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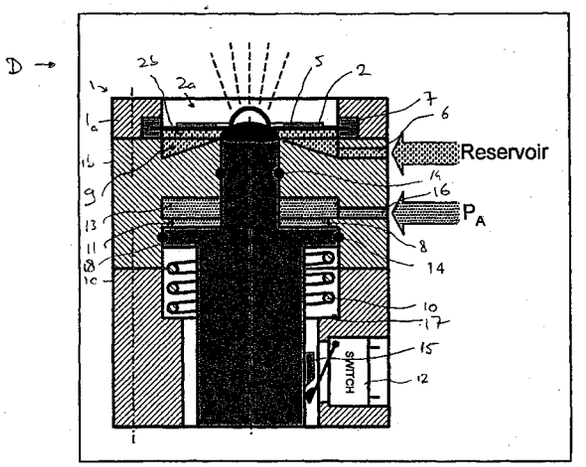
A request for correction of the description has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

## (54) Liquid droplet spray device having a hydrodynamic valve

(57) The invention concerns a liquid droplet spray device for atomising a liquid substance and comprises a housing (1) comprising a cavity (3) for containing a liquid substance, a perforated membrane (2) having one or more perforations and covering said cavity (3) such that said liquid substance may exit the cavity (3) and the device (D) by traversing the one or more perforations of said perforated membrane (2), an electromechanical actuation means (5) for actuating said liquid substance in said cavity (3) such that said liquid substance undergoes a vibration and contacts the perforated membrane (2) thereby traversing the one or more perforations as a liquid droplet spray, and obturating means disposed adjacent said perforated membrane, and comprising: a fluid inlet (16, 36) for receiving a fluid, an extendible volume element (8, 28), and a hydrodynamic valve (4, 24), which, in a first position, is in close contact with said perforated membrane (2) so as to obturate each of the one or more perforations of said perforated membrane (2) when said device is not in use, and which, in a second position, is removed from said perforated membrane (2), thereby allowing said liquid substance to contact said perforated membrane (2) and to exit said device (D) by traversing the one or more perforations, whereby, when said fluid or gas enters said fluid inlet (16, 36), said extendible volume element (8) extends in volume such that it urges said hydrodynamic valve (4, 24) from said first position to said second position.

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## Description

**[0001]** The present invention relates to a liquid droplet spray device suitable for atomising a liquid substance such as a drug, a fragrance or other aerosolised liquids. Such a device may be used, e.g., for perfume dispensers, for inkjet printer heads, for deposition of an array or arrays of droplets on a surface, for fuel injection devices of an engine or for administrating a nebulized drug to a patient by means of his or her respiratory system. The device delivers a liquid substance as a dispersion of atomised droplets. More specifically, the present invention concerns an improved liquid droplet spray device which efficiently creates and which fully expels a liquid droplet spray thereby avoiding seepage of the liquid substance when the liquid droplet spray device is not in use.

**[0002]** Various devices are known for atomising a liquid. Document EP 0 516 565 describes an ultrasonic wave nebuliser which atomises water. This apparatus is used as a room humidifier. Vibration is transmitted through the water to the water surface from which the spray is produced. A perforate membrane is provided to retain the water in absence of oscillation.

**[0003]** Typically, inhaler devices use the same principle to atomise the liquid into droplets, see for example the document WO 95/15822.

**[0004]** In such devices, the liquid substance is generally contained in a reservoir or a cavity (chamber) that is covered by a perforated membrane. When a force is applied to the liquid substance, typically a vibration caused by a piezoelectric element acting on the liquid substance, the liquid substance undergoes the vibration and contacts the membrane and is expelled as a spray of droplets.

**[0005]** However, when such a device is used as a portable device, for example as a perfume dispenser where it may be located in a person's handbag, or as a miniature ambulatory liquid drug spray device, uncontrolled forward flow may occur, i.e. the liquid substance not only contacts the perforated membrane, but, due to e.g. gravity, seeps through the perforations and exits the device.

**[0006]** In order to avoid such uncontrolled flow, or seepage, it is known to use a valve that is arranged between the liquid containing cavity and the perforated membrane. For example, the document WO02/097270 describes a micro-pump that is capable of doing work upon a fluid by transporting a volume of that fluid from a first region, the pump inlet, to a second region, the pump outlet. The device comprises a valve dispose adjacent a perforated plate so as to close the perforations when the device is not in use. A drive means is further provided for vibrating and thus displacing the perforated plate. When the perforated plate moves away from the valve, liquid may enter the thus created gap and traverse the perforated plate, but cannot return to the reservoir from which the liquid originated. The valve open gap is the difference between the vibration amplitudes of the valve and the perforated plate. However, it may be understood that such a device does not allow for a precise dosage as the valve open gap is extremely small and of very short duration. In fact, when the perforated plate starts to vibrate, the valve is supposed to vibrate in resonance but out of phase so as to allow for the gap. The liquid should then enter the created gap and expel from the perforations. The amount of liquid entering the gap is therefore difficult to predict and the amount that will be expelled is also not precisely defined. Further, the operation of the device requiring out of phase vibration of the valve with respect to the perforated plate indicates a potential reliability problem of the operation of the device.

**[0007]** It is, therefore, an object of the present invention to provide a liquid droplet spray device which overcomes the above-mentioned inconveniences and which allows for a controllable and reliable flow rate thereby avoiding seepage of the liquid substance when the device is not is use.

**[0008]** It is another object of the present invention to provide such a device that is simple, reliable to manufacture, small in size and low in energy consumption and cost.

**[0009]** Thus, the present invention concerns a liquid droplet spray device as defined in the appended claims.

**[0010]** Thanks to the use of a hydrodynamic valve, it is possible to ensure a full sealing free of seepage when the device is not in use and, when using the device, to provide a predefined gap between the valve and the perforated membrane such that it is possible to determine the amount of liquid substance that will enter the gap to be expelled from the device.

**[0011]** It should be noted that the term "hydrodynamic" used in this invention disclosure is used as a general term, including both hydrostatics and hydraulics, together with pneumatics and acoustics. For example, the hydrodynamic valve may be a pneumatic valve operated by pressurised air or other gas, but it may also be a hydraulic valve operated by a fluid acting a pressure on the valve.

**[0012]** Further, the term "fluid" has a dual meaning throughout this disclosure of both a gas, such as air, and a liquid.

**[0013]** Other features and advantages of the liquid spray device according to the present invention will become clear from reading the following description, which is given solely by way of a non-limitative example thereby referring to the attached drawings in which:

- FIGURE 1 is a schematic cross-section of a liquid droplet spray device according to the present invention is a first preferred embodiment, and
- FIGURE 2a to 2b is a schematic cross-section of a liquid droplet spray device according to the present invention is a second preferred embodiment.

**[0014]** An example of a first preferred embodiment will

be described hereafter while referring to figure 1.

**[0015]** The liquid droplet spray device according to the present invention, indicated by general reference D, consists of a housing 1 separated, for ease of assembly, in this example into three parts when considering the cylinder along its longitudinal axis, housing top part 1a, housing middle part 1b, and housing bottom part 1c. Preferably, housing 1 has overall symmetry and its top part 1a is cylinder shaped with a hollow centre portion. A perforated membrane 2, which may be a thin metal plate, is located across the hollow portion perpendicular to the longitudinal axis of the cylinder and fixed in the inner sidewall of the housing top part 1a by way of retaining elements 7 that seal the housing top part 1a. Preferably, the perforated membrane has the form of a thin membrane with a central dome section having one or more perforations there through. Such perforation may be fabricated for example by laser drilling, electroforming or other well known drilling technique. Perforate membrane 2 is located at a distance from both extremities of the hollow centre portion such that a top region 2a and a bottom region 2b are defined in the hollow centre portion along the longitudinal axis of the housing cylinder. The exact position of the membrane depends on design characteristics, but does not play an essential role for the present invention. In fact, the bottom region 2b constitutes a part of the cavity that will contain the liquid substance to be atomised.

**[0016]** An electromechanical actuator 5, which may be made of a piezoelectric material, is preferably mounted on perforated membrane 2 and may constitute a ring concentric with the perforated dome portion of the membrane. Actuator 5 may be mounted on the outer surface of the membrane, i.e. that surface that faces away from the cavity. Electrodes, not shown, are provided and are connected to a driver circuit, not shown, in any conventional manner to actuate the actuator. As such, the actuator 5 may transmit a vibration as well as a certain compression to the liquid contained in the cavity. When the liquid is excited at an appropriate frequency and under the appropriate pressure, it will be ejected as a spray of droplets through the one or more perforations with a very low exit velocity. The preferred operation is at the fundamental resonance frequency of actuator 5 or at subsequent harmonics.

**[0017]** Housing middle portion 1b has a through hole traversing the middle portion along its longitudinal axis. Thus, the centre of housing middle portion 1b is hollow, and has a diameter smaller than the hollow centre of the housing top portion 1a, but sufficiently large to accommodate a valve 4, as will be described in detail hereafter. Middle portion 1b has a top section adjacent housing top portion 1a that is partly hollow having a space arranged centrally around the through hole and extending away from the central through hole and defines a first space 9 for containing the liquid substance. This space 9 constitutes together with bottom region 2b a cavity 3 for containing the liquid substance that is to be atomised. A liquid substance inlet channel 6 may be provided in the sidewall of housing middle portion 1b perpendicular to its longitudinal axis for supplying the liquid substance from a reservoir, not shown, to the cavity 3. Such reservoir may form part of the device or may be provided externally, as known from conventional devices. The bottom section of housing middle portion 1c also has a space 13. This space 13 is arranged centrally around the through hole. The middle portion 1b has a protrusion 11 along its inner sidewall extending into space 13 and against which a part of a main body 4b of valve 4 will abut thereby defining a first position of the valve, as will be explained in detail hereafter. Space 13 constitutes an extendible volume element 8. A fluid inlet channel 16 is provided in the middle portion 1b perpendicular to its longitudinal axis and allows filling the extendible volume element 8 with a fluid or a pressurised gas, such as air.

**[0018]** Housing bottom portion 1c also has a through hole traversing the bottom portion along its longitudinal axis. The top part of the through hole is adjacent to space 13 of housing middle portion 1b and an extension thereof along the longitudinal axis of the housing bottom portion 1c. In this example, the lower part of the through hole is smaller in diameter than the part adjacent space 13, and thus creates a shoulder 17 at the region where the two through holes adjoin, as shown in figure 1. A switch 12 may be provided in the inner sidewall of the housing bottom portion below the shoulder. This switch may be an electromechanical switch connected to the driver circuit of actuator 5 and may be triggered by the main body 4b of the valve 4 when the latter moves away from its above-mentioned first defined position as will be explained in detail hereafter.

**[0019]** Valve 4 is provided in the housing 1 and is accommodated in the central through hole traversing housing 1. Valve 4 is a hydrodynamic valve, which means that it may be actuated by pneumatic (gas) or hydraulic pressure and the like, and comprises a valve top 4a and a main valve body 4b. When the liquid droplet spray device D is not in use, valve top 4a is in close contact with perforated membrane 2 so as to fully seal the one or more perforations thus preventing any liquid substance from seeping through any of the membrane perforations. To this effect, the valve top has a shape such that it matches that of the perforated membrane. In this example, the membrane has a dome section that contains the one or more perforations, so the valve top has a dome shape so as to obturate the one or more perforations.

**[0020]** The main valve body 4b in this example is an integrally formed object that may be divided for sake of explanation into three sections: a first thin top section, a second thick middle section, and a third intermediate thickness bottom section. The first section is adjacent the valve top and extending downwards towards space 13 in housing middle portion 1b along the through hole provided in housing middle portion 1b. A gasket 14 may be provided between main valve body 4b and the side-

wall of the through hole to prevent any leakage of liquid substance or of fluid there through. The diameter of the main valve body 4b is smaller than that of space 13 so that space 13 can further be filled with fluid to be provided through fluid inlet 16. Main valve body 4b has a middle section, as shown in figure 1, which is substantially of the same diameter as space 13 so that it may seal space 13. Advantageously, another gasket, which may be similar to gasket 14, may be provided to ensure sealing. In fact, the middle section of main valve body 4b may be considered as a flange 18 projecting from the main valve body beyond the first and the third sections. The flange 18 is used as a blocking shoulder against protrusion 11 to define the position of the valve when the liquid droplet spray device is not in use. Main valve body 4b further has the lower section that is smaller in diameter than the through hole traversing housing bottom portion 1c. A projection 15 may be provided on the lower section that is disposed to contact the switch 12 for activating or deactivating the electromechanical actuator 5.

**[0021]** A spring 10 is provided which surrounds the lower section of main valve body 4b. Spring 10 is fitted between shoulder 17 of the housing bottom portion 1c and the flanged middle section 18 of main valve body 4b, as shown in figure 1. By fitting the spring with a slight pre-tension in this position when the device is not in use, the flanged middle section 18 of main valve body 4b is pushed against protrusion 11 of housing middle portion 1b. In this state, the normal non-operating state of device D, the valve top is then also pushed against perforated membrane 2.

**[0022]** Space 13 constitutes a volume element 8 of predefined size. However, when fluid enters fluid inlet 16, the flanged middle section 18 of main valve body 4a will be pushed downwards, and it will compress spring 10 and extend the volume of volume element 8, as will be explained in more detail later. Thus, volume element 8 constitutes an extendible volume element as its volume may vary.

**[0023]** The operation of the liquid droplet spray device according to the first embodiment of the present invention is as follows.

**[0024]** When liquid droplet spray device D is not being used, the valve, i.e. valve top 4a, will lie against and engage with perforated membrane 2 and seal the perforations such that no liquid substance that may be present in cavity 3 can seep through the perforations out of the device. Thus, independent of the position of the device, a correct sealing, free of seepage is obtained. By allowing fluid, such as pressurised air, to enter extendible volume element 8 via fluid inlet 16, the volume of this volume element 8 will increase, as the pressurised air will push against flange 18 of the main valve body 4b so that the valve 4 will descend towards a second predefined operational position. Due to this movement, spring 10 will be compressed against shoulder 17 until it reaches it maximum compression whereby extendible volume element 8 thus reaches its maximum volume and the valve has thus reached its second position. Due to the downward movement of the valve from its first to its second position, the valve top 4a disengages from perforated membrane 2 thus unblocking the one or more perforations. Cavity 3 may hen be filled with liquid substance that can be provided through inlet 6 from a reservoir. The downward movement further pushes projection 15 on the main valve body against switch 12 to turn the switch on. By turning switch 12 on, the driver circuit, not shown, of actuator 5 will also be turned on so that actuator 5 will start vibrating. This vibration will cause membrane 2 to vibrate thus transmitting a vibration to the liquid substance contained in cavity 3. This then causes, in a manner well known to the skilled person, a disturbance in the liquid substance which results in a flow of the liquid substance through perforated membrane 2 and thus through the one or more perforations as a spray of droplets. By letting the pressurised air escape from extendible volume element 8, the spring will urge the valve back to its first position. This will cause projection 15 to turn switch 12 off, thus also turning off the actuator driver circuit and the actuator 5 itself. The device stops atomising air and regains its initial state with fully sealed perforations.

**[0025]** The second preferred embodiment will now be described while referring to figure 2. Similar parts are indicated by same reference numerals and will not be further explained.

**[0026]** As can be seen, the housing is again divided in this example, for ease of explanation, into three portions, where the housing top portion 21a is identical to housing top portion 1a of the first embodiment. Here too, a perforate membrane 2 is fixed in the same way as described above for the first embodiment and also has an electromechanical actuator 5.

**[0027]** Housing middle portion 21b has a first central hole for accommodating a hydrodynamic valve 24. An inlet 6 is further provided traversing the sidewall of housing middle portion 21b perpendicular to its longitudinal axis for allowing liquid substance to enter a space 29 in the liquid droplet spray device D. Valve 24 is disposed centrally along the longitudinal axis of housing 21 in space 29 and occupies a substantial part of space 29. Space 29 is adjacent region 2b of top housing portion 21b and that part of space 29 not occupied by valve 24 together with region 2b constitute a cavity 23 for containing the liquid substance to be expelled as a spray of droplets. The central hole is sufficiently deep to fully accommodate valve 24 and has a bottom surface delimiting the hole. Housing middle portion has another, second, central hole on the bottom side of the middle portion which extends until the bottom surface of the first central hole, as shown in figure 2.

**[0028]** Housing bottom portion 21c is shaped as a letter "T" upside-down where the protrusion corresponds to and fully first into the second central hole of housing middle portion 21b. A fluid inlet channel 36 traverses

housing bottom portion 21c and enters space 29.

**[0029]** Valve 24 consists of a valve top 24a similar to valve top 4a of the fist embodiment. A valve main body 24b comprises a rigid section 24b1 adjacent valve top 24a, and a flexible section 24b2. Flexible section 24b is hollow with flexible sidewalls and has a fluid inlet passage in its bottom surface. Valve 24 is disposed in space 29 in such a way that all fluid that enters fluid inlet 36 will enter the fluid inlet passage and thus the hollow portion 24b2 of valve main body 24b. Thus, in this second embodiment, the flexible section 24b constitutes an extendible volume element indicated by reference 28.

**[0030]** The operation of the liquid droplet spray device according to the second embodiment of the present invention is as follows.

**[0031]** Similar to the first embodiment, when liquid droplet spray device D is not being used, the valve, i.e. valve top 24a, will lie in a first predefined position against and engage with perforated membrane 2 and seal the perforations such that no liquid substance that may be present in cavity 3 can seep through the perforations out of the device. Thus, independent of the position of the device, a correct sealing, free of seepage is obtained. By allowing fluid, such as pressurised air, to enter extendible volume element 8 via fluid inlet 36, the volume of this volume element 8 will increase, as the pressurised air will push the flexible sidewalls of the flexible section 24b of the main valve body 4b so that the valve top 24a will descend towards a second predefined operational position. Following this movement, liquid substance may enter the cavity 3 through inlet 6. By activating the actuator 5, the liquid substance will be atomised and expelled as a spray by traversing the one or more perforations of perforated membrane 2 in the same way as described above for the first embodiment. When cavity 3 has been emptied, the actuator 5 is deactivated and fluid inlet 36 is blocked so that extendible volume element 28 returns to its original state. Due to this, valve top 24a also returns to its original first state and thus again seals the perforated membrane thus avoiding seepage of any liquid substance out of device D.

**[0032]** Having described a preferred embodiment of this invention, it will now be apparent to one of skill in the art that other embodiments incorporating its concept may be used. It is felt, therefore, that this invention should not be limited to the disclosed embodiment, but rather should be limited only by the scope of the appended claims.

**[0033]** For example, the same liquid droplet spray device may generally be used for creating nebulized liquids of different physico-chemical compositions, e.g. using aqueous or alcoholic or other liquid substances.

## Claims

**1.** Liquid droplet spray device (D) comprising:

- a housing (1) comprising a cavity (3) for containing a liquid substance,
- a perforated membrane (2) having one or more perforations and covering said cavity (3) such that said liquid substance may exit the cavity (3) and the device (D) by traversing the one or more perforations of said perforated membrane (2),
- an electromechanical actuation means (5) for actuating said liquid substance in said cavity (3) such that said liquid substance undergoes a vibration and contacts the perforated membrane (2) thereby traversing the one or more perforations as a liquid droplet spray, and
- obturating means disposed adjacent said perforated membrane,

**characterised in that**
said obturating means comprises:

- a fluid inlet (16, 36) for receiving a fluid or a gas,
- an extendible volume element (8, 28), and
- a hydrodynamic valve (4, 24), which, in a first position, is in close contact with said perforated membrane (2) so as to obturate each of the one or more perforations of said perforated membrane (2) when said device is not in use, and which, in a second position, is removed from said perforated membrane (2), thereby allowing said liquid substance to contact said perforated membrane (2) and to exit said device (D) by traversing the one or more perforations,

whereby, when said fluid or gas enters said fluid inlet (16, 36), said extendible volume element (8) extends in volume such that it urges said hydrodynamic valve (4, 24) from said first position to said second position.

**2.** Liquid droplet spray device (D) according to claim 1, wherein said perforated membrane (2) is a metal plate.

**3.** Liquid droplet spray device (D) according to claim 1 or 2, wherein said device (1) is a portable device.

**4.** Liquid droplet spray device (D) according to anyone of the preceding claims, wherein said hydrodynamic valve (4, 24) is a pneumatic valve or a hydraulic valve.

**5.** Liquid droplet spray device (D) according to anyone of the preceding claims, wherein said valve (4, 24) is elastic.

**6.** Liquid droplet spray device (D) according to anyone of the preceding claims, wherein said electromechanical actuation means (5) is a piezoelectric ele-

ment.

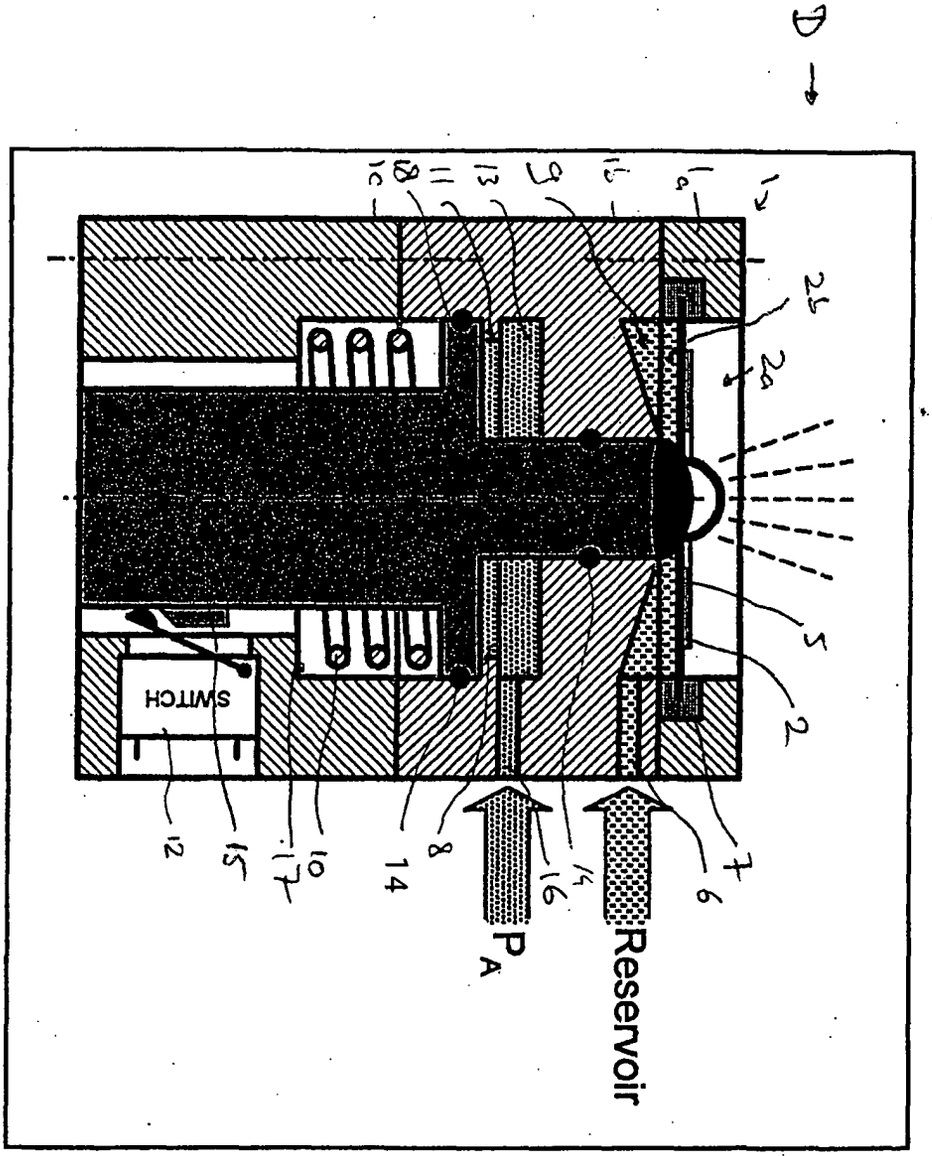
**7.** Liquid droplet spray device (D) according to anyone of the preceding claims, wherein said electromechanical actuation means (5) is arranged on said perforated membrane (2).

**8.** Liquid droplet spray device (D) according to anyone of the preceding claims, wherein said device (D) is a perfume dispenser.

**9.** Liquid droplet spray device (D) according to anyone of the preceding claims, wherein said hydrodynamic valve (4, 24) comprises a main valve body (4b, 24b) and a valve top (4a, 24a), said valve top (4a, 24a) being in close contact with said perforated membrane (2) when said device is not in use.

**10.** Liquid droplet spray device (D) according to claim 9, wherein said device housing (1) has a central longitudinal through hole for accommodating said main valve body (4b).

**11.** Liquid droplet spray device (D) according to the preceding claim 10, wherein said obturating means further comprises a spring element (10) disposed around said main valve body (4b) such that it urges said valve top against said perforated membrane (2) when said device is not in use.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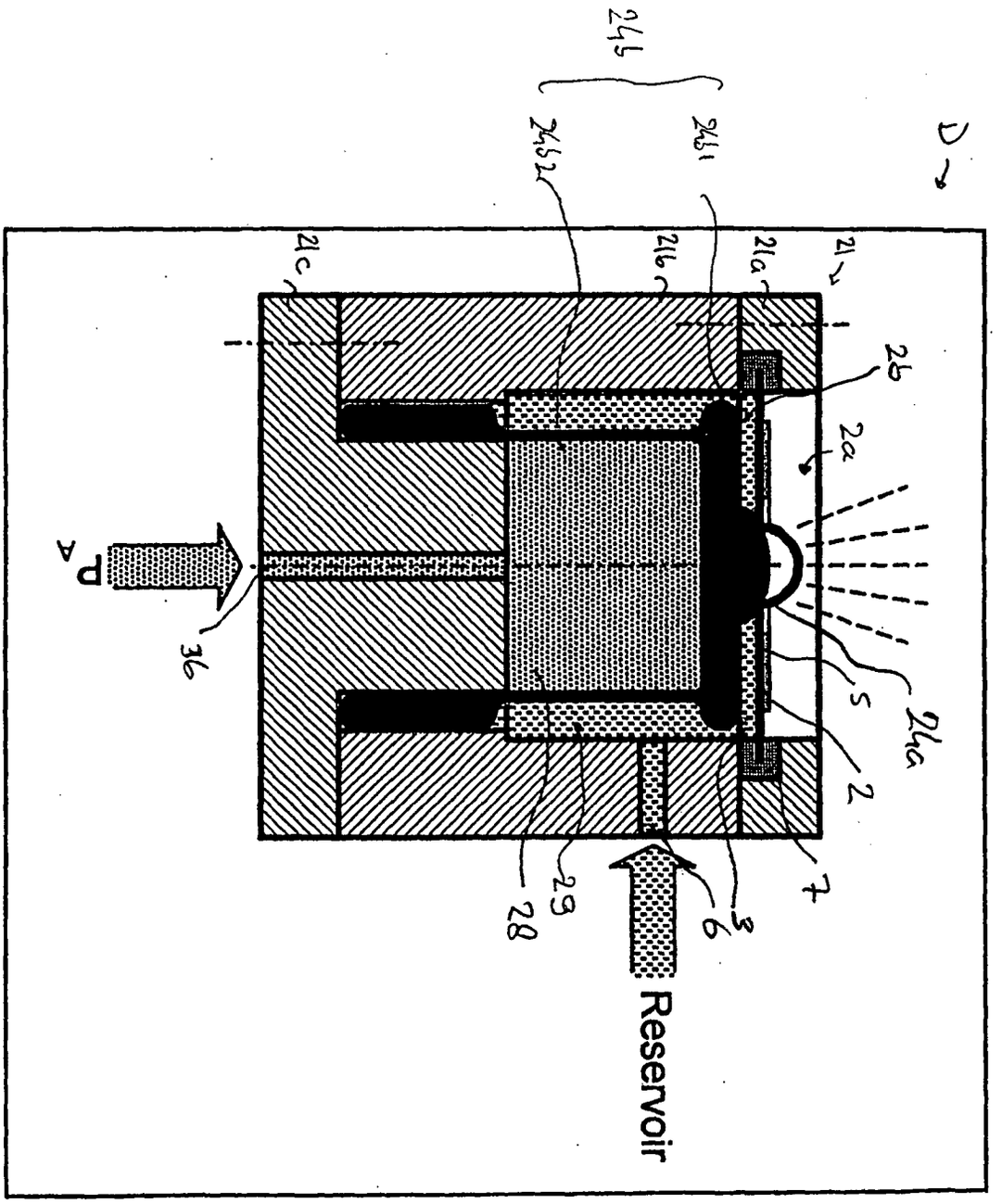
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# EUROPEAN SEARCH REPORT

Application Number
EP 03 01 9452

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.7) |
|---|---|---|---|
| X | US 2002/185125 A1 (IVRI YEHUDA ET AL) 12 December 2002 (2002-12-12) * paragraph [0113] - paragraph [0117] * * figures 25,26 * --- | 1-11 | B05B17/06 B05B1/30 |
| X | US 4 537 354 A (EITH GERHARD) 27 August 1985 (1985-08-27) * column 2, line 23 - line 40 * * figures * --- | 1 | |
| A | DE 38 41 442 A (BARLIAN REINHOLD) 13 June 1990 (1990-06-13) * the whole document * --- | 1 | |
| A | US 5 685 485 A (KAPPEL ANDREAS ET AL) 11 November 1997 (1997-11-11) * the whole document * ----- | 1 | |

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B05B

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 10 February 2004 | Barré, V |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 01 9452

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10-02-2004

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 2002185125 A1 | 12-12-2002 | US 6427682 B1 | 06-08-2002 |
| | | US 2002023639 A1 | 28-02-2002 |
| | | US 6205999 B1 | 27-03-2001 |
| | | US 6014970 A | 18-01-2000 |
| | | US 5938117 A | 17-08-1999 |
| | | AU 2777401 A | 24-07-2001 |
| | | CA 2396917 A1 | 19-07-2001 |
| | | EP 1250168 A1 | 23-10-2002 |
| | | JP 2003520079 T | 02-07-2003 |
| | | WO 0151110 A1 | 19-07-2001 |
| | | AU 4560399 A | 30-12-1999 |
| | | BR 9906489 A | 21-08-2001 |
| | | CA 2300975 A1 | 16-12-1999 |
| | | CN 1303309 T | 11-07-2001 |
| | | EP 1009363 A2 | 21-06-2000 |
| | | JP 2002529114 T | 10-09-2002 |
| | | NZ 502308 A | 01-02-2002 |
| | | NZ 515778 A | 25-07-2003 |
| | | WO 9963946 A2 | 16-12-1999 |
| | | US 2002011247 A1 | 31-01-2002 |
| | | US 2003019493 A1 | 30-01-2003 |
| | | US 2002121274 A1 | 05-09-2002 |
| | | US 2002104530 A1 | 08-08-2002 |
| | | AU 5442196 A | 23-10-1996 |
| | | EP 0822865 A1 | 11-02-1998 |
| | | WO 9631289 A1 | 10-10-1996 |
| | | US 2003000520 A1 | 02-01-2003 |
| | | US 6540153 B1 | 01-04-2003 |
| | | US 2004000598 A1 | 01-01-2004 |
| | | US 2004004133 A1 | 08-01-2004 |
| | | US 6467476 B1 | 22-10-2002 |
| | | US 6540154 B1 | 01-04-2003 |
| US 4537354 A | 27-08-1985 | DE 3209139 A1 | 15-09-1983 |
| | | DE 3361952 D1 | 13-03-1986 |
| | | EP 0089031 A1 | 21-09-1983 |
| | | JP 1705817 C | 27-10-1992 |
| | | JP 3069580 B | 01-11-1991 |
| | | JP 58166955 A | 03-10-1983 |
| DE 3841442 A | 13-06-1990 | DE 3841442 A1 | 13-06-1990 |
| | | DE 8815305 U1 | 05-04-1990 |
| US 5685485 A | 11-11-1997 | DE 4409848 A1 | 19-10-1995 |
| | | DE 59505999 D1 | 01-07-1999 |
| | | EP 0681873 A1 | 15-11-1995 |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 01 9452

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10-02-2004

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 5685485 A | | JP 7256155 A | 09-10-1995 |

EPO FORM P0459

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