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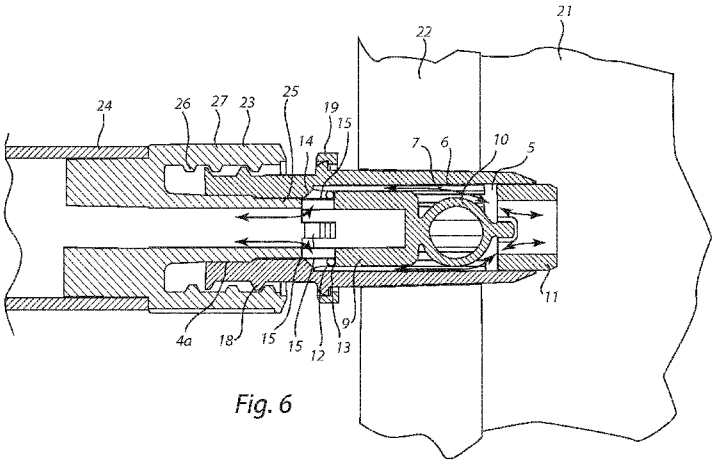


Fig. 6

(57) **Abstract**: A valve (1) comprises a housing (2) defining a flow path (5) between a first end (3) and a second end (4) of the housing (2). The valve further comprises a piston device (8) having a movable portion (9), which is movable between a closed position, in which liquid flow along the flow path is prevented, and an open position, in which liquid flow along the flow path is enabled. The movable portion (9) has a sealing portion (13) arranged to seal against an inside sealing surface (14) of the housing (2) in the closed position of the piston device (8). The piston device further has a spring portion (10) arranged to bias the movable portion (9) towards the closed position. The spring portion (10) forms an integral part of the piston device (8). The piston device (8) has a fixing portion (11), which is fixedly attached to said housing (2) and which defines part of the flow path (5). In the open position, liquid flow is enabled around the movable portion (9). A container (21) for a medical solution is also disclosed, as well as a tube set for use in a medical device. Further, a method of manufacturing a valve and a method of establishing a flow path between two liquid vessels are disclosed.

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VALVE AUTOMATICALLY OPENING ON CONNECTION, AND APPLICATIONS THEREFOR

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a valve comprising a housing having a first end and a second end, said housing defining a flow path between the first and second ends of the housing, and a piston device arranged in said housing, said piston device having a movable portion, which is movable between a closed position, in which liquid flow along the flow path between the first and second ends is prevented, and an open position, in which liquid flow along the flow path between the first and second ends is enabled, the movable portion having a sealing portion arranged to seal against an inside sealing surface of the housing in the closed position of the piston device, and a spring portion arranged to bias the movable portion towards the closed position, said spring portion forming an integral part of the piston device. The invention also relates to a container for a medical solution, said container having a valve arranged in an outlet opening. Further, the invention relates to a tube set for use in a medical device, said tube set having a valve arranged in a tube end. Still further, the invention relates to a method of manufacturing a valve and to a method of establishing a flow path between a liquid reservoir and a liquid duct.

BACKGROUND ART

Numerous valves for connection between two liquid ducts or between a liquid duct and a liquid reservoir are known. One example of such a valve is shown in US-6,089,541. This valve has a valve body in which a deformable stem is located. The stem is made of a resilient elastomeric material, such as silicone. When an

instrument is engaged with an aperture in the stem, the stem is urged from a closed position into the valve body and the aperture deforms to allow liquid to flow through the stem, to or from the instrument. Valves of this or similar type may be used when connecting a container holding a medical solution with a tube for administering the solution or for adding a liquid to the medical solution in the container. The valve may then be activated or opened by a connector on the end of the tube, e.g., a male luer connector. The valve then ensures that no liquid flows out of the tube or the container when the tube is disconnected from the reservoir. A problem with this known type of valve is, however, that as soon as the connector on the end of the tube has been inserted into the deformable stem, the resilient material of the stem seals against the outer surface of the connector. Thus, the user is given the impression that the tube is correctly connected to the valve, but if the connector is not inserted far enough into the stem, the channel that forms through the stem may not be wide enough, resulting in an insufficient flow rate through the valve. An additional problem with this type of valve is that it has a spring that biases the stem towards the closed position. The spring adds to the number of components of the valve, thereby making manufacture more complicated and expensive. Further, the spring is generally made of metal, thus increasing the number of constituent materials in the valve. This leads to difficulties in recycling the materials of the valve when disposing of the valve after use.

Another type of valve is shown in GB-1 466 242. This valve has a valve body of plastics material in which a valve plug of rubber is arranged. The valve plug has a valve biasing element in the form of a resilient tail. When a syringe is inserted into the valve body, it presses against a spigot of the valve plug. The valve plug is thereby urged from a closed position in which it

seals against a valve seating, such that fluid may flow past the valve plug. A problem with this type of valve is that, if the syringe is inserted too far into the valve body, the tail may deform to such an extent that the spigot deflects away from the central axis of the valve body, and does not return to the closed position when the syringe is removed. Further, it is complicated to manufacture this type of valve, since the valve plug has to be arranged inside a closed valve body.

It may be seen that there remains a need for a valve which ensures a sufficient flow when a connector is connected to the valve and which seals reliably when the connector is disconnected from the valve. There is also a need for a valve that is easy and inexpensive to manufacture.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a valve which solves, or at least lessens, the problems associated with prior art valves.

A particular object of the invention is to provide a valve which ensures a secure connection between two liquid ducts or between a liquid reservoir and a liquid duct, thus ensuring a sufficient flow rate when connected and reliable sealing when disconnected.

Another object of the invention is to provide a valve which may be manufactured easily and inexpensively.

An additional object is to provide a valve that may easily be recycled after use.

A further object is to provide a container for a medical solution which ensures a secure connection to a liquid duct for administering the medical solution or for adding a liquid to the container.

Yet another object of the invention is to provide a tube set for a medical device for fluid passage, which ensures a secure connection to another liquid duct or to a liquid reservoir.

It is also an object of the present invention to provide a method for manufacturing a valve, which is easy and inexpensive.

Still another object is to provide a method of establishing a flow path between two liquid vessels, which easily ensures a sufficient flow rate.

These objects are achieved, in full or at least in part, by a valve as defined in independent claim 1. Embodiments thereof are defined in dependent claims 2-9. These objects are also achieved, in full or at least in part, by a container as defined in claim 10 and a tube set as defined in claim 11. Additionally, these objects are achieved, in full or at least in part, by a method of manufacturing as defined in claim 12 and a method of establishing a flow path as defined in claim 13.

According to the invention, a valve comprises:

a housing having a first end and a second end, said housing defining a flow path between the first and second ends of the housing, and

a piston device arranged in said housing, said piston device having:

a movable portion, which is movable between a closed position, in which liquid flow along the flow path between the first and second ends is prevented, and an open position, in which liquid flow along the flow path between the first and second ends is enabled,

the movable portion having a sealing portion arranged to seal against an inside sealing surface of the housing in the closed position of the piston device, and

a spring portion arranged to bias the movable portion towards the closed position, said spring portion forming an integral part of the piston device, wherein

the piston device has a fixing portion, which is fixedly attached to said housing and which defines part of said flow path, and wherein

in the open position liquid flow is enabled around the movable portion. Such a valve makes it possible to ensure

a tight sealing when the valve is not connected to allow liquid flow along the flow path, and to ensure a reliable flow rate when the valve is connected to allow liquid flow along the flow path. Further, since the fixing portion is fixedly attached to the housing, the movements of the movable portion of the piston device are restricted, such that it is ensured that the sealing portion returns to abut against the inside sealing surface of the housing when a force acting against the biasing force of the spring portion is removed, thereby ensuring renewed sealing. The fact that the spring portion is integrated in the piston device reduces the number of components of the valve.

The second end of the housing may comprise a female connector connectable to a male connector of a liquid duct to be connected to the valve. Thus, simple connection of the valve may be achieved.

The female connector may provide a sealing connection to a male connector of the liquid duct, thereby affording a secure connection in a simple way.

In an embodiment, grooves are formed on an inside surface of the housing, said grooves defining part of the flow path between the first and second ends of the housing. This makes it possible to easily enable a liquid flow along the flow path, even by a relatively small movement of the movable portion of the piston device.

The second end of the housing may have an outer thread. Such a thread simplifies connection to any instrument to be connected to the valve.

According to an embodiment, the valve further comprises a cap having an inside thread, which is threadedly engagable with the outer thread of the second end of the housing. The valve may in this manner be protected against contamination.

The fixing portion may be press fit, snap fit or fit by threading in the first end of the housing. These are

practical ways of achieving a secure fixing of the fixing portion in the first end of the housing.

In an embodiment, the inside sealing surface of the housing is formed by an annular shoulder portion against which the sealing portion seals in the closed position of the movable portion of the piston device. This is a mechanically simple way of ensuring a secure seal.

The sealing portion may comprise a sealing ring, which is a sealing method well known to the skilled person. In another embodiment the sealing portion may comprise an injection molded portion of the piston device. The use of a separate sealing ring or an injection molded portion of the piston device makes it possible to choose optimal materials for the sealing ring or the injection molded portion of the piston device as well as for the remaining piston device.

According to the invention, a container for a medical solution has a valve according to the invention arranged in the container, wherein

the first end of the valve is facing an interior of the container,

the second end of the valve is facing an exterior of the container, and wherein

the container forms a liquid tight seal around the valve. Such a container may be securely closed when not connected to, e.g. a tube for administration of the medical solution or for adding another liquid to the medical solution, and may easily be connected to allow secure withdrawal of the medical solution or addition of another liquid.

Further according to the invention, a tube set for use in a medical device for fluid passage has a tube end, a valve according to the invention being arranged in said tube end.

A method according to the invention of manufacturing an inventive valve comprises the steps of

providing a housing,

providing a piston device,

introducing a movable portion of the piston device in a first end of the housing,

sliding the piston device inside the housing until a sealing portion of the movable portion abuts an inside sealing surface of the housing and a fixing portion of the piston device is fixedly attached to the first end of the housing. This method makes it possible to easily and inexpensively manufacture the valve of the invention.

According to the invention, a method of establishing a flow path between a first liquid vessel and a second liquid vessel, comprises the steps of

providing a valve according to the invention,

connecting the first end of the valve to the first liquid vessel,

connecting the second end of the valve to the second liquid vessel, thereby urging the movable portion of the piston device into the open position, such that the sealing portion of the movable portion is moved away from the inside sealing surface of the housing, and such that liquid flow is enabled along said flow path between the first and second ends of the housing. Hereby, a flow path is easily established between the two liquid vessels. The first liquid vessel may be a liquid reservoir and the second liquid vessel a tube, or the both liquid vessels may be tubes.

Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached claims, as well as from the drawings. It is noted that the invention relates to all possible combinations of features.

Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to “a/an/the [element, device, component, means, step, etc.]” are to be interpreted openly as referring to at least one instance of said

element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in more detail with reference to the appended schematic drawings, which show an example of a presently preferred embodiment of the invention.

Fig. 1 is a cross-sectional view of a valve according to an embodiment of the invention.

Fig. 2 is a perspective view of a housing of the valve of Fig. 1.

Fig. 3 is a perspective view of a piston device of the valve of Fig. 1.

Fig. 4 is a perspective view of a protective cap of the valve of Fig. 1.

Fig. 5 is a side view of the valve of Fig. 1.

Fig. 6 is a cross-sectional view of the valve of Fig. 1 attached at one end in an opening of a container, such as a bag, and at the other end connected to a connector of, e.g., a tube.

Fig. 7 is a view similar to that of Fig. 6, but attached at one end to a tube, instead of a container.

Fig. 8 is a side view of a an alternative piston device for use in a valve.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

In Fig. 1, a valve 1 according to an embodiment of the present invention is shown. The valve 1 has a housing 2 having a first end 3 and a second end 4. The housing 2 defines a flow path 5 between the first and second ends 3, 4 of the housing 2. Grooves 6 are formed in an inside surface 7 of the housing forming part of the flow path 5. A piston device 8 is arranged in the housing 2.

The piston device 8 may also be seen in Fig. 3 and has a movable portion 9, a spring portion 10, and a fixing portion 11. Returning to Fig. 1, the fixing portion 11 is hollow and fixed inside the first end 3 of the housing 2. A sealing ring 12 is arranged on the movable portion 9 forming a sealing portion 13. The sealing ring 12 abuts sealingly against an inside sealing surface 14 in the form of an annular shoulder in the housing 2. In the movable portion 9, three openings 15 are formed.

A protective cap 16, which may also be seen in Fig. 4, is screwed onto the second end 4 of the housing 2 via an inner thread 17 on the cap 16 and a corresponding outer thread 18 on the second end 4 of the housing 2. A tear-off ring 19 is provided at the opening 20 of the cap 16 as tamper proofing.

The manufacture of the valve 1 will now be described. The housing 2 and the piston device 8 are manufactured of suitable plastics material, such as polycarbonate or polypropylene, by injection moulding. The sealing ring 12 is manufactured of a suitable elastomeric material, such as silicone, or thermoplastic elastomer, such as TPE, by injection moulding. The sealing ring 12 is arranged on the movable portion 9 of the piston device 8 to form the sealing portion 13 of the piston device 8. The piston device 8 is then introduced in the housing 2 by inserting the movable portion 9 through the open first end 3 of the housing 2. The piston device 8 is pushed into the housing 2 until the sealing portion 13 abuts the inner sealing surface 14 in the housing 2 and the fixing portion 11 is fixed inside the first end 3 of the housing 2. Hereby, the piston device 9 is secured inside the housing 2, with the fixing portion 11 fixed in relation to the housing, whereas the movable portion 9 may be moved in a longitudinal direction of the valve 1 by elastically deforming the spring portion 10. When no external force is exerted on the movable portion

9, the sealing portion 13 abuts against the inner sealing surface 14, since the movable portion 9 is biased towards the inner sealing surface 14 by the spring portion 10. Hence, the piston device is in a closed position, in which flow is prevented through the flow path 5 between the first and second ends 3, 4 of the housing 2. The valve will normally be manufactured and delivered with the piston device 8 in this closed position. The protective cap 16 may be manufactured in polypropylene or another softer material than the housing 2. In order to prevent contamination through the second end 4 of the housing 2, the protective cap 16 is screwed onto the outer thread 18 on the second end 4 of the housing 2.

In the following, a method of establishing a flow path using the valve 1 will be described. As may be seen in Fig. 6, the valve 1 is attached to a liquid reservoir or container, here in the form of a bag 21, of which a part is shown. The valve 1 is with the first end 3 facing the interior of the bag 21, wherein an outer surface of the housing 2 is welded to the bag in a seam 22. The weld seals liquid tightly around the housing 2 of the valve 1, preventing leaking fluid and preventing contaminants from entering the bag 21. The bag 21 is delivered to the place of use, and the cap 16 is screwed off of the second end 4 of the housing 2. When the cap 16 is screwed off, the tear-off ring is left behind on the housing 18, thus indicating that the cap has been removed, even if the cap is later replaced. A male connector 23, in this case a male luer type connector, at the end of a tube 24 is inserted with an inner conical part 25 into the second end 4 of the housing 2, and is secured to the valve 1 by an inner thread 26 in an outer part 27 of the male connector 23 engaging with the outer thread 18 of the housing 2. The inside of the second end 4 thus constitutes a female connector 4a. When the male connector 23 is fully inserted into the housing 2, the inner part 25 of the male connector presses against the

movable portion 9 of the piston device 8, thereby elastically deforming the spring portion 10, since the fixing portion 11 is fixed in the first end 3 of the housing 2. Thus, the sealing portion 13 is urged away from the inner sealing surface 14 of the housing 2. The piston device 8 is now in the open position, which is shown in Fig. 6. Liquid flow is hereby enabled through the flow path 5 between the first and second ends 3, 4 of the housing 2, as indicated by the double arrows. It may be seen that the openings 15 in the movable portion 9 of the piston device 8 enable liquid flow, even though the inner part 25 of the male connector 23 is pressed tightly against the movable portion 9 of the piston device 8. Once the sealing portion 13 leaves the inner sealing surface 14, liquid flow is possible through the grooves 6 in the inner surface 7 of the housing. Liquid may thus flow from the bag 21, through the hollow fixing portion 11, around the spring portion 10 and the movable portion 9, through the openings 15, through the male connector 23 and into the tube 24. In this manner, liquid contained in the bag 21 may be withdrawn from the bag 21 and led elsewhere through the tube 24. For instance, the liquid in the bag 21 may be a dialysis fluid that is to be led to and used in a dialysis machine.

When the piston device 8 is in the open position, liquid flow is also possible in the opposite direction, i.e. from the tube 24 and into the bag 21. In this manner a liquid may be filled in the bag 21, or an additive may be added to a liquid already contained in the bag 21.

A flow path may also be established between two tubes, such as shown in Fig. 7. Here, the valve 1 is welded into an end 28 of a second tube 29. The establishment of a flow path between the tube 24 and the second tube 29 is done in the exact same way as the establishment of the flow path between the container 21 and the tube 24 discussed in relation to Fig. 6. Also in the case of two tubes, when the piston device 8 is in the

open position, liquid flow is enabled from the tube 24 to the second tube 29, as well as from the second tube 29 to the tube 24.

With reference to Fig. 8, a piston device 108 according to another embodiment is shown. The basic structure of this piston device 108 is the same as that of the piston device 8 shown in Fig. 3, with a movable portion 109, a spring portion 110, and a fixing portion 111. The piston device 108 in Fig. 8 differs from the piston device 8 described above in that the spring portion 110 is made up of two flexible, interconnected loops, instead of just one. Further, on the movable portion 109, a circumferential groove or recess 115 is formed. The working principle of this piston device 108 is the same as that of the piston device 8 described above, such that when a male connector is inserted in the valve, the movable portion 115 of the piston device 108 is pressed into the housing, towards the fixed portion 111, compressing the spring portion 110, and liquid flow is enabled around the movable portion 109. The recess 115 provides part of the flow path around the movable portion 109.

The skilled person realizes that a number of modifications of the embodiments described herein are possible without departing from the scope of the invention, which is defined in the appended claims.

For instance, the sealing ring 12 could be dispensed with if the movable portion is made of a material that may in itself provide sufficiently reliable sealing in abutment with the inner sealing surface 14 of the housing 2. The movable portion may, e.g., be made of an elastomeric material with sufficient elasticity to function as a sealing portion 13 and sufficient rigidity to enable suitable resilience of the spring portion 10 and suitable stability of the fixing portion 11. A sealing lip could be formed on the movable portion 9 to function as the sealing portion 13. Alternatively, the

movable portion 9 could be made of a rigid plastics material and coated with a sealing material, such as an elastomeric material.

The fixing portion 11 could be fixed in the first end 3 of the housing 2 in a number of ways known to the skilled person, such as press fitting, snap fitting, threading, gluing, welding or heat shrinking.

The male connector 23 used in the embodiment discussed above is a male luer connector. Other conical connectors are also possible to use, such as luer-like connectors and conical connectors with a 6 % conicity. Regardless of which particular one of these connectors is used, the valve 1 may be considered a luer activated valve.

The grooves 6 forming part of the flow path 5 may be splines, but they may also be of other shapes and arrangements.

Instead of forming grooves on the inside surface of the housing for forming part of the flow path between the first and second ends of the housing, grooves may be formed on the movable portion of the piston device. It is also possible to combine grooves on the inside surface of the housing with grooves on the movable portion.

As mentioned above, the bag 21 may contain a medical solution, such as a dialysis fluid. Naturally, the invention is equally applicable to other liquid reservoirs or containers containing other medical solutions, such as an infusion fluid or blood, or other, non-medical liquids.

The container need not be a bag, but may be, e.g., a bottle or box.

The tube 29 may be part of a tube set intended for use in a medical device for fluid passage. For instance, the tube 29 may be part of a tube set for a dialysis machine. However, the tube 29 may also be intended for use in another type of medical device, such as an infusion set, or for use in a non-medical device.

In summary, the valve of the invention may be useful in all instances where a secure sealing is required when the valve is disconnected and where a reliable flow rate is required when the valve is connected.

CLAIMS

1. A valve comprising:

a housing (2) having a first end (3) and a second end (4), said housing (2) defining a flow path (5) between the first and second ends (3, 4) of the housing (2), and

a piston device (8; 108) arranged in said housing (2), said piston device (8; 108) having:

a movable portion (9; 109), which is movable between a closed position, in which liquid flow along the flow path (5) between the first and second ends (3, 4) is prevented, and an open position, in which liquid flow along the flow path (5) between the first and second ends (3, 4) is enabled,

the movable portion (9; 109) having a sealing portion (13) arranged to seal against an inside sealing surface (14) of the housing (2) in the closed position of the piston device (8; 108), and

a spring portion (10; 110) arranged to bias the movable portion (9) towards the closed position, said spring portion (10) forming an integral part of the piston device (8),

wherein the piston device (8) has a fixing portion (11), which is fixedly attached to said housing (2) and which defines part of said flow path (5),

c h a r a c t e r i s e d i n that

in the open position, liquid flow is enabled around the movable portion (9; 109).

2. A valve as claimed in claim 1, wherein the second end (4) of the housing (2) comprises a female connector (4a) connectable to a male connector (23) of a liquid duct (24) to be connected to the valve (1).

3. A valve as claimed in claim 2, wherein the female connector (4a) provides a sealing connection to a male connector (23) of the liquid duct (24).

4. A valve as claimed in any one of claims 1-3, wherein grooves (6) are formed on an inside surface (7) of the housing (2), said grooves (6) defining part of the flow path (5) between the first and second ends (3, 4) of the housing (2).

5. A valve as claimed in any one of the preceding claims, wherein the second end (4) of the housing (2) has an outer thread (18).

6. A valve as claimed in claim 5, further comprising a cap (16) having an inside thread (17), which is threadedly engagable with the outer thread (18) of the second end (4) of the housing (2).

7. A valve as claimed in any one of the preceding claims, wherein the fixing portion (11) is press fit, snap fit or fit by threading in the first end (3) of the housing (2).

8. A valve as claimed in any one the preceding claims, wherein the inside sealing surface of the housing (2) is formed by an annular shoulder portion (14) against which the sealing portion (13) seals in the closed position of the movable portion (9) of the piston device (8).

9. A valve as claimed in any one of the preceding claims, wherein the sealing portion (13) comprises a sealing ring (12).

10. A container for a medical solution, a valve (1) as claimed in any one of the preceding claims being arranged in the container (21), wherein

the first end (3) of the valve (1) is facing an interior of the container (21),

the second end (4) of the valve (1) is facing an exterior of the container (1), and wherein

the container (21) forms a liquid tight seal (22) around the valve (1).

11. A tube set for use in a medical device for fluid passage, said tube set (29) having a tube end (28), a valve as claimed in any one of claims 1-9 being arranged in said tube end.

12. A method of manufacturing a valve (1) as claimed in any one of claims 1-9, comprising the steps of

providing a housing (2),

providing a piston device (8),

introducing a movable portion (9) of the piston device (8) in a first end (3) of the housing (2),

sliding the piston device (8) inside the housing (2) until a sealing portion (13) of the movable portion (9) abuts an inside sealing surface (14) of the housing (2) and a fixing portion (11) of the piston device (8) is fixedly attached to the first end (3) of the housing (2).

13. A method of establishing a flow path between a first liquid vessel (21; 29) and a second liquid vessel (24), comprising the steps of

providing a valve (1) as claimed in any one of claims 1-9,

connecting the first end (3) of the valve (1) to the first liquid vessel (21; 29),

connecting the second end (4) of the valve (1) to the second liquid vessel (24), thereby urging the movable portion (9) of the piston device (8) into the open

position, such that the sealing portion (13) of the movable portion (9) is moved away from the inside sealing surface (14) of the housing (2), and such that liquid flow is enabled along said flow path (5) between the first and second ends (3, 4) of the housing (2).

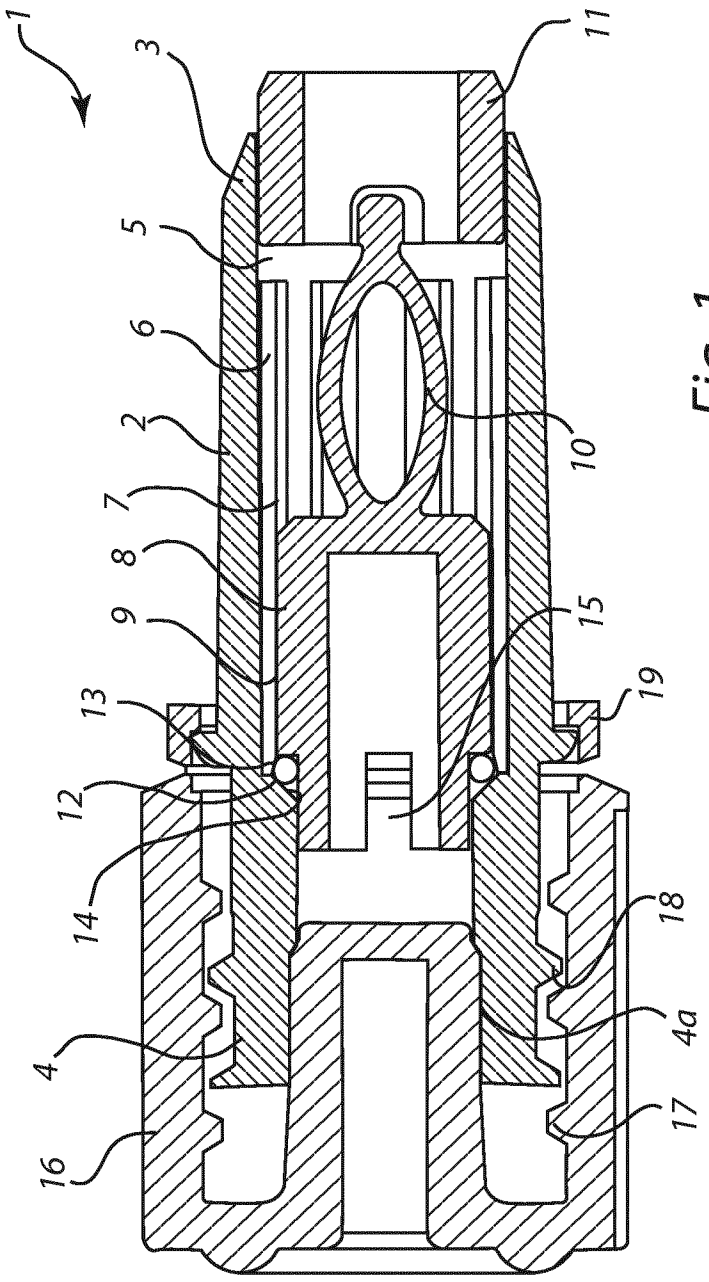


Fig. 1

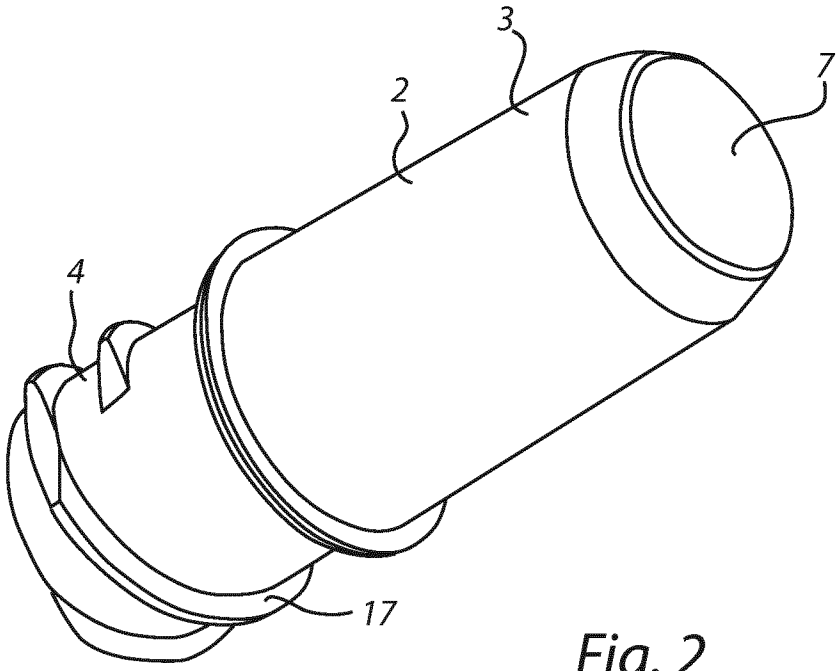


Fig. 2

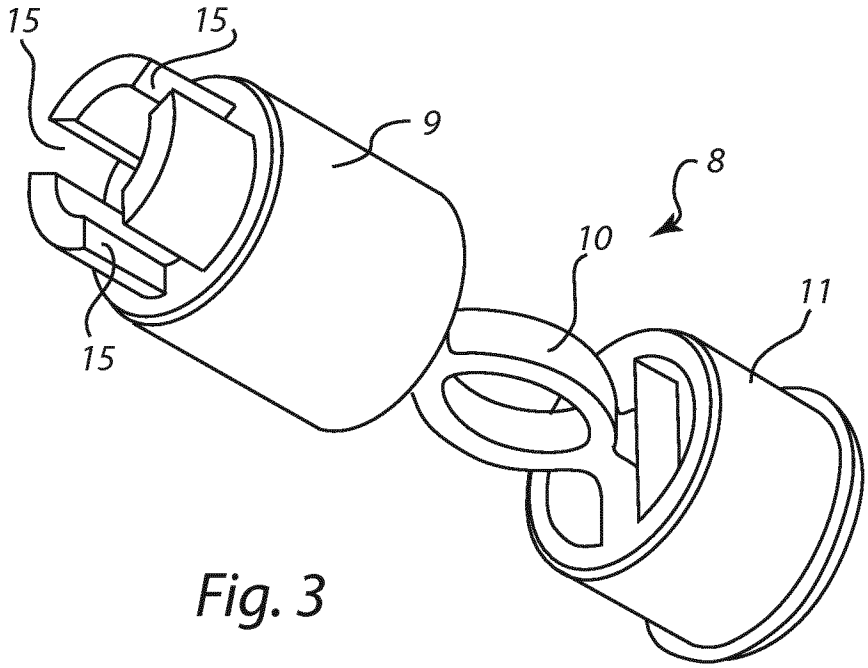


Fig. 3

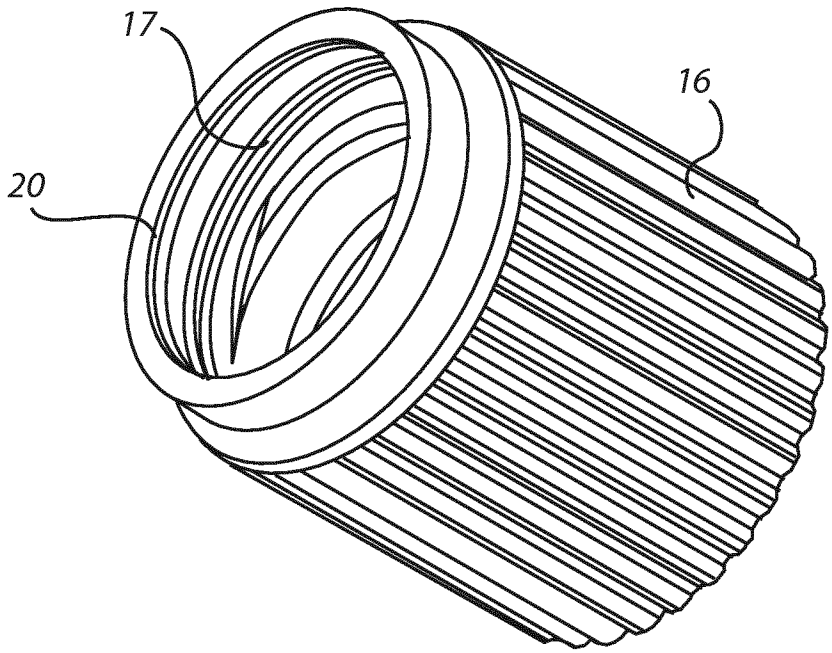


Fig. 4

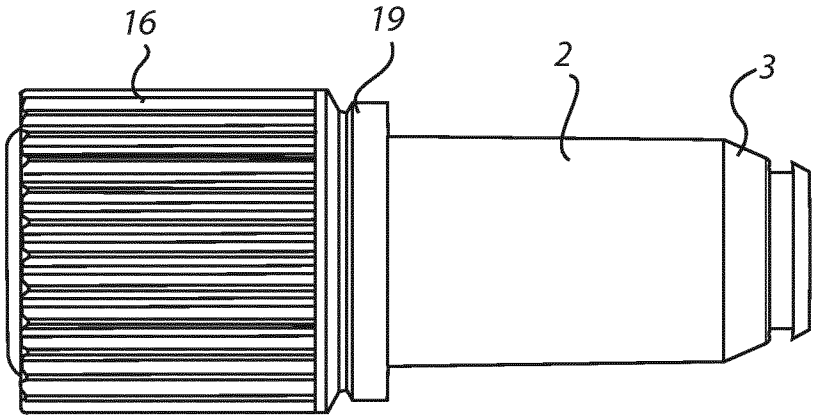


Fig. 5

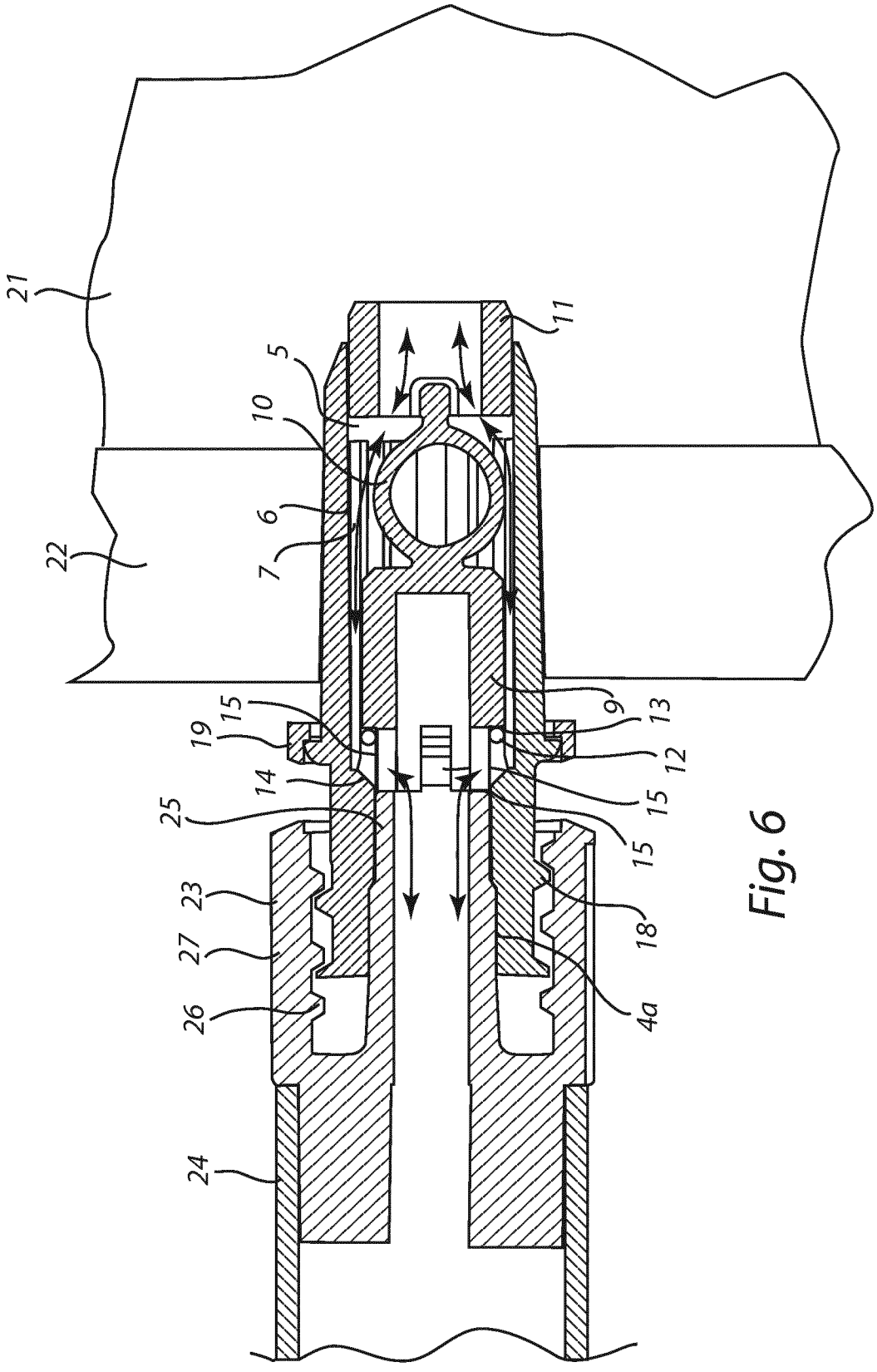


Fig. 6

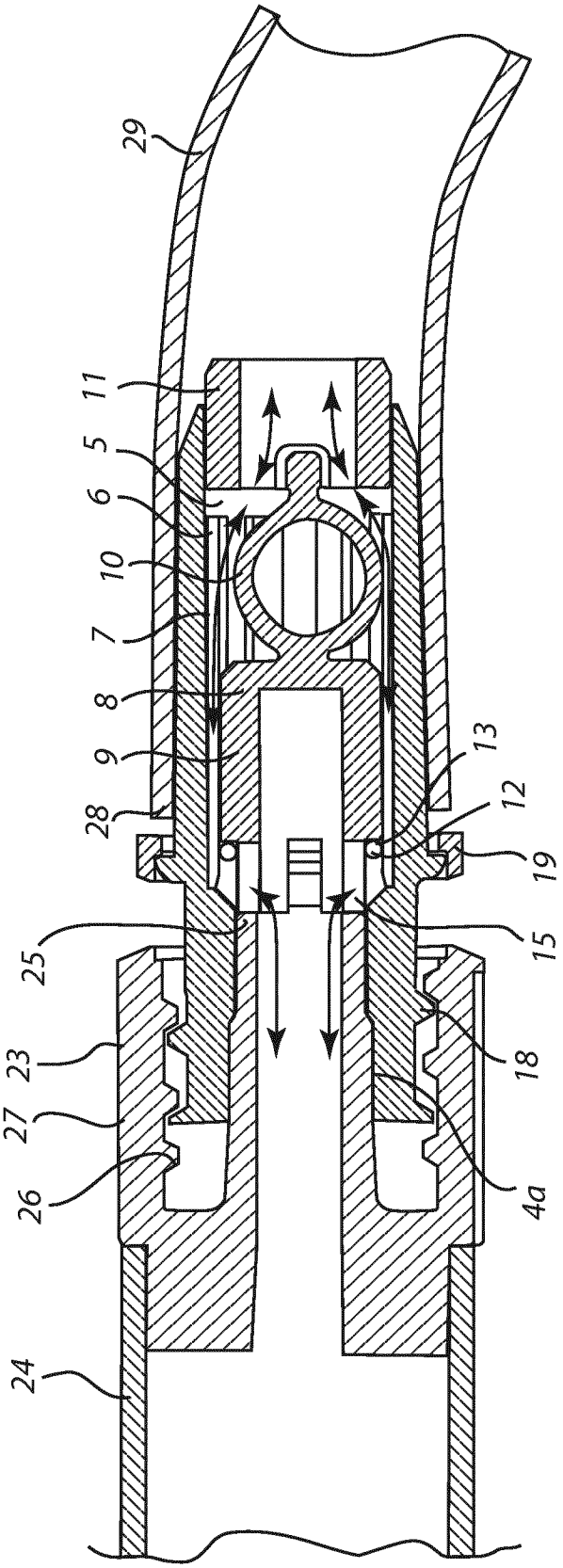


Fig. 7

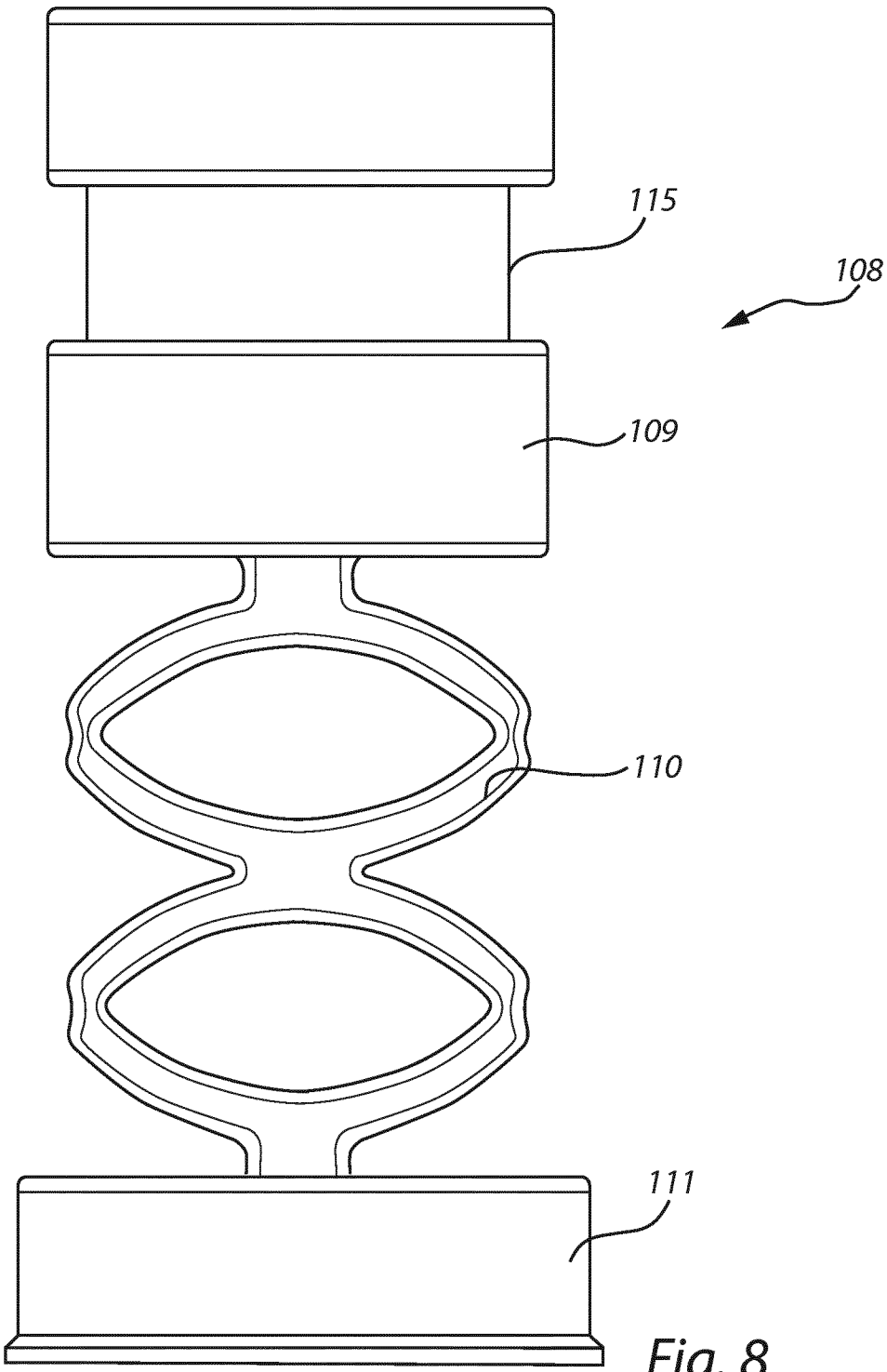


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/061398

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M39/26 F16L29/04
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M F16L

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 046 645 A (HAGAN RICHARD J [US] ET AL) 10 September 1991 (1991-09-10) figures 2-5	1-13
X	WO 2004/112866 A2 (FILTERTEK INC [US]; RUSCHKE RICKY R [US]; KANDEL EDWARD [US]; LEONHARD) 29 December 2004 (2004-12-29) figures 5-7,13,26-30,30A,32,47,51,	1-13
X	US 5 509 433 A (PARADIS JOSEPH R [US]) 23 April 1996 (1996-04-23) figure 2D	1-13
X	WO 2011/060384 A1 (CAREFUSION 303 INC [US]; TRUITT TIM L [US]; MAZZA ALEX T [US]) 19 May 2011 (2011-05-19) figures 2A,3A,3B	1-13

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 September 2012	25/09/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Krassow, Heiko

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/061398

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 163 922 A (MCELVEEN JR CHARLES E [US] ET AL) 17 November 1992 (1992-11-17) figures 1,2	1-13
X	EP 1 413 328 A1 (BIOSERVICE S P A [IT]) 28 April 2004 (2004-04-28) figures 1,2	1-13

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2012/061398

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5046645 A	10-09-1991	NONE	
WO 2004112866 A2	29-12-2004	CA 2529429 A1	29-12-2004
		EP 1639286 A2	29-03-2006
		US 2006163515 A1	27-07-2006
		US 2009184275 A1	23-07-2009
		WO 2004112866 A2	29-12-2004
US 5509433 A	23-04-1996	US 5509433 A	23-04-1996
		WO 9739791 A1	30-10-1997
WO 2011060384 A1	19-05-2011	AU 2010320036 A1	24-05-2012
		CA 2779703 A1	19-05-2011
		EP 2501435 A1	26-09-2012
		WO 2011060384 A1	19-05-2011
US 5163922 A	17-11-1992	NONE	
EP 1413328 A1	28-04-2004	NONE	