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(71) Applicant: **PROVENSIS LIMITED** [GB/GB]; 5 Fleet Place, London Greater London EC4M 7RD (GB).

(72) Inventors: **WRIGHT, David Dakin Iorwerth**; C/O BTG International Limited, 5 Fleet Place, London Greater London EC4M 7RD (GB). **FAULKNER, David, Ian**; C/O BTG International Limited, 5 Fleet Place, London Greater London EC4M 7RD (GB).

(74) Agent: **MCANALLY, Gerard, David**; BTG International Limited, 5 Fleet Place, London Greater London EC4M 7RD (GB).

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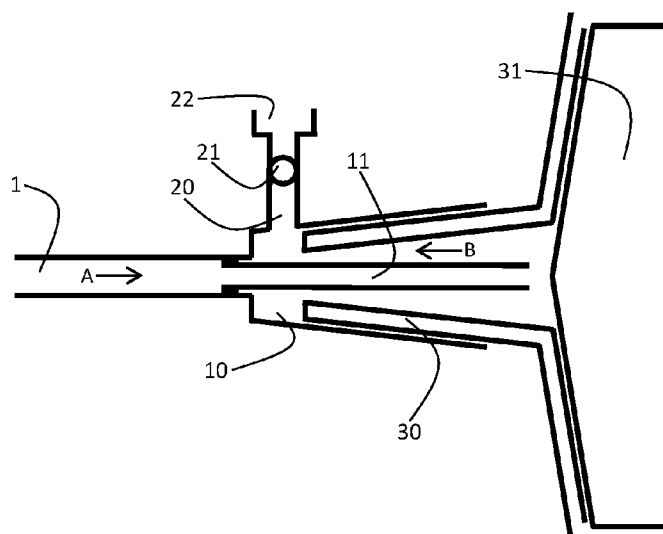
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(54) Title: DEVICE AND METHOD FOR DISPENSING FOAM

Figure 1



(57) Abstract: A foam transfer or dispensing device is described which dispenses foam from a source of foam, typically a pressurised canister, and which enables efficient purging or air and an initial volume of foam from the device to ensure foam sterility and quality when a syringe is filled from the device. The device comprises a foam inlet arranged for communication with a source of foam, a foam pathway in fluid communication with the foam inlet and comprising a foam outlet, arranged for engagement by a syringe nozzle; and a waste outlet in fluid communication with the foam pathway. The foam pathway comprises a tubular projection arranged to extend through the foam outlet and into a syringe nozzle when a syringe is connected to the foam outlet, which improves the efficiency of the purging process and prevents pooling of air or foam. The device further comprises a means for restricting displacement of material through the waste outlet, so that the user can control the volume of foam that is wasted.



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Device and method for dispensing foam

[0001] The present invention relates to devices and methods for dispensing foam from a source of foam, e.g. from a pressurised canister which generates foam by passing liquid and gas through a fine mesh. The invention is suitable, in particular, for dispensing a medical foam, for which control of sterility and gas content is essential if the foam is to be injected into a patient e.g. for sclerotherapy of varicose veins.

[0002] WO 2005/023678 describes a foam-generating canister and a dispensing device, which transfers foam from the canister to an administration device, for example, a syringe. The dispensing device includes an inlet in communication with a source of foam, a usable foam outlet and a waste bleed outlet, which is in fluid communication with the inlet and which has a higher resistance to flow of foam than that of the usable foam outlet. The differential resistances between the usable foam outlet and the waste bleed outlet, within the device, ensures that foam only flows through the waste bleed outlet when flow is restricted through the useable foam outlet. This allows the user to flush the device of any fluid that is present within the device prior to use by blocking the foam outlet and diverting an initial volume of gas and/or foam through the waste bleed outlet. Once the, initial volume of gas and foam (which is typically air-contaminated and of insufficient quality) has been diverted to waste, the foam outlet is unblocked so that only usable foam of a desired quality is delivered to the foam outlet and, subsequently, administered to a patient. The blocking and unblocking of the useable foam outlet is typically achieved manually, by the user connecting a syringe to the useable foam outlet and holding the syringe plunger in its depressed state to prevent it from filling.

[0003] In one specific embodiment, WO 2005/023678 (Figure 19) provides a foam dispensing device that includes an inlet 718 in communication with a source of foam, a foam outlet 719, a waste outlet 717 and a flexible waste container 706. The foam outlet 719 is a metal cannula that extends into the nozzle of a syringe. Foam is delivered into the syringe nozzle through the metal cannula 719 and displaces air from the nozzle through the waste outlet 717 and into the waste container 706. When the waste container 706 is filled with gas and foam the back-pressure created by delivery of additional foam into the waste chamber causes the foam to flow into the syringe barrel and fills the syringe with foam i.e. the user does not need to manually block the foam outlet and the syringe will fill automatically once the pressure in the waste chamber is sufficiently high to overcome the break-out force of the syringe plunger in the barrel.

[0004] The device described above dispenses foam into a syringe and enables both flushing of air and "purging" of foam to be carried out in a semi-automatic manner before foam is collected and administered to a patient. However, the syringe cannot be filled with foam until sufficient material has been purged to fill the waste container 706 such that the pressure reaches a level sufficient to move the syringe plunger. This arrangement means that a new device is required every time a syringe is filled with foam which is inconvenient and leads to undesirable wastage of foam during the dispensing process. For example, after an initial injection of foam to a varicosity, the administering physician may choose to make a second, smaller injection, for example to treat tributary veins. In this case, more foam may be purged than is actually administered to the patient, which is undesirable from a practical and regulatory perspective.

[0005] The present invention provides a device which can be used to dispense foam in the same way as described above but which is not limited to single use,. The device of the present invention has a similar design to that described in WO 2005/023678 but comprises a useable foam outlet with improved geometry for more efficient purging and filling of a syringe, which is attached to it. The device further comprises a modified waste outlet, which includes a means for preventing the flow of gas and/or foam into a waste chamber thus eliminating the need to completely fill the waste container prior to dispensing the foam. Delivery of foam into the syringe nozzle displaces the contents of the syringe nozzle into a waste outlet as in the prior art device but the geometry of the useable foam outlet prevents pooling of air or foam in the syringe which can occur in the restricted volume of a typical syringe nozzle. The modified waste outlet enables control of the volume of foam that enters the waste chamber such that, after a first syringe is filled, additional syringes can be filled using the same device (until the waste chamber is full) thereby simplifying the foam preparation process for the user. In practice, this enables a physician to use the same device when treating a single patient with multiple injections without having to replace the device with each injection but still allowing replacements between patients.

[0006] In a first aspect the present invention provides a device for dispensing foam from a source of foam, the device comprising:

- a foam inlet arranged for communication with a source of foam;
- a foam pathway in fluid communication with the foam inlet and comprising a foam outlet arranged for connection to a syringe nozzle; and
- a waste outlet in fluid communication with the foam pathway,

wherein the foam pathway comprises a tubular projection arranged to extend through the foam outlet and into a syringe nozzle when it is connected to the outlet, and wherein the device further comprises a means for restricting displacement of material into the waste outlet.

- 5 **[0007]** The means for restricting displacement of material, e.g. liquid, gas or foam, into the waste outlet allows a user to control the amount of air and foam that is displaced from a syringe as waste before the syringe is filled. By preventing displacement of material through the waste outlet the user can allow the syringe to be filled with foam either by pressure provided from the source of foam or by simple aspiration of the
- 10 syringe, i.e. withdrawal of the syringe plunger. This arrangement provides a solution to the technical problem of allowing more than one syringe to be filled with foam using a single device while also potentially reducing the amount of foam that is wasted when purging syringes. These advantages serve to improve usability of foam products in treating vascular disease.
- 15 **[0008]** The means for restricting displacement of material into the waste outlet can be a valve or an arrangement of pathways that provides increased resistance to foam within the waste outlet relative to the resistance of the syringe to be filled. Preferably flow of foam into the waste outlet (and a waste chamber) is controlled with a valve. The valve may operate automatically to close the waste outlet on displacement of a pre-set
- 20 volume of foam or after a pre-set time has elapsed after the process has begun. The valve may be manually controlled by the user but, preferably, is a pressure-valve that opens in response to increased pressure in the foam pathway and closes when that pressure decreases. Such pressure changes can easily be achieved by the user holding a syringe plunger in place until sufficient pressure is built up in the foam pathway
- 25 to open the valve. Once the valve is open and foam has started to flow through the waste outlet, the syringe plunger may be released, allowing it to move back under the pressure of the foam pathway and causing the syringe to fill with foam. The filling of the syringe with foam will reduce the pressure in the foam pathway sufficient to close the valve and prevent further flow through the waste outlet. Preferably the valve is operated
- 30 manually as this provides a simple and cost-effective solution to the problem of allowing more than one syringe to be filled with foam using a single device while also potentially reducing the amount of foam that is wasted when purging syringes.

[0009] The device comprises a foam inlet through which foam is provided from a source of foam. The source of foam may be provided together with the device or it may be provided separately from it. It will be understood that where a source of foam is provided separately, the foam inlet will comprise a connector to allow secure attachment and fluid communication with the source of foam. Such connectors are well known in the art. Typically, the source of foam is a pressurized canister as described in WO 2005/023678 and in WO 00/72821.

[0010] The foam pathway is in fluid communication with the foam inlet such that a flow path is defined therebetween. The foam pathway is defined by the distal end of the flow path and includes a foam outlet, in the form of an aperture. The aperture is typically in the form of a luer or other connection which provides a seal between the foam pathway and the nozzle of a standard syringe. The foam pathway comprises a tubular protrusion that is designed to extend through and beyond the foam outlet, such that when a syringe is connected to the foam outlet the tubular protrusion extends into the syringe nozzle, without contacting any part of the inside of the nozzle and without interfering with the seal created between the syringe and the foam pathway. The tubular protrusion has the effect of providing a vent within the syringe nozzle, such that foam delivered to the syringe nozzle efficiently displaces the contents of the nozzle into the waste outlet. As foam flows directly into the syringe nozzle, and the "dead space" between the nozzle and the syringe plunger, it fills the nozzle and displaces its contents (i.e. air and an initial volume of foam) from the nozzle into the waste outlet. The tubular protrusion is conveniently proportioned to allow displacement of syringe nozzle contents from adjacent the syringe plunger into the waste outlet such that the syringe nozzle is filled with foam. This has been found to be effective in displacing the air from the syringe nozzle and into the waste outlet as more foam is delivered and prevents pooling within the inner volume of the nozzle

[0011] The tubular projection can be made of any material that is suitable for medical device applications i.e. materials which are sterile or can be sterilized. Typically, the protrusion will be formed from a rigid or non-deformable material that will resist breakage or deformation, if accidentally knocked prior to or during connection of a syringe to the foam outlet. Suitable materials will be inert to the foam constituents and include metals, such as aluminium and stainless steel, and plastics such as styrenic block copolymers (TPE-s), polyolefin blends (TPE-o), elastomeric alloys (TPE-v or TPV), thermoplastic polyurethanes (TPU), thermoplastic copolyesters and thermoplastic

polyamides. Preferably the tubular projection is a metal tube, formed from stainless steel.

[0012] A standard syringe nozzle comprises a frustoconical chamber, for example a luer slip, that tapers to an aperture having an internal diameter of between 1.5mm and 2.5mm. Typically the syringe nozzle aperture has an internal diameter of approximately 2mm, and therefore it is desirable that the tubular projection has an external diameter of less than 2mm to allow it to extend into the syringe nozzle. In use, when the tubular projection is extended into a syringe nozzle, it is necessary that sufficient clearance is provided between its circumferential edge and the internal edge of the syringe nozzle aperture to allow delivery of foam into the syringe nozzle or displacement of the contents of the syringe nozzle into the waste outlet. Therefore, the protrusion will typically have an external diameter between 0.5mm and 1.5mm. Preferably the external diameter of the protrusion is between 0.75mm and 1.25mm, and more preferably the external diameter is approximately 1mm.

[0013] The device may be used with a standard syringe having a plunger depressed (i.e. in the form in which syringes are normally provided) to reduce the volume of air that needs to be purged. However, for certain uses, particularly when small volume syringes are being used, as is typical for cosmetic indications, it is desirable to use a 'pre-cracked' syringe. These are syringes which are provided with the plunger pulled back in the syringe barrel so as to reduce the pressure that is needed to force back the plunger as the syringe is filled with foam. Syringes in this format are purged in effectively the same way as the standard syringes described above, except that the volume of air to be purged is defined by the volume of the syringe nozzle and the barrel volume created by pulling back the plunger. For these applications, the tubular protrusion can be elongated such that it extends through the nozzle and into the barrel to a point that is in close proximity to the syringe plunger. This is advantageous as it allows displacement of air from the barrel of the syringe and the nozzle into the waste outlet. Provided the flow of foam is not blocked, the tubular projection may contact the syringe plunger to ensure that all of the air is displaced by foam and reduce the risk that any air is trapped as foam fills the volume.

[0014] Where foam is provided from a pressurized canister device, it will be understood that foam initially generated by the device may not be of the required specification until all of the foam pathway has been flushed of fluid. The present

invention enables purging of out of specification foam by simply continuing to dispense foam after air has been purged while allowing flow into the waste outlet to continue, as described above, until an initial volume of foam has been displaced from the syringe nozzle (or barrel) and diverted through the waste outlet into a waste chamber.

5 Optionally, a waste chamber is contained in a common housing with the foam inlet and foam outlet, and is connected to the waste outlet, such that waste is collected for disposal. In this regard the waste chamber can be removable so that any waste foam collected can be discarded after each administration. Alternatively, and preferably the waste chamber is contained within the device and the entire device is disposed of after

10 each course of administration of foam (for example, between patients), to reduce the risk of contamination. The incorporation of a waste chamber into the device provides an enhanced experience for the user, as waste foam is never collected into the syringe. Depending on whether or not the device is intended for single or multiple use, the volume of the waste chamber can be defined to ensure it is of sufficient size to capture

15 all of the waste foam. Preferably the waste chamber is of a predetermined fixed volume that captures all purged air and poor quality foam. Preferably the waste chamber is formed of a transparent material, and is visible through a transparent section of the device/housing, such that the user can see when foam has started to fill the waste chamber and, consequently, can be confident that initial "poor quality" foam has been

20 diverted to waste. If desired, the waste chamber can be vented to allow purged air to escape the chamber before it is filled with foam.

[0015] It is not essential that the device is used with a pressurised source of foam. Provided there is sufficient driving force to fill a syringe nozzle and displace air, the syringe may be aspirated as normal, by pulling back the syringe plunger until the desired

25 quantity of foam has been collected. This arrangement is advantageous as it is simple and inexpensive to manufacture and it doesn't require a power source or any additional equipment to operate.

[0016] The device can optionally comprise a source of foam in communication with the foam inlet. Such a device simplifies use or the user by combining the production

30 and dispensing of foam for administration to a patient. The source of foam can be pressurized canister system comprising a single can or two cans. Preferably the source of foam comprises a canister charged with liquid and gas under pressure. Such a source of foam is advantageous as it provides foam in a simple format that is easy to use and that has been approved for use in the USA for producing therapeutic foam.

[0017] In a second aspect the present invention provides a kit according to the first aspect of the invention and a syringe.

[0018] The second aspect of the invention provides the same optional features and advantages as described above for the first aspect. Providing the device and syringe together in a kit is advantageous as it ensures that syringes are used which are of the appropriate size for connecting to the foam outlet and are suitable for administration of foam to patients, for example, pre-cracked syringes may be required for particular indications, as discussed above. In a particular embodiment the kit is provided with a syringe pre-connected to the foam outlet. This is particularly advantageous in reducing handling by the user and ensuring sterility.

[0019] In a third aspect the present invention provides a method of dispensing foam using a device according to the first aspect of the invention comprising the steps of:

connecting a syringe to the foam outlet;
causing foam to flow from a source of foam into the foam inlet and simultaneously holding a plunger of the syringe in a fully depressed position until a volume of foam has displaced the contents of the syringe dead space and an initial volume of foam into the waste outlet; and releasing the plunger to fill the syringe with foam.

[0020] The third aspect of the invention provides the same optional features and advantages as described above for the first and second aspects. The method allows the user to dispense foam into a syringe while simultaneously purging the contents of the syringe nozzle and removing the need for an additional syringe purging step to ensure safe administration of foam to the patient. The method above is equally applicable to the situation when the device is provided in the form of a kit, with syringe pre-connected to the foam outlet, as described above. In this embodiment, it will be understood that the first step of connecting the syringe is not necessary.

[0021] Further features and advantages of the invention will be apparent from the following description of a specific embodiment, which is made with reference to the accompanying drawing.

[0022] Figure 1 shows a schematic view of a portion of a first embodiment according to the first aspect of the invention together with a syringe nozzle.

[0023] Figure 2 shows a schematic view of a portion of a second embodiment according to the first aspect of the invention together with a syringe nozzle.

[0024] Figure 3 shows a schematic view of a portion of a third embodiment according to the first aspect of the invention together with a syringe nozzle.

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[0025] A portion of a first embodiment according to the first aspect of the invention is shown in Figure 1, in which a foam pathway (10) is engaged by a syringe nozzle (30) as these elements would be arranged while the device is in use dispensing foam into a syringe.

10 **[0026]** The foam pathway (10) is in fluid communication with a foam inlet (1), through which foam is supplied from a pressurized canister system as described in WO 00/72821 which provides a source of foam, under pressure (not shown). Foam arrives at the foam inlet (1) and flows in the direction of the arrow A, entering the syringe nozzle (30) via a metal tube (11) which extends out from the foam outlet and into the inner
15 volume of the connected syringe nozzle.

[0027] The foam is delivered into the syringe nozzle (30) at the surface of the syringe plunger (31) such that air in the syringe nozzle (30) is displaced in the direction of the arrow B out of the syringe nozzle (6) through the foam pathway (10) and into the waste outlet (20).

20 **[0028]** As further foam is delivered to the syringe nozzle (30) air in the waste outlet (20) is displaced through a valve (21) into a waste chamber (22).

[0029] Once the syringe nozzle (30) is filled with foam, a portion of foam is displaced into the waste outlet (20), through the valve (21) and into the waste chamber (22).

25 **[0030]** The valve (21) is then closed manually by the user so that no further foam or air can pass through the waste outlet (20) into the waste chamber (22), and this leads to an increase in pressure within the foam pathway (10) and the syringe nozzle (30). The increased pressure forces the syringe plunger (31) to move toward a more withdrawn position, and consequently the syringe fills with foam as it is delivered through the metal
30 tube (11).

[0031] The syringe is filled with foam and contains no air. The user is not required to carry out a purge step to remove trapped air and can have increased confidence that the foam in the syringe is less likely to cause air embolism in the patient.

5 **[0032]** A second embodiment according to the first aspect of the invention is shown in Figure 2.

[0033] The device of this embodiment is similar to that of the first embodiment and is shown engaged by a syringe nozzle (30) as these elements would be arranged while the device is in use. However, it includes a branch pathway (2) in the foam inlet (1).
10 Foam arrives at the foam inlet (1) from the source of foam (not shown), and it is prevented from flowing into the foam pathway (10) because the valve (21) in the waste outlet (20) is closed. Instead the foam flows into the branch pathway (2) where it is observed by the user. When the foam reaches the required quality the user opens the valve (21), and the device functions in the same manner as the first embodiment to fill
15 the syringe with foam.

[0034] A third embodiment according to the first aspect of the invention is shown in Figure 3 engaged with a syringe nozzle (30) as these elements would be arranged while the device is in use.

20 **[0035]** The foam pathway (10) is in fluid communication with a foam inlet (1), through which foam is supplied from a pressurized canister system as described in WO 00/72821 which provides a source of foam, under pressure (not shown). Foam arrives at the foam inlet (1) and flows into the foam pathway (10) from where it enters the syringe nozzle (30) and travels in the direction of the arrow A. As the foam travels
25 toward the surface of the syringe plunger (31) it displaces air from the syringe nozzle into the metal tube (11) and further into the waste outlet (20).

[0036] As more foam is delivered to the syringe nozzle (30) air in the waste outlet (20) is displaced through a valve (21) into a waste chamber (22).

[0037] Once the syringe nozzle (30) is filled with foam, a portion of foam is
30 displaced through the metal tube (11), into the waste outlet (20), through the valve (21) and into the waste chamber (22).

[0038] The valve (21) is then closed manually by the user so that no further foam or air can pass through the waste outlet (20) into the waste chamber (22), and this leads to an increase in pressure within the foam pathway (10) and the syringe nozzle (30). The increased pressure forces the syringe plunger (31) to move toward a more withdrawn position, and consequently the syringe fills with foam as it is delivered through the foam pathway (10).

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Claims

1. A device for dispensing foam from a source of foam, the device comprising:
 - (a) a foam inlet arranged for communication with a source of foam;
 - 5 (b) a foam pathway in fluid communication with the foam inlet and comprising a foam outlet, arranged for engagement by a syringe nozzle; and
 - (c) a waste outlet in fluid communication with the foam pathway,wherein the foam pathway comprises a tubular projection arranged to extend through the foam outlet and into a syringe nozzle when a syringe is connected to the foam outlet,
10 and wherein the device further comprises a means for restricting displacement of material through the waste outlet.
2. A device according to claim 1 wherein the means for restricting displacement of material through the waste outlet is a valve.
15
3. A device according to claim 2 wherein the valve is a pressure valve.
4. A device according to any previous claim wherein a waste chamber is provided in fluid communication with the waste outlet.
20
5. A device according to any previous claim wherein the tubular projection comprises a metal tube.
6. A device according to claim 5 wherein the metal tube has an external diameter
25 between 0.5mm and 1.5mm.
7. A device according to claim 6 wherein the metal tube has an external diameter of 1mm.
- 30 8. A device according to any previous claim wherein the tubular projection extends across the entire length of the syringe nozzle.
9. A device according to any previous claim wherein the tubular projection makes physical contact with the syringe plunger.

10. A device according to any previous claim wherein at least a portion of the foam inlet, a portion of the foam pathway, a portion of the waste outlet or a portion of the waste chamber is transparent to allow inspection of foam in the device.
- 5 11. A device according to any previous claim comprising a source of foam in communication with the foam inlet.
12. A device according to claim 11 wherein the source of foam comprises a canister
10 charged with liquid and gas under pressure.
13. A kit comprising a device as claimed in any previous claim and a syringe.
14. A kit according to claim 13 wherein the syringe is connected to the foam pathway
15 of the device.
15. A method of dispensing foam using a device according to any of claims 1 to 12 comprising the steps of:
- (a) connecting a syringe to the foam pathway;
- 20 (b) causing foam to flow from a source of foam into the foam inlet and simultaneously holding a plunger of the syringe in a fully depressed position until a volume of foam has displaced the contents of the syringe nozzle and flowed into the waste outlet; and
- (c) releasing the plunger to fill the syringe with foam.

25

Figure 1

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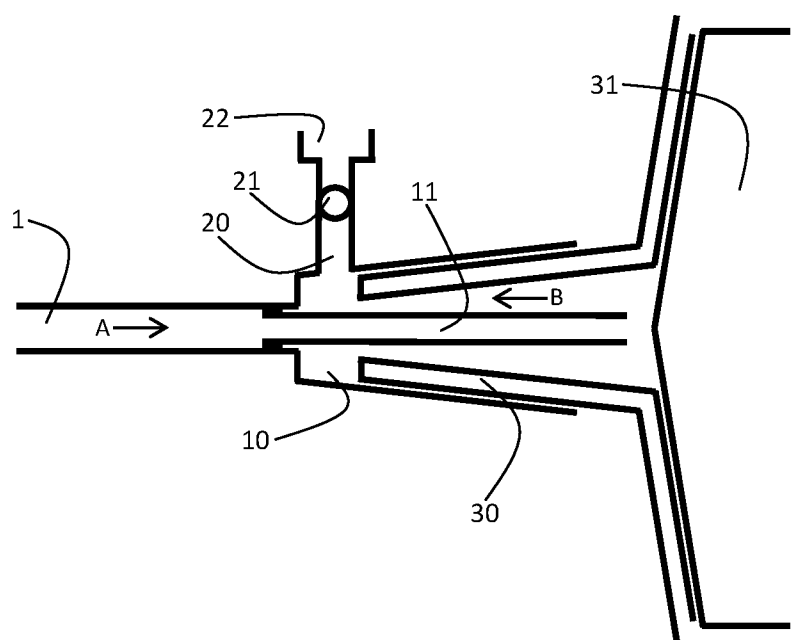


Figure 2

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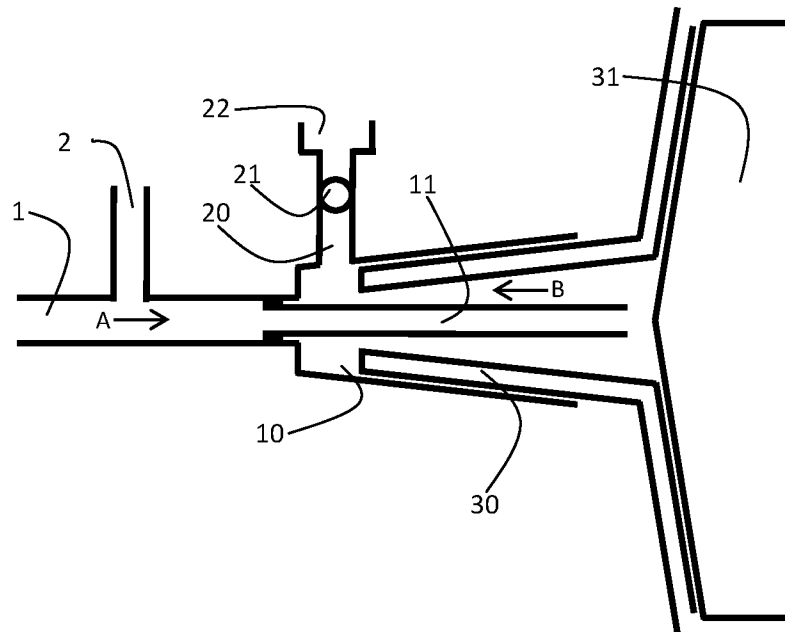
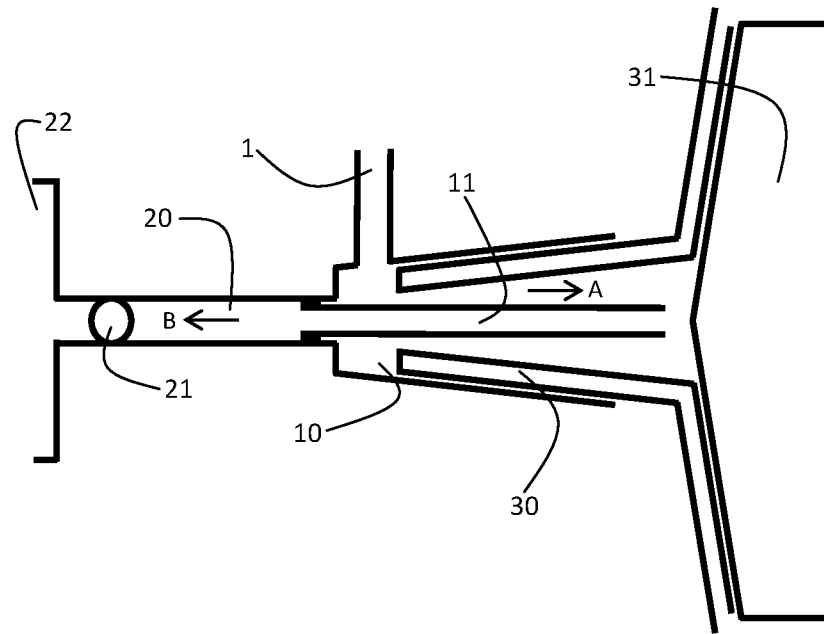


Figure 3

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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER INV. B65D83/14 A61B17/12 A61M5/178 A61J1/20 A61M39/22 ADD. A61M5/31		
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) B65D A61M A61B A61J		
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	WO 2005/023678 A1 (BTG INT LTD [GB]; HARMAN ANTHONY DAVID [GB]; WRIGHT DAVID DAKIN IOWERT) 17 March 2005 (2005-03-17)	1,4-15
Y	page 38, line 27 - page 39, line 31; figure 19	2,3
Y	----- US 2008/294096 A1 (UBER ARTHUR E III [US] ET AL) 27 November 2008 (2008-11-27) paragraphs [0466], [0467] figure 18B	2,3
A	----- US 2014/276215 A1 (NELSON DAVID [US] ET AL) 18 September 2014 (2014-09-18) figures 1, 2	1-15
	----- -/-	
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 23 June 2017		Date of mailing of the international search report 06/07/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Mathis, Martin

INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2005/053776 A1 (BTG INT LTD [GB]; KAY STUART BRIAN WILLIAM [GB]; HURLSTONE CHRISTOPHER) 16 June 2005 (2005-06-16) the whole document -----	1-15
A	US 2013/041258 A1 (PATRICK TIMOTHY [US] ET AL) 14 February 2013 (2013-02-14) figures 16A-D -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2017/051137

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2005023678	A1	17-03-2005	AT 486023 T 15-11-2010
		AU 2004270475 A1 17-03-2005	
		BR PI0414281 A 21-11-2006	
		CA 2538172 A1 17-03-2005	
		CN 1878706 A 13-12-2006	
		CY 1111096 T1 11-06-2015	
		DK 1673293 T3 31-01-2011	
		EP 1673293 A1 28-06-2006	
		ES 2354695 T3 17-03-2011	
		JP 4731483 B2 27-07-2011	
		JP 5107445 B2 26-12-2012	
		JP 2007504872 A 08-03-2007	
		JP 2011136192 A 14-07-2011	
		KR 20060121915 A 29-11-2006	
		PT 1673293 E 05-01-2011	
		RU 2344060 C2 20-01-2009	
		SI 1673293 T1 28-02-2011	
		US 2007051426 A1 08-03-2007	
		US 2011024448 A1 03-02-2011	
		WO 2005023678 A1 17-03-2005	
US 2008294096	A1	27-11-2008	NONE
US 2014276215	A1	18-09-2014	AU 2014238008 A1 24-09-2015
		CA 2906335 A1 25-09-2014	
		CN 105163796 A 16-12-2015	
		EP 2968894 A1 20-01-2016	
		JP 2016510671 A 11-04-2016	
		KR 20150140292 A 15-12-2015	
		TW 201509456 A 16-03-2015	
		US 2014276215 A1 18-09-2014	
		WO 2014149566 A1 25-09-2014	
WO 2005053776	A1	16-06-2005	AT 515281 T 15-07-2011
		AU 2004294799 A1 16-06-2005	
		CA 2547089 A1 16-06-2005	
		EP 1701755 A1 20-09-2006	
		ES 2366953 T3 26-10-2011	
		JP 2007516822 A 28-06-2007	
		US 2007112308 A1 17-05-2007	
		US 2012089083 A1 12-04-2012	
		US 2016114106 A1 28-04-2016	
		US 2016303328 A1 20-10-2016	
		WO 2005053776 A1 16-06-2005	
US 2013041258	A1	14-02-2013	CA 2853336 A1 02-05-2013
		US 2013041258 A1 14-02-2013	
		US 2013079635 A1 28-03-2013	
		WO 2013063140 A2 02-05-2013	