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(54) **DEVICE FOR ATOMIZING A FLUID**

VORRICHTUNG ZUR ZERSTÄUBUNG EINES FLUIDS

DISPOSITIF D'ATOMISATION D'UN FLUIDE

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(73) Proprietor: **Airbus Defence and Space GmbH**
85521 Ottobrunn (DE)

(72) Inventors:
- **BLECHSCHMIDT, Markus**
  85737 Ismaning (DE)
- **SCHWARZ, Sebastian**
  81671 Munich (DE)
- **BAUER, Karin**
  82041 Oberhaching (DE)

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a device for atomizing a fluid, a use of such device for e.g. injection of combustible, spraying, fire extinction, cooling, heating and heat exchange and a method for atomizing a fluid.

BACKGROUND OF THE INVENTION

[0002] In the prior art, device for atomizing a fluid are known which comprise moving components. These device can, however, be greatly improved. See for example US3748852.

SUMMARY OF THE INVENTION

[0003] Hence, there may be a need to provide an improved device for atomizing a fluid, which is in particular easy to manufacture.

[0004] The problem of the present invention is solved by the subject-matters of the independent claim, wherein further embodiments are incorporated in the dependent claims. It should be noted that the aspects of the invention described in the following apply to the device for atomizing a fluid and the use of such device.

[0005] According to the present invention, a device for atomizing a fluid is presented.

[0006] Thereby, the present invention provides a device for atomizing a fluid, wherein the design and/or mechanical structure of the device is simple and therefore easy and cheap to manufacture, to maintain, to repair and to use.

[0007] The device can be designed without moving parts, which further increases the benefits in view of manufacturing and handling. In other words, the device is a passive fluidic device which is only driven by the provided pressurized gas. The first and second fluids can be automatically sucked in the chamber from preferably unpressurized container(s) by means of the pressurized gas provided by the pressure inlet. The first and second fluids are then automatically atomized in the chamber, again by means of the pressurized gas. The pressurized gas might be e.g. air with 1 bar excess pressure, different water solutions at the like.

[0008] Then, the first and second fluids can be outputted or released alternating or alternatively through the first outlet and the second outlet by means of the construction of the chamber as fluidic oscillator. In such fluidic oscillator, oscillations are produced purely by fluid-dynamic instabilities within the chamber.

[0009] The fluidic oscillator might be a bi-stable fluidic oscillator which is a device designed and formed to alternating attach the pressurized gas to a chamber wall next to the first fluid inlet or to the second fluid inlet, so that the pressurized gas alternating draws the first fluid and the second fluid into the chamber and outputs the atomized first fluid and the atomized second fluid alternating or alternatively through the first outlet and the second outlet.

[0010] As a result, the released atomized first fluid and the atomized second fluid are pulsed from the first and the second outlets or orifices. The first and the second outlets can be alternating at high and variable frequency of e.g. up to 250 Hz. The first and the second outlets can be alternating to produce coherent turbulent structures, such that e.g. heat can be carried away efficiently.

[0011] The device according to the invention can be designed to be very compact and small, even quasi 2D is possible, and can therefore be designed to be incorporated in a small installation space. The device for atomizing a fluid can also be easily scaled in a wide range for applications with different requirements of e.g. installation space, output pressure, output volume, output speed and the like. For example, sizes from 30 cm to less than 1 cm are possible.

[0012] The device for atomizing a fluid according to the invention allows using either gas or liquid and allows a generation of very fine particles e.g. in the range of 100 nm to 0.5 mm. Further, a good degree of mixing can be achieved without mixing the fluids in advance.

[0013] In an example, the fluidic oscillator is configured to mix the first atomized fluid and the second atomized fluid by alternating outputting the atomized first fluid and the atomized second fluid. In an example, the fluidic oscillator is configured to mix the first atomized fluid and the second atomized fluid in the chamber before alternating outputting. In an example, the mixing of the first atomized fluid and the second atomized fluid is based on turbulences in the first atomized fluid and the second atomized fluid. In an example, the first outlet and the second outlet are configured to further atomize the first fluid and the second fluid.

[0014] The device for atomizing a fluid according to the invention can be used for injection and fine distribution of combustible for efficient burning, for spraying one- or two-component paint or varnish, for spraying with a catalytic component for e.g. large surfaces, for fire extinction in e.g. cargo and/or cabin compartments of an aircraft or vehicle with one- or two-component fire extinguisher, for cooling and temperature reduction of e.g. exhaust plume, hot spots and/or surfaces, for heat exchange and the like.

[0015] In an example, a geometry of at least one of a group of the pressure inlet, the first fluid inlet, the second fluid inlet, the first outlet and the second outlet is variable to control a frequency of outputting the atomized first fluid and/or a frequency of outputting the atomized second fluid. In an example, a geometry of at least one of the group of the pressure inlet, the first fluid inlet and the second fluid inlet is variable to control the atomization.

[0016] Of course, the device according to the invention may comprise more than two fluid inlets, e.g. a third fluid inlet leading into the chamber. The fluidic oscillator might then be a tri-stable fluidic oscillator configured to alternating attach the pressurized gas to the first, second or

to third fluid inlet so that the pressurized gas alternating draws the first, second or to third fluids into the chamber, atomizes the first, second or to third fluids and outputs the atomized first, second or to third fluid alternating through the first outlet and the second outlet. Here, also a third outlet can be provided to output the first, second or to third fluids through the first, second or to third outlets.

[0017] In an example, the first outlet and/or the second outlet are a nozzle designed based on the application field of the device according to the invention.

[0018] The components of the device according to the invention can be made from metals, polymers and/or many other materials, according to temperature requirements.

[0019] According to the present invention, also a use of a device as described above is presented for injection of combustible, spraying, fire extinction, cooling, heating, heat exchange and/or the like.

[0020] These and other aspects of the present invention will become apparent from and be elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Exemplary embodiments of the invention will be described in the following with reference to the accompanying drawing:

Figure 1 shows schematically and exemplarily an isometric view of a device for atomizing a fluid.

Figure 2 shows schematically and exemplarily a plan view of the device shown in Figure 1.

Figure 3 shows schematically and exemplarily an alternating outputting of an atomized first fluid and an atomized second fluid.

Figure 4 shows schematically and exemplarily a method for atomizing a fluid which is not part of the invention as claimed.

DETAILED DESCRIPTION OF EMBODIMENTS

[0022] **Figure 1** shows schematically and exemplarily an isometric view of a device 10 for atomizing a fluid. The device 10 for atomizing a fluid comprises a top part 1, a bottom part 2, a pressure inlet 13 for providing a pressurized gas 23, a first fluid inlet 11 for providing a first fluid 21, a second fluid inlet 12 for providing a second fluid 22, a chamber 14, a first outlet 15, and a second outlet 16. **Figure 2** shows schematically and exemplarily a plan view of the bottom part 2 of the device 10 shown in Figure 1. The pressure inlet 13, the first fluid inlet 11 and the second fluid inlet 12 lead into the chamber 14 and the first outlet 15 and the second outlet 16 leave the chamber 14.

[0023] The pressure inlet 13, the first fluid inlet 11 and the second fluid inlet 12 are designed such that the pressurized gas 23 provided by the pressure inlet 13 draws the first fluid 21 and the second fluid 22 into the chamber 14. The chamber 14 is part of a fluidic oscillator to alternating attach the pressurized gas 23 to the first fluid inlet 11 or to the second fluid inlet 12, so that the pressurized gas 23 alternating draws the first fluid 21 and the second fluid 22 into the chamber 14, atomizes the first fluid 21 and the second fluid 22 and outputs the atomized first fluid 21 and the atomized second fluid 22 alternating through the first outlet 15 and the second outlet 16.

[0024] The first fluid 21 might be a gas or a liquid. The second fluid 22 might also be a gas or a liquid. The first outlet 15 and the second outlet 16 are here nozzles designed based on the particular application field of the device 10.

[0025] The device 10 is designed without any moving parts, which means the device 10 is a passive fluidic device 10 which is only driven by the pressurized gas 23 provided by the pressure inlet 13. The first and second fluids are first automatically sucked from unpressurized containers into the chamber 14 and then therein automatically atomized by means of the pressurized gas 23. The pressurized gas 23 is e.g. air with about 1 bar excess pressure.

[0026] The chamber 14 and the fluidic connections around form a bi-stable fluidic oscillator designed to alternating attach the pressurized gas 23 to a chamber 14 wall next to the first fluid inlet 11 or to a chamber 14 wall next to the second fluid inlet 12, so that the pressurized gas 23 alternating draws the first fluid 21 and the second fluid 22 into the chamber 14 and outputs the atomized first fluid 21 and the atomized second fluid 22 alternating through the first outlet 15 and the second outlet 16. As a result, the released atomized first fluid 21 and the atomized second fluid 22 are pulsed from the first and the second outlets 16 or orifices.

[0027] The first and the second fluid 22 are here different. The fluidic oscillator then mixes the first atomized fluid and the second atomized fluid by alternating outputting the atomized first fluid 21 and the atomized second fluid 22 as shown in **Figure 3.**

[0028] Additionally and at first, the fluidic oscillator further mixes the first atomized fluid and the second atomized fluid in the chamber 14 before alternating outputting.

[0029] A geometry of the pressure inlet 13, the first fluid inlet 11, the second fluid inlet 12, the first outlet 15 and/or the second outlet 16 may be variable to control a frequency of outputting the atomized first fluid 21 and/or a frequency of outputting the atomized second fluid 22. Also a geometry of the pressure inlet 13, the first fluid inlet 11 and/or the second fluid inlet 12 may be variable to control the atomization.

[0030] **Figure 4** shows schematically and exemplarily a method for atomizing a fluid which is not part of the invention as claimed.

[0031] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. The invention is not limited to the disclosed embodiments. Other vari-

ations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing a claimed invention, from a study of the drawings, the disclosure, and the dependent claims.

[0032] In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfil the functions of several items recited in the claims. The mere fact that certain measures are re-cited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. Device (10) for atomizing a fluid, comprising:

   - a pressure inlet (13) for providing a pressurized gas (23),
   - a first fluid inlet (11) for providing a first fluid (21),
   - a second fluid inlet (12) for providing a second fluid (22),
   - a chamber (14),
   - a first outlet (15), and
   - a second outlet (16),

   wherein the pressure inlet (13), the first fluid inlet (11) and the second fluid inlet (12) lead into the chamber (14) and the first outlet (15) and the second outlet (16) leave the chamber (14),
   wherein the pressure inlet (13), the first fluid inlet (11) and the second fluid inlet (12) are configured such that the pressurized gas (23) provided by the pressure inlet (13) draws the first fluid and the second fluid (22) into the chamber (14),
   wherein the chamber (14) is part of a fluidic oscillator configured to alternating attach the pressurized gas (23) to the first fluid inlet (11) or to the second fluid inlet (12), so that the pressurized gas (23) alternating draws the first fluid and the second fluid (22) into the chamber (14), atomizes the first fluid (21) and the second fluid (22) and outputs the atomized first fluid (21) and the atomized second fluid (22) alternating through the first outlet (15) and the second outlet (16),
   characterized in that a geometry of at least one of a group of the pressure inlet (13), the first fluid inlet (11), the second fluid inlet (12) is variable to control the atomization and/or a frequency of outputting the atomized first fluid (21) and/or a frequency of outputting the atomized second fluid (22).

2. The device (10) according to claim 1, wherein the fluidic oscillator is configured to mix the first atomized fluid and the second atomized fluid in the chamber (14).

3. The device (10) according to one of the preceding claims, wherein the first outlet (15) and the second outlet (16) are configured to further atomize the first fluid (21) and the second fluid (22).

4. The device (10) according to one of the preceding claims, further comprising an unpressurized container for the first fluid (21) and the second fluid (22).

5. The device (10) according to one of the preceding claims, wherein a geometry of at least one of a group of the first outlet (15) and the second outlet (16) is variable to control a frequency of outputting the atomized first fluid (21) and/or a frequency of outputting the atomized second fluid (22).

6. Use of a device (10) according to one of the preceding claims for one of a group of injection of combustible, spraying, fire extinction, cooling, heating and heat exchange.

7. Use according to claim 6, wherein the first fluid (21) is the same as the second fluid (22).

8. Use according to claim 6, wherein the second fluid (22) is different to the first fluid (21), and wherein the fluidic oscillator is configured to mix the first atomized fluid and the second atomized fluid by alternating outputting the atomized first fluid (21) and the atomized second fluid (22).

9. Use according to claim 8, wherein the mixing of the first atomized fluid and the second atomized fluid is based on turbulences in the first atomized fluid and the second atomized fluid.

10. Use according to one of the preceding claims 6-9, wherein the device (10) is only driven by the provided pressurized gas (23).

Patentansprüche

1. Vorrichtung (10) zur Zerstäubung eines Fluids, umfassend:

   - einen Druckeinlass (13) zum Bereitstellen eines druckbeaufschlagten Gases (23),
   - einen ersten Fluideinlass (11) zum Bereitstellen eines ersten Fluids (21),
   - einen zweiten Fluideinlass (12) zum Bereitstellen eines zweiten Fluids (22),
   - eine Kammer (14),
   - einen ersten Auslass (15), und
   - einen zweiten Auslass (16),

wobei der Druckeinlass (13), der erste Fluideinlass (11) und der zweite Fluideinlass (12) in die Kammer (14) führen und der erste Auslass (15) und der zweite Auslass (16) die Kammer (14) verlassen,
wobei der Druckeinlass (13), der erste Fluideinlass (11) und der zweite Fluideinlass (12) so ausgestaltet sind, dass das druckbeaufschlagte Gas (23), welches durch den Druckeinlass (13) bereitgestellt wird, das erste Fluid und das zweite Fluid (22) in die Kammer (14) zieht,
wobei die Kammer (14) Teil eines fluidtechnischen Oszillators ist, der ausgestaltet ist, um alternierend das druckbeaufschlagte Gas (23) an dem ersten Fluideinlass (11) oder an dem zweiten Fluideinlass (12) anzubringen, so dass das druckbeaufschlagte Gas (23) alternierend das erste Fluid und das zweite Fluid (22) in die Kammer (14) zieht, das erste Fluid (21) und das zweite Fluid (22) zerstäubt und das zerstäubte erste Fluid (21) und das zerstäubte zweite Fluid (22) alternierend durch den ersten Auslass (15) und den zweiten Auslass (16) ausgibt,
dadurch gekennzeichnet, dass eine Geometrie von mindestens einer von einer Gruppe des Druckeinlasses (13), des ersten Fluideinlasses (11), des zweiten Fluideinlasses (12) variabel ist, um die Zerstäubung und/oder eine Frequenz der Ausgabe des zerstäubten ersten Fluids (21) und/oder eine Frequenz der Ausgabe des zerstäubten zweiten Fluids (22) zu steuern.

2. Vorrichtung (10) nach Anspruch 1, wobei der fluidtechnische Oszillator ausgestaltet ist, um das erste zerstäubte Fluid und das zweite zerstäubte Fluid in der Kammer (14) zu mischen.

3. Vorrichtung (10) nach einem der vorhergehenden Ansprüche, wobei der erste Auslass (15) und der zweite Auslass (16) ausgestaltet sind, um das erste Fluid (21) und das zweite Fluid (22) weiter zu zerstäuben.

4. Vorrichtung (10) nach einem der vorhergehenden Ansprüche, des Weiteren umfassend einen nicht druckbeaufschlagten Behälter für das erste Fluid (21) und das zweite Fluid (22).

5. Vorrichtung (10) nach einem der vorhergehenden Ansprüche, wobei eine Geometrie von mindestens einem von einer Gruppe des ersten Auslasses (15) und des zweiten Auslasses (16) variabel ist, um eine Frequenz des Ausgebens des zerstäubten ersten Fluids (21) und/oder eine Frequenz des Ausgebens des zerstäubten zweiten Fluids (22) zu steuern.

6. Verwendung einer Vorrichtung (10) nach einem der vorhergehenden Ansprüche für eines aus einer Gruppe von Einspritzung eines Brennstoffs, Sprühen, Feuerlöschen, Kühlen, Heizen und Wärmetausch.

7. Verwendung nach Anspruch 6, wobei das erste Fluid (21) das gleiche wie das zweite Fluid (22) ist.

8. Verwendung nach Anspruch 6, wobei das zweite Fluid (22) sich von dem ersten Fluid (21) unterscheidet, und wobei der fluidtechnische Oszillator ausgestaltet ist, um das erste zerstäubte Fluid und das zweite zerstäubte Fluid zu mischen, indem das Ausgeben des zerstäubten ersten Fluids (21) und des zerstäubten zweiten Fluids (22) alterniert wird.

9. Verwendung nach Anspruch 8, wobei das Mischen des ersten zerstäubten Fluids und des zweiten zerstäubten Fluids auf Turbulenzen in dem ersten zerstäubten Fluid und dem zweiten zerstäubten Fluid basiert.

10. Verwendung nach einem der vorhergehenden Ansprüche 6 bis 9, wobei die Vorrichtung (10) nur durch das bereitgestellte druckbeaufschlagte Gas (23) angetrieben wird.

Revendications

1. Dispositif (10) d'atomisation d'un fluide, comprenant :

- une entrée de pression (13) pour fournir un gaz sous pression (23),
- une première entrée de fluide (11) pour fournir un premier fluide (21),
- une deuxième entrée de fluide (12) pour fournir un deuxième fluide (22),
- une chambre (14),
- une première sortie (15), et
- une deuxième sortie (16),

dans lequel l'entrée de pression (13), la première entrée de fluide (11) et la deuxième entrée de fluide (12) mènent dans la chambre (14) et la première sortie (15) et la deuxième sortie (16) sortent de la chambre (14),
dans lequel l'entrée de pression (13), la première entrée de fluide (11) et la deuxième entrée de fluide (12) sont configurées de telle sorte que le gaz sous pression (23) fourni par l'entrée de pression (13) attire le premier fluide et le deuxième fluide (22) dans la chambre (14),
dans lequel la chambre (14) fait partie d'un oscillateur fluidique configuré pour fixer en alternance le gaz sous pression (23) à la première entrée de fluide (11) ou à la deuxième entrée de fluide (12), de sorte que le gaz sous pression (23) attire en alternance le premier fluide et le deuxième fluide (22) dans la chambre (14), atomise le premier fluide (21) et le

deuxième fluide (22) et émette le premier fluide atomisé (21) et le deuxième fluide atomisé (22) en alternance à travers la première sortie (15) et la deuxième sortie (16), **caractérisé en ce qu'**une géométrie d'au moins une dans un groupe constitué de l'entrée de pression (13), de la première entrée de fluide (11), de la deuxième entrée de fluide (12) est variable pour commander l'atomisation et/ou une fréquence d'émission du premier fluide atomisé (21) et/ou une fréquence d'émission du deuxième fluide atomisé (22).

2. Dispositif (10) selon la revendication 1, dans lequel l'oscillateur fluidique est configuré pour mélanger le premier fluide atomisé et le deuxième fluide atomisé dans la chambre (14).

3. Dispositif (10) selon l'une des revendications précédentes, dans lequel la première sortie (15) et la deuxième sortie (16) sont configurées pour atomiser davantage le premier fluide (21) et le deuxième fluide (22).

4. Dispositif (10) selon l'une des revendications précédentes, comprenant en outre un récipient non sous pression pour le premier fluide (21) et le deuxième fluide (22).

5. Dispositif (10) selon l'une des revendications précédentes, dans lequel une géométrie d'au moins une dans un groupe constitué de la première sortie (15) et de la deuxième sortie (16) est variable pour commander une fréquence d'émission du premier fluide atomisé (21) et/ou une fréquence d'émission du deuxième fluide atomisé (22).

6. Utilisation d'un dispositif (10) selon l'une des revendications précédentes pour l'un parmi un groupe constitué de l'injection de combustible, la pulvérisation, l'extinction d'incendies, le refroidissement, le chauffage et l'échange de chaleur.

7. Utilisation selon la revendication 6, dans laquelle le premier fluide (21) est le même que le deuxième fluide (22).

8. Utilisation selon la revendication 6, dans laquelle le deuxième fluide (22) est différent du premier fluide (21), et dans laquelle l'oscillateur fluidique est configuré pour mélanger le premier fluide atomisé et le deuxième fluide atomisé par émission en alternance du premier fluide atomisé (21) et du deuxième fluide atomisé (22).

9. Utilisation selon la revendication 8, dans laquelle le mélange du premier fluide atomisé et du deuxième fluide atomisé est basé sur des turbulences dans le premier fluide atomisé et le deuxième fluide atomisé.

10. Utilisation selon l'une des revendications précédentes 6 à 9, dans laquelle le dispositif (10) est seulement entraîné par le gaz sous pression (23) fourni.

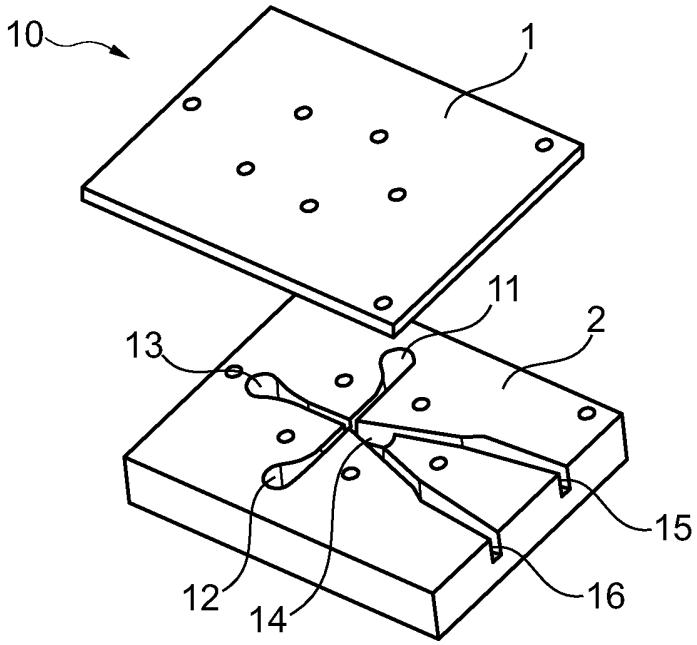

Fig. 1

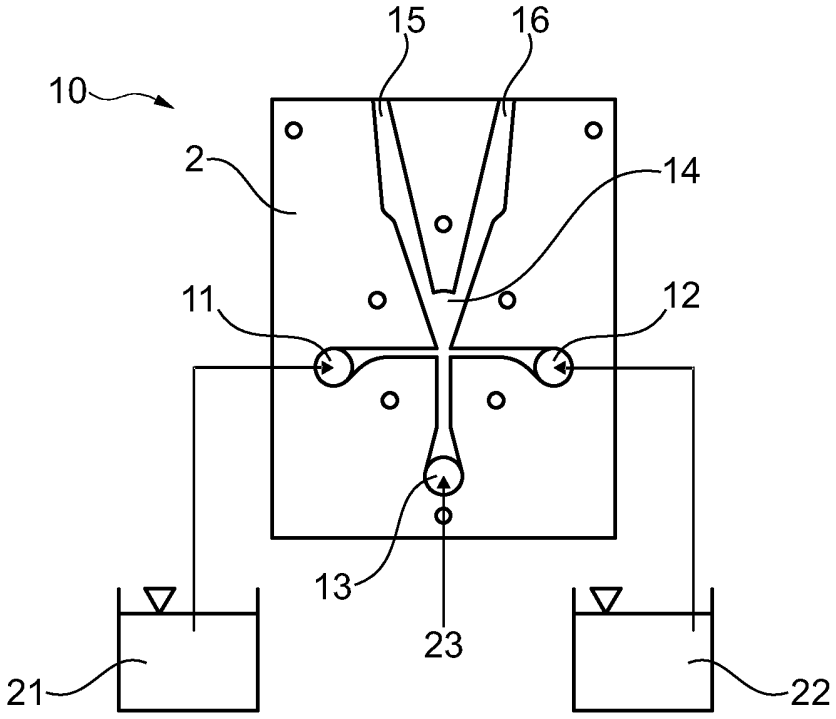

Fig. 2

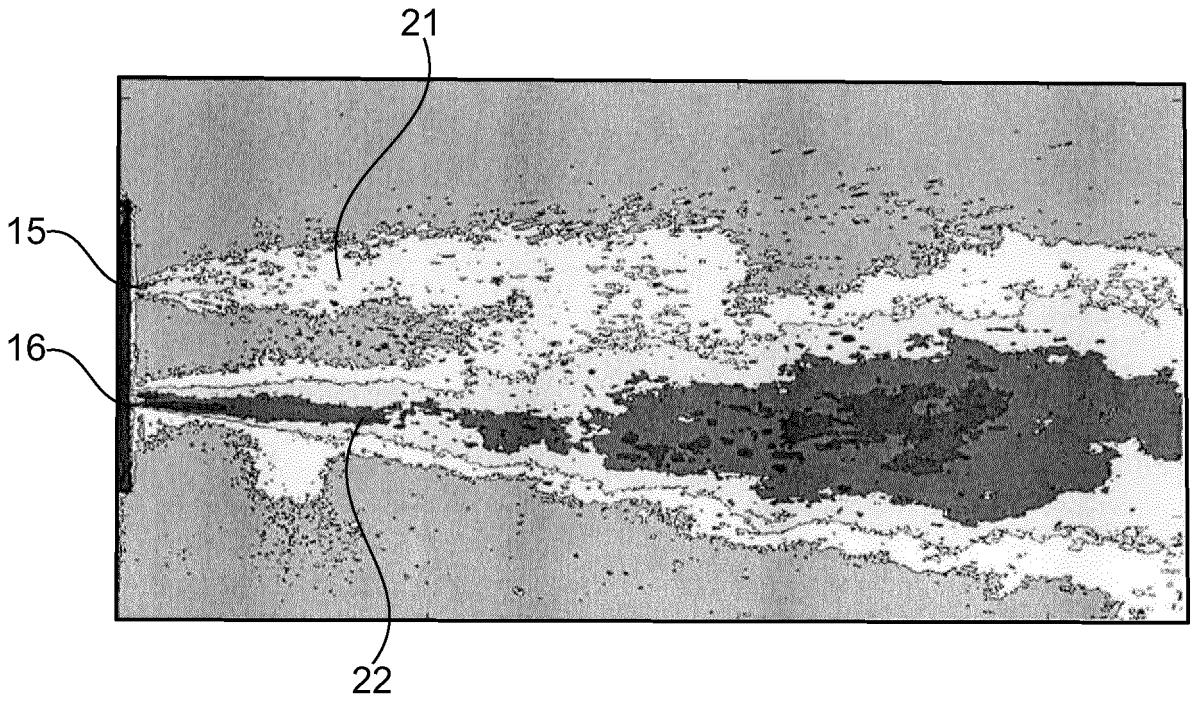

Fig. 3

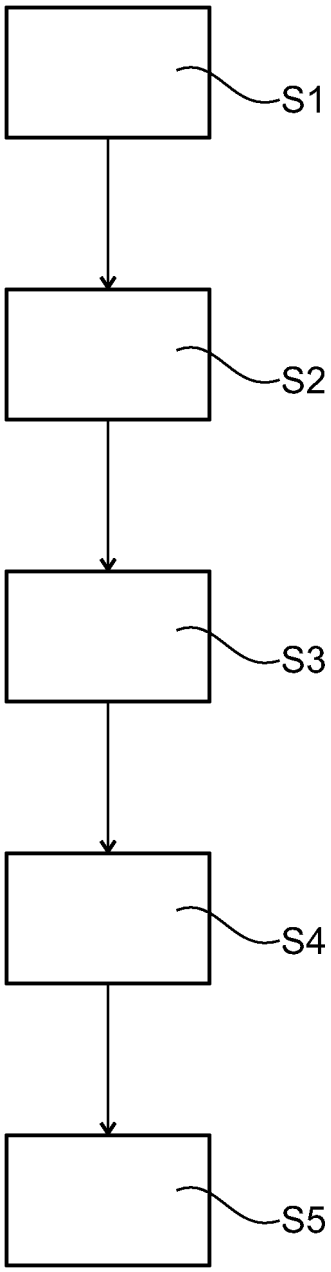

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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