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(54) Title: A DEVICE FOR ATOMISING A LIQUID

(57) Abstract: A device (10) for atomising a liquid comprising a reservoir of liquid (16) connected to an outlet nozzle (18). The device also has a moveable barrier (20), a space (13) containing a cylinder of pressurised gas (14), and a channel (30) connecting the pressurised gas with the nozzle. The device is operates to allow the pressurised gas to escape from the cylinder into the space so that a first portion of the gas acts on the moveable barrier to force liquid in the reservoir to pass through the outlet nozzle and be emitted as an aerosol, and a second portion of the gas to be bled into the nozzle via the channel.

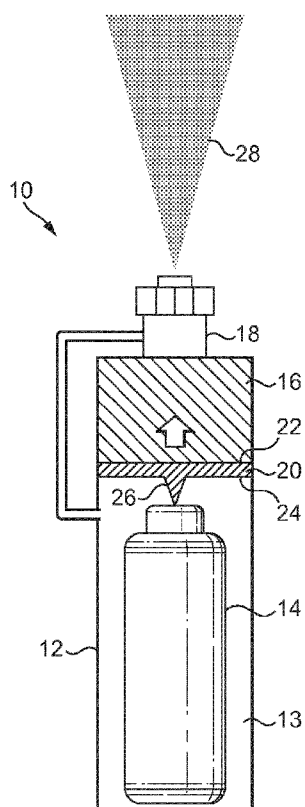


FIG. 1



MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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— *with international search report (Art. 21(3))*

A DEVICE FOR ATOMISING A LIQUID**BACKGROUND OF THE INVENTION**

5 The present invention relates to a device for atomising a liquid.

Atomised liquids are used for many purposes. One such use is for therapy, for example, by application to the skin or by inhalation. One example is the atomisation of sodium chloride for inhalation to assist with the removal of mucus and debris from the lungs. Another example is atomisation of hyaluronic acid for skin beauty purposes.

15 A device for atomising liquids to form a mist is disclosed in EP 2626052. It consists of a gas cylinder attached at its top end via a manifold to a separate cartridge containing a liquid to which gas is supplied in order to generate a mist. A face mask is attached at an outlet port on the top of the cartridge by which a user inhales the vapour.

In order to gain wider acceptance, there is a need for a single-use disposable version of such atomisers.

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SUMMARY OF THE INVENTION

According to the present invention there is provided a reservoir of liquid fluidly connected to an outlet nozzle, a moveable barrier, a space containing a cylinder of pressurised actuating gas, and a channel fluidly connecting the pressurised actuating gas with the nozzle; wherein the

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device is operable in use to allow the pressurised actuating gas to escape from the cylinder into the space such that:

- i) a first portion of the gas acts on the moveable barrier to force liquid in the reservoir to pass through the outlet nozzle and be emitted as an aerosol; and
- ii) a second portion of the gas is bled into the nozzle via the channel.

The present invention thus provides a simple device for dispensing a liquid in aerosol form.

Furthermore, by bleeding a portion of the gas into the nozzle, the size of the droplets in the aerosol is reduced, making the aerosol from the device easier to inhale.

The moveable barrier may be a piston, or a resiliently deformable membrane.

The device may further comprise a piercing element for piercing the cylinder when the device is operated. In this case, the piercing element may be connected to the moveable barrier to reduce the number of moving components present during the operation of the device. A portion of the housing is preferably deformable to allow the size of the space to be reduced such to move the cylinder into engagement with the piercing element when the device is operated.

The gas inside the cylinder is preferably at a pressure of up to 300 Bar. By containing gases at such high pressure, the cylinder can be made very small so as to minimise the overall size of the device.

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The cylinder preferably has a water capacity less than or equal to 50ml, more preferably less than or equal to 20ml, and more preferably less than or equal to 10ml. In this way, the device contains only a small amount of gas so
5 that the device can only be used once.

The nozzle is preferably arranged to generate an aerosol which comprises droplets of a diameter of less than 10µm.

10 Preferably, the nozzle comprises a fluid inlet for the liquid from the reservoir and an outlet which are substantially parallel, and further comprises a tangential inlet fluidly connected to the channel. This arrangement helps the gas from the channel to mix with the liquid from
15 the reservoir.

The liquid inside the reservoir may be a saline solution, for example a solution of sodium chloride. The device is then useable to assist with the removal of mucus
20 and debris from the lungs. The liquid may instead contain hyaluronic acid so that the device can be used for skin beauty purposes.

The pressurised actuating gas is preferably a breathing
25 gas such as compressed air or helium (a mixture of helium and oxygen).

The device may be provided as a single-use disposable cartridge. It may also be provided as part of an assembly
30 further comprising a base unit comprising an actuating means for operating the device.

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BRIEF DESCRIPTION OF THE FIGURES

The invention will now be described with reference to the accompanying Figures in which:

5 Figure 1 which shows a cross section view of an atomiser device; and

 Figure 2 shows a cross section view of nozzle for use with the atomiser device of Figure 1.

DETAILED DESCRIPTION

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 With reference to Figure 1, there is shown an atomiser device 10 which comprises a generally cylindrical housing 12 within which is located a reservoir 16 for liquid, and a
15 cavity 13 for holding a container 14 of pressurised gas.

 The container 14 is preferably a gas cylinder. Depending on the liquid contained in the reservoir 16, the gas inside the cylinder 14 is pressurised at a pressure of up to a 300
20 Bar.

 A nozzle 18 is connected to the housing 12 and is fluidly connected to the liquid contained in the reservoir 16 such to define an outlet for the liquid from the device
25 10. A closure means (not shown in the Figures), such as a valve or a peelable film, is located between the reservoir 16 and the nozzle 18 to control the flow of liquid through the nozzle 18.

30 The size of each of the reservoir 16 and the cavity 13 is controlled by a moveable barrier 20 located in the housing 12. As shown in Figure 1, the moveable barrier 20 is

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a piston which acts as a common wall for both the reservoir 16 and the cavity 13. A first face 22 of the piston is in contact with the liquid from the reservoir 16 whilst a second face 24 of the piston is in fluid communication with the gas contained in the cavity 13. In use, the piston is slideable along the length of the cylindrical housing to vary the size of each of the reservoir 16 and the cavity 13.

The second face 24 of the actuating member 20 comprises an element 26 for piercing the cylinder 14 when the device is used. The element 26 is actuated by an opening mechanism not shown in the Figures. The opening mechanism may take the form of anything which can move the piercing element 26 relative to the cylinder 14. For instance, the bottom of the housing 12 may be deformable to allow the cylinder 14 to be pushed into engagement with the piercing element 26. Alternatively, the housing 12 may be provided as two parts which can be screwed together to push the cylinder 14 into engagement with the piercing element 26.

Extending off from the cavity 13 is a channel 30 which is fluidly connected to the nozzle 18.

The interior of the nozzle 18 is best shown with reference to Figure 2. The nozzle 18 is generally cylindrically shaped and defines a liquid inlet 32 into which liquid from the reservoir 16 enters (signified by the arrow shown in Figure 2) when the closure means is open. As the liquid flows through the nozzle, the nozzle induces a swirling motion on the liquid to generate an aerosol spray 28 from the outlet 34 with droplets having a diameter of less than 10µm. Formation of the swirling motion is assisted

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by a tangential inlet 36 inside the nozzle 18 which is fluidly connected to the channel 30. The tangential inlet 36 is substantially perpendicular to both the fluid inlet 32 and the outlet 34.

5

In use of the device 10, the opening mechanism is operated so that the piercing element 26 pierces the cylinder 14 to allow gas to escape therefrom. The escaped pressurised gas enters the cavity 13 and a portion of this gas generates a force on the second face 24 of the piston 20, which forces the piston 20 to slide inside the housing 12 towards the nozzle 18. Due to the reduction in size of the reservoir, some of the liquid contained in the reservoir 16 forces open, and passes through, the closure means into the nozzle 18 and out of the device 10 as an aerosol spray 28.

The remaining portion of the escaped gas is bled into via the channel 30 to assist with the formation of the swirling motion inside the nozzle 18.

The liquid contained within the reservoir is any liquid which can be atomised. Exemplary liquids which can be used include a solution of sodium chloride for when the device is used assisting with the removal of mucus and debris from the lungs, and hyaluronic acid for use in skin beauty purposes.

The device 10 preferably takes the form of a disposable cartridge which comes pre-filled with a liquid in the reservoir 16 and a cylinder 14 of pressurised gas in the cavity 13. The cylinder 14 from the device 10 preferably has a water capacity less than or equal to 50ml, more preferably

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less than or equal to 20ml, and even more preferably a water capacity less than or equal to 10ml.

The cartridge may be supplied together with a base unit
5 comprising an actuating means for operating the opening mechanism of the cartridge.

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CLAIMS

1. A device for atomising a liquid, the device comprising a reservoir of liquid fluidly connected to an outlet nozzle, a moveable barrier, a space containing a cylinder of pressurised actuating gas, and a channel fluidly connecting the pressurised actuating gas with the nozzle; wherein the device is operable in use to allow the pressurised actuating gas to escape from the cylinder into the space such that:

i) a first portion of the gas acts on the moveable barrier to force liquid in the reservoir to pass through the outlet nozzle and be emitted as an aerosol; and

ii) a second portion of the gas is bled into the nozzle via the channel.

2. A device according to any preceding claim wherein the moveable barrier is a piston.

3. A device according to claim 1 wherein the moveable barrier is a resiliently deformable membrane.

4. A device according to any preceding claim wherein the device further comprises a piercing element for piercing the cylinder when the device is operated.

5. A device according to claim 2 wherein the piercing element is connected to the moveable barrier.

6. A device according to any preceding claim wherein the gas inside the cylinder is at a pressure of up to 300 Bar.

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7. A device according to any preceding claim wherein the cylinder has a water capacity less than or equal to 50ml.

8. A device according to any preceding claim wherein the
5 cylinder has a water capacity less than or equal to 20ml.

9. A device according to any preceding claim wherein the cylinder has a water capacity less than or equal to 10ml.

10 10. A device according to any preceding claim wherein the nozzle is arranged to generate an aerosol which comprises droplets of a diameter of less than 10µm.

11. A device according to any preceding claim wherein the
15 nozzle comprises a fluid inlet for the liquid from the reservoir and an outlet which are substantially parallel, and further comprises a tangential inlet fluidly connected to the channel.

20 12. A device according to any preceding claim wherein the liquid inside the reservoir is a saline solution.

13. A device according to any preceding claim wherein the pressurised actuating gas is a breathing gas.

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14. A device according to any preceding claim wherein the device is a single-use disposable cartridge.

15. An assembly comprising the device of any preceding
30 claim and a base unit comprising an actuating means for operating the device.

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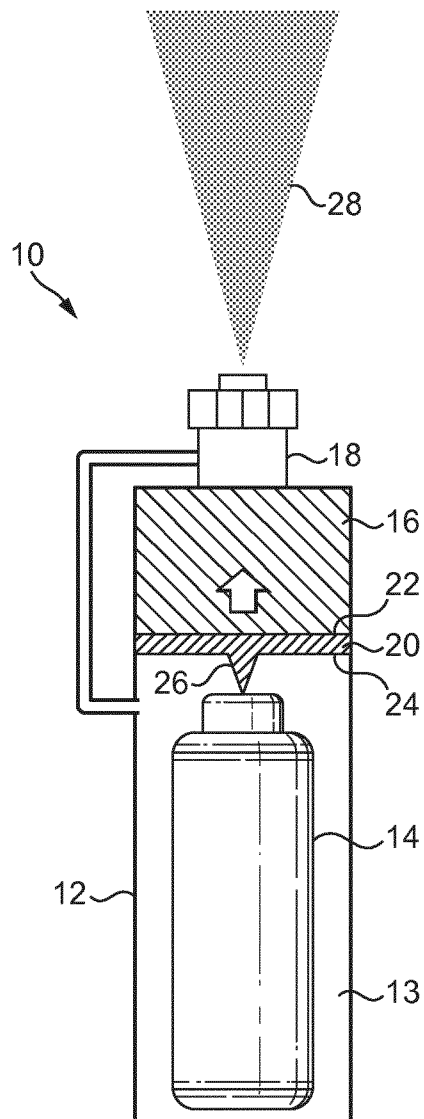


FIG. 1

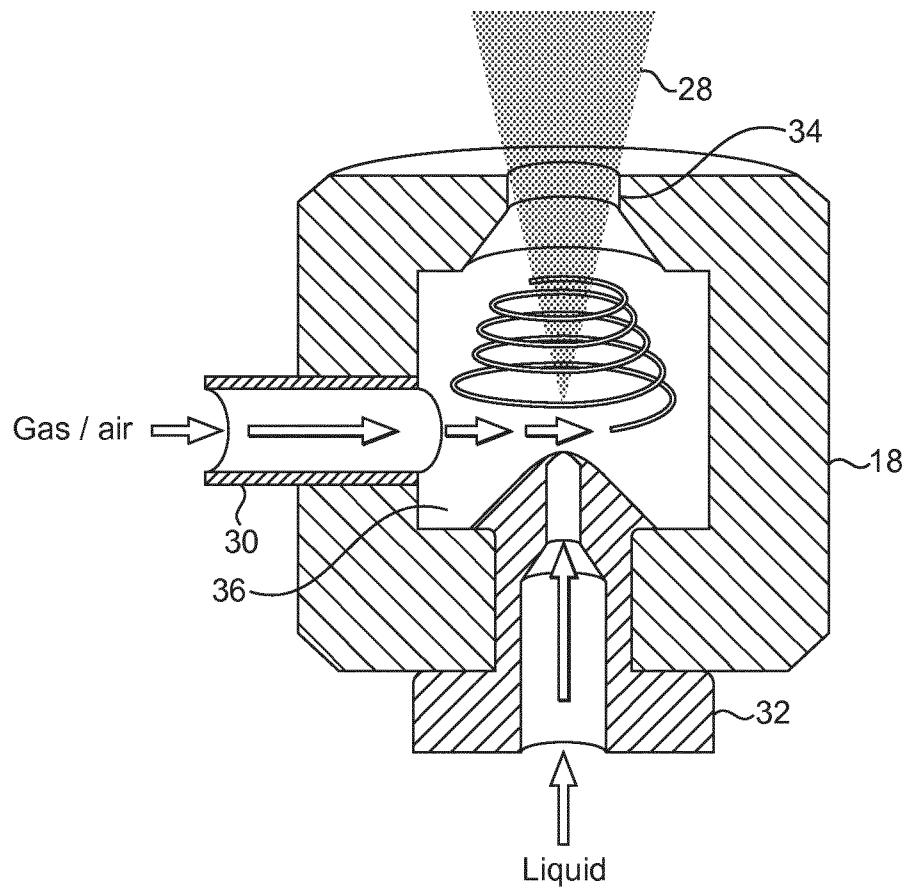


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/055316

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M11/00
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

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.
A	GB 2 251 898 A (D M W [GB]) 22 July 1992 (1992-07-22) pages 1,7; figure 5 pages 1-8; figures 1-6 -----	1-15
A	GB 2 410 190 A (MEDICAL HOUSE PLC [GB]) 27 July 2005 (2005-07-27) pages 10-14; figures 1-6 -----	1-15
A	WO 2007/106686 A2 (NOVO NORDISK AS [DK]; VALENTIN BORIS N [NO]; BUROLA VICTOR P [US]; WA) 20 September 2007 (2007-09-20) page 2, line 23 - page 5, line 11; figures 1-11 -----	1-15
A	GB 2 375 310 A (CAMBRIDGE CONSULTANTS [GB]) 13 November 2002 (2002-11-13) pages 1-16; figures 1-8 ----- -/-	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/055316

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 2009/087053 A1 (MEDIC ACTIV VERTRIEBS GMBH [DE]; BRUNNER MASCHB GMBH [DE]; BRUNNER PET) 16 July 2009 (2009-07-16) paragraphs [0001] - [0032]; figure 1 -----	1
A	US 2003/093030 A1 (LANDAU SERGIO [US]) 15 May 2003 (2003-05-15) paragraphs [0003], [0037] - [0042]; figures 2-10 -----	1-15
A	FR 2 787 732 A1 (PORTAL BRUNO [FR]) 30 June 2000 (2000-06-30) pages 4,5; figures 1-3,7,8 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/055316

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2251898	A	22-07-1992	NONE
GB 2410190	A	27-07-2005	CA 2455930 A1 26-07-2005 GB 2410190 A 27-07-2005 US 2005165349 A1 28-07-2005
WO 2007106686	A2	20-09-2007	NONE
GB 2375310	A	13-11-2002	AT 403459 T 15-08-2008 ES 2309180 T3 16-12-2008 GB 2375308 A 13-11-2002 GB 2375309 A 13-11-2002 GB 2375310 A 13-11-2002 KR 20040023597 A 18-03-2004
WO 2009087053	A1	16-07-2009	DE 102008003542 A1 09-07-2009 EP 2229204 A1 22-09-2010 EP 2529778 A2 05-12-2012 WO 2009087053 A1 16-07-2009
US 2003093030	A1	15-05-2003	AT 359095 T 15-05-2007 AU 2002352565 A1 26-05-2003 EP 1443985 A2 11-08-2004 US 2003093030 A1 15-05-2003 WO 03041762 A2 22-05-2003
FR 2787732	A1	30-06-2000	NONE