement.

The following is claimed:

1. A medical connector comprising:

a housing comprising:

a proximal region comprising:

a female luer end portion including an external thread on an outer surface of the female luer end portion, the female luer end portion being configured to receive a male luer,

a first channel portion, and

a generally tubular projection extending distally from the female luer end portion, and

a distal region comprising:

a second channel portion, and

a shroud comprising an internal thread configured to receive a separate medical connector;

a fluid flow path extending through the first channel portion and the second channel portion, at least a portion of the fluid flow path being configured to be opened and closed to permit passage of fluid through the medical connector;

a valve member having a closed position configured to inhibit fluid flow to or from the separate medical connector, the valve member having an open position configured to allow fluid flow to or from the separate medical connector, the valve member being configured to move generally longitudinally along the generally

tubular projection as the valve member transitions between the closed position and the open position, the valve member comprising:

a valve channel in fluid communication with the first channel portion and the second channel portion, the valve channel extending between the valve member and the generally tubular projection, and

a seal contacting the generally tubular projection, the seal extending generally around at least a portion of the generally tubular projection in both the open position and the closed position,

wherein a portion of the fluid flow path located within the second channel portion is configured to be selectively opened when the separate medical connector is received by the shroud,

wherein the seal is positioned closer to the female luer end portion when the valve member is in the open position than when the valve member is in the closed position,

wherein, when the valve member transitions from the open position to the closed position, an increased fluid volume is created within the valve channel, and

wherein the valve member is biased towards the closed position; and

an actuating member positioned between the second channel portion and the shroud of the distal region of the housing, the actuating member configured to actuate the valve member from the closed position to the open position, wherein the actuating member is in contact with the valve member at a location proximal from a distal end of the valve member.

2. The medical connector of claim **1**, wherein the generally tubular projection is located entirely within the proximal region of the housing.

3. The medical connector of claim **1** wherein the generally tubular projection comprises a distal end tip located proximal from the shroud.

4. The medical connector of claim **1** wherein a portion of the fluid flow path located within the valve channel increases in width when the valve member transitions from the open position to the closed position.

5. The medical connector of claim **1** wherein the fluid flow path comprises proximal fluid path region located within the first channel portion and a distal fluid path region located within the second channel portion, and wherein the distal fluid path region and the proximal fluid path region are separated by an internal wall when the valve member is in the open position.

6. The medical connector of claim **1**, wherein the fluid flow path comprises a longitudinal section and a transverse section, and wherein the longitudinal section is in fluid communication with the transverse section.

7. The medical connector of claim **6**, wherein the transverse section is positioned within the distal region of the housing.

8. The medical connector of claim **1**, wherein the valve member comprises a plug at the distal end of the valve member, the plug configured to selectively obstruct fluid flow to or from the separate medical connector.

9. The medical connector of claim **1**, wherein the valve member is formed of a single piece of material.

10. The medical connector of claim **1**, wherein at least a portion of the actuating member extends along the shroud when the valve member is in the closed position.

11. The medical connector of claim **1** further comprising a second seal located distal from the seal of the valve member, the second seal configured to maintain fluid within the fluid flow path.

12. The medical connector of claim **11**, wherein the second seal does not move along with the valve member.

13. The medical connector of claim **1** further comprising a biasing member configured to bias the valve member toward the closed position.

14. The medical connector of claim **13**, wherein the biasing member is located within the proximal region of the housing.

15. The medical connector of claim **1**, further comprising:

a second seal located distal from the seal of the valve member, the second seal configured to maintain fluid within the fluid flow path; and

a biasing member configured to bias the valve member toward the closed position,

wherein a portion of the fluid flow path located within the valve channel increases in width when the valve member transitions from the open position to the closed position,

wherein the fluid flow path comprises a longitudinal section and a transverse section, and wherein the longitudinal section is in fluid communication with the transverse section, and

wherein at least a portion of the actuating member extends along the shroud when the valve member is in the closed position.

16. A medical connector comprising:

a housing comprising:

a proximal region comprising a female luer end portion and a generally tubular projection extending from the female luer end portion, the proximal region comprising a first channel portion, and

a distal region comprising a shroud, the shroud comprising an internal thread configured to receive a separate medical connector, the distal region comprising a second channel portion;

a valve member having a closed position and an open position, the valve member being configured to move generally longitudinally between the closed position and the open position with the separate medical connector, the valve member comprising a valve channel portion in fluid communication with the first channel portion and the second channel portion, wherein the valve member is configured to slidably engage the generally tubular projection;

a seal contacting the generally tubular projection of the proximal region of the housing, the seal extending generally around a portion of the generally tubular projection in both the open position and the closed position;

a fluid flow path extending through the first channel portion and the second channel portion, the fluid flow path comprising:

an intermediate fluid path region being located within the valve channel portion, the intermediate fluid path region comprising an internal fluid volume located between the valve member and the generally tubular projection of the proximal region of the housing,

wherein the internal fluid volume of the intermediate fluid path region is smaller when the valve member is in the open position than when the valve member is in the closed position, and

wherein, when the valve member transitions from the open position to the closed position, the internal fluid volume of the intermediate fluid path region increases, and

an actuating member configured to actuate the valve member from the closed position to the open position, wherein the actuating member is coupled to the valve member at a location proximal from a distal end of the valve member.

17. The medical connector of claim **16**, wherein the generally tubular projection is located entirely within the proximal region of the housing.

18. The medical connector of claim **16**, wherein the generally tubular projection comprises a distal end tip located proximal from the shroud.

19. The medical connector of claim **16**, wherein the intermediate fluid path region increases in width when the valve member transitions from the open position to the closed position.

20. The medical connector of claim **16**, wherein the fluid flow path comprises a longitudinal section and a transverse section, and wherein the longitudinal section is in fluid communication with the transverse section.

21. The medical connector of claim **20**, wherein the transverse section is between a distal fluid path region and a proximal fluid path region.

22. The medical connector of claim **16**, wherein the valve member comprises a plug at the distal end of the valve member, the plug configured to selectively obstruct fluid flow to or from the separate medical connector.

23. The medical connector of claim **16**, wherein the valve member is formed of a single piece of material.

24. The medical connector of claim **16**, wherein at least a portion of the actuating member extends along the shroud when the valve member is in the closed position.

25. The medical connector of claim **16** further comprising a second seal located distal from the seal, the second seal configured to maintain fluid within the fluid flow path.

26. The medical connector of claim **25**, wherein the second seal does not move along with the valve member.

27. The medical connector of claim **16** further comprising a biasing member configured to bias the valve member toward the closed position.

28. The medical connector of claim **27**, wherein the biasing member is located within the proximal region of the housing.

29. The medical connector of claim **16**, further comprising:

a second seal located distal from the seal, the second seal configured to maintain fluid within the fluid flow path; and

a biasing member configured to bias the valve member toward the closed position,

wherein the intermediate fluid path region increases in width when the valve member transitions from the open position to the closed position,

wherein the fluid flow path comprises a longitudinal section and a transverse section, and wherein the longitudinal section is in fluid communication with the transverse section, and

wherein at least a portion of the actuating member extends along the shroud when the valve member is in the closed position.

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