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DESCRIPTION

[0001] The invention relates to an atomizer nozzle for atomizing a fluid, in particular a liquid, with a nozzle opening, with a rotation chamber, and with at least one supply channel for supplying the fluid into the rotation chamber, wherein at least one supply channel opens into the rotation chamber via at least one inlet opening.

[0002] The atomization of fluids, in particular liquids like water, is used in very many applications. During atomization or during nebulization, a liquid is separated into fine droplets, thus into an aerosol, for example, into mist, wherein the droplets are located in a vector gas, for example, air. The atomization or nebulization of water is used, for example, for fire safety, wherein the nebulized water is used to reduce the temperature and to displace oxygen. Furthermore, toxic flue gases may be bonded by the nebulized water. Moisture nebulas may also be used for binding dust and odors, for cooling, for improving indoor climates, for regulating humidity, and for maintaining anti-static requirements. In agriculture, for example, nebulized water may be used for adiabatic cooling of stall areas. In devices with high hygiene criteria, nebulized disinfection agents, for example, may be used, for example for decontamination.

[0003] An atomizer for nebulizing a liquid is known, for example, from DE 101 38 622 C2, which is provided for nebulizing water to improve air conditioning in animal husbandry. The atomizer has a nozzle opening and a rotation chamber connected upstream of the nozzle opening, comprising multiple rotational channels opening somewhat tangentially into the rotation chamber to set the liquid into a rotational movement coaxial to the nozzle opening. In order to achieve the smallest possible droplet size, the water is set into a rotational movement prior to the nebulization.

[0004] Document JP 2001104490 A further describes an atomizer for an endoscope, which is provided to spray a liquid uniformly on an inner wall using an endoscope. For this purpose, liquid supply tubes and rotation guide grooves are provided, which are arranged on the ends of the liquid supply lines. A liquid rotation chamber, from which the liquid is discharged, is located at the ends of the rotation grooves. The front side of the atomizer is hereby closed by a wall. An annular liquid opening is arranged on the outer wall of the rotation chamber.

[0005] In order to achieve an optimal effectiveness of the atomizer, for example, for applications in climate control technology or to bind dust and contaminant particles and also for use in fire safety, the distribution of the liquid into the smallest possible droplets is necessary.

[0006] The underlying problem of the invention is to provide an atomizer nozzle for atomizing a fluid, with which the smallest possible droplet size may be achieved.

[0007] This problem is solved by an atomizer nozzle with the features of patent claim 1. Refinements and advantageous embodiments are listed in the subclaims.

[0008] In the case of an atomizer nozzle for atomizing a fluid, in particular a liquid, with a nozzle opening, with a rotation chamber, and with at least one supply channel for supplying the fluid medium into the rotation chamber, wherein at least one supply channel opens into the rotation chamber via at least one inlet opening, it is provided according to the invention that the rotation chamber has a curved bottom, that the bottom is curved away from the nozzle opening, and that at least one supply channel is directed in the direction of the bottom.

[0009] The atomizer nozzle has a rotation chamber, in which the fluid to be atomized is set into rotation. The fluid to be atomized is preferably a liquid, for example, water. The cross section of the rotation chamber is preferably designed as rotationally symmetrical, in particular circular. The liquid to be atomized is introduced into the rotation chamber via at least one, preferably two supply channels. For this purpose, the rotation chamber has inlet openings, through which the supply channels open into the rotation chamber. The supply channels are arranged tangential to the cross section of the rotation chamber and open tangentially into the same. In a projection onto the plane of the cross section of the rotation chamber, the supply channels run in particular tangentially to the cross section of the rotation chamber. The supply channels are hereby preferably arranged such that the flow directions of the liquid in the supply channels face in opposite directions in a projection onto the cross sectional plane. The inlet openings are preferably arranged distributed uniformly across the circumference of the cross section of the rotation chamber. In particular, two inlet openings are arranged spaced apart from one another by one half of the circumference. The liquid is set into a rotation coaxial to the nozzle opening by the at least approximately tangential introduction of the liquid to be atomized into the rotation chamber and the rotationally symmetrical cross section of the rotation chamber. As both supply channels open into the rotation chamber and the flow directions of the liquid in the supply channels are directed opposite one another in the projection onto the cross sectional plane, the rotation of the liquid is supported by the two supply channels. The rotation chamber has a curved bottom, which is arranged on the end of the rotation chamber facing away from the nozzle opening. The curvature of the bottom is thereby directed away from the plane which is defined by the nozzle opening. With respect to the plane defined by the nozzle opening, the bottom has a convex curvature. The supply channels are also arranged tangential to the curvature of the bottom, in addition to the tangential arrangement to the cross section of the rotation chamber. The inlet openings are arranged facing the bottom so that the liquid to be atomized is introduced into the rotation chamber in the direction of the bottom. The flow direction of the liquid to be atomized during introduction into the rotation chamber is thus directed in the direction of the bottom and faces away from the nozzle opening. For example, the curve of the bottom may be designed as a hemisphere. The point, around which the radius of the hemisphere is defined, may hereby lie on the plane defined at the level of the inlet opening. In particular, the reference point of the hemisphere lies on the symmetrical center axis of the rotation chamber and the nozzle opening. The bottom preferably has a lesser curvature than a hemisphere. The rotation chamber may have conically tapering inner walls, which run between the nozzle opening and the bottom. The inlet openings of the supply channels are arranged in the area of the transition of the conical area of the rotation chamber to the curved bottom of the rotation chamber. Due to the supply of the fluid to be atomized into this area, in particular due to the introduction in the direction of the curved bottom, there is a particularly good distribution of pressure in the entire rotation chamber, and also an acceleration of the supplied fluid in the direction of the nozzle opening. Upon the exit of the liquid out of the nozzle opening, there is a good nebulization of the liquid based on the high centrifugal force acting on the liquid molecules. Furthermore, at least one supply channel runs obliquely at least in sections to the plane defined by the edge of the bottom area. The supply channels are arranged tangential to the curvature of the bottom area. Thus, the supply channels run obliquely at least in sections to the plane, which is defined by the edge of the bottom area.

[0010] In one refinement of the invention, the rotation chamber has a conical shape at least in sections and the rotation chamber widens, starting from the nozzle opening, in the direction of the inlet opening. The rotation chamber has a conical shape, wherein the walls of the rotation chamber taper, starting from the nozzle opening, in the direction of the inlet openings of the supply channels. The formation of a liquid column with a very high rotational speed is facilitated hereby. In particular, the rotational axis coaxial to the nozzle opening, about which the liquid column rotates, has very high rotational speeds herein, as only very small frictional forces act here. Due to the conically tapering side walls, it is ensured that approximately constant pressure conditions are established between the nozzle opening and the inlet openings of the supply channels, so that laminar flow conditions, that are as free of turbulence as possible, may be generated. In addition, a guiding of the rotating fluid column in the direction of the nozzle opening results from the conically tapering side walls. The flow speed, in particular the rotational speed, of the fluid column hereby increases in the direction of the nozzle opening. Thus, a very fine nebulization of the liquid to be atomized is facilitated, even at low fluid pressure.

[0011] In one refinement of the invention, at least one inlet opening is arranged in the area of the largest clear width of the rotation chamber. The inner walls of the rotation chamber may have a conical shape. The supply channels are arranged tangential to the cross section of the rotation chamber, at least in one projection onto the plane defined by the cross section. In addition, the supply channels are arranged tangential to the curvature of the bottom, and have inlet openings in the inner wall of the rotation chamber. A uniform pressure build up in the rotation chamber is facilitated by the arrangement of the inlet openings in the area of the largest clear width of the rotation chamber, thus at the widest point of the rotation chamber, and by the introduction in the direction of the bottom. Before the fluid to be atomized may exit out of the rotation chamber through the nozzle opening, it must pass through the entire rotation chamber.

[0012] In one refinement of the invention, at least one supply channel is arranged at least in sectionally tangential to the curvature of the curved bottom. The curved bottom of the rotation chamber has a curvature, wherein this curvature is directed away from the nozzle opening. The inlet channels are arranged tangential to the cross section of the rotation chamber in a projection onto the plane defined by the edge of the curved bottom. In addition, the supply channels are arranged tangential to the curvature of the curved bottom. In particular, the supply channels and thus the inlet openings are hereby designed facing the bottom, so that the liquid, guided through the supply channels, is introduced into the rotation chamber in the direction of the bottom. The introduced liquid thus flows along the curved bottom. An uninterrupted guiding of the liquid in the direction of the nozzle opening is facilitated by the introduction of the liquid in the direction of the bottom, and in particular by a flow along the curved bottom surface. A rotational movement of the liquid and also an acceleration in the direction of the nozzle opening is achieved by the additional arrangement tangential to the cross section of the rotation chamber. This leads to a particularly fine atomization of the liquid to be atomized during discharge out of the nozzle opening.

[0013] In one refinement of the invention, the edges of the bottom define a plane and this plane is arranged parallel to a plane defined by the nozzle opening. The edges of the bottom are formed by the area, in which the curvature of the bottom transitions into the convex shape of the rotation chamber. The edges of the curved bottom define a plane, which is arranged parallel to the plane, which is defined by the nozzle opening. Due to the arrangement of the bottom to the nozzle opening, a uniform distribution of pressure occurs in the rotation chamber, and an acceleration of the supplied liquid is facilitated by the curve of the bottom.

[0014] In one refinement of the invention, the atomizer nozzle is constructed in at least two parts, the atomizer nozzle has a bottom part having the curved bottom and an opening part having the nozzle opening, and at least one supply channel is designed in the bottom part. A modular composition of the atomizer nozzle is facilitated by the two-part design. The opening part having the nozzle opening may have, for example, a bore hole or another type of opening, by which the nozzle opening is formed. The rotation chamber may be formed by a recess in the opening part with conically tapering walls and be connected to the nozzle opening. In the case of a bottom part, the curved bottom of the atomizer nozzle may be formed, for example, by a recess, in particular by a curved recess. The component with the bottom recess is arranged with respect to the opening part such that the edges delimiting the recess and the edges of the conically tapering area of the rotation chamber connect to one another. In the bottom part, the supply channels for supplying a liquid into the rotation chamber may, for example, be formed by bore holes running obliquely to the plane defined by the edge of the bottom recess.

[0015] In one embodiment of the invention, at least one supply channel is designed in the shape of a through passage in the bottom part. The bottom part may be designed as substantially cylindrical. The bottom of the rotation chamber may be formed by a curved recess in an end face of the bottom part. For example, the bottom part may have through passages, which form the supply channels at least in sections, on the end face forming the bottom area. The through passages may, for example, be bore holes which are arranged tangential to the curvature of the bottom and open into the recess of the bottom area.

[0016] In one refinement of the invention, the atomizer nozzle has two conically tapering areas which are arranged between the plane defined by the edges of the bottom and the plane defined by the nozzle opening, and the two conically tapering areas have different taper angles. A hollow cylindrical area may run from the nozzle opening, on which a first conically tapering area of the rotation chamber abuts, which first conically tapering area connects to a second conically tapering area. The first conically tapering area has a smaller angle of increase that the second conical area with respect to the plane defined by the nozzle opening. A particularly uniform distribution of pressure in the rotation chamber is facilitated by the arrangement of two conical areas.

[0017] In one refinement of the invention, the atomizer nozzle has at least one cylindrical area and the cylindrical area is designed between the nozzle opening and a conically tapering area. The nozzle opening has a hollow cylindrical, thus a sleeve-shaped area, to connect a conically tapering area to the nozzle opening. The cylindrical wall of the nozzle opening transitions into the conically tapering area of the rotation chamber.

[0018] In one refinement of the invention, the opening part is designed as sleeve-shaped at least in sections, the symmetrical center axis of the nozzle opening is coincident with the symmetrical center axis of the sleeve-shaped area, the sleeve-shaped area is designed at least in sections to accommodate the bottom part, and at least one channel is designed between the bottom part and the opening part for guiding liquid. The opening part having the nozzle opening may have a sleeve-shaped area, in which the preferably substantially cylindrical bottom part may be inserted. In the joined state, the symmetrical center axis of the sleeve-shaped area is coincident with the symmetrical center axis of the rotation chamber and the nozzle opening, and also with the symmetrical center axis of the bottom. Thus, the bottom of the rotation chamber and also the nozzle opening may be arranged one below the other. A circumferential gap, through which the fluid may penetrate into the supply channel of the atomizer nozzle and thus be introduced into the rotation chamber, may be designed between the wall of the substantially cylindrical bottom part and the inner wall of the sleeve-shaped area of the opening part.

[0019] The invention will be subsequently explained in greater detail with reference to an exemplary embodiment depicted in the drawing. The schematic depictions show in detail:

Figure 1: an atomizer nozzle in a partially sectional depiction;

Figure 2: a projection of the cross section of an atomizer nozzle with two supply channels; and

Figure 3: an atomizer nozzle designed in two parts with an opening part and a bottom part in a sectional depiction.

[0020] A longitudinal section of an atomizer nozzle 1 according to the invention with a nozzle opening 2 and a rotation chamber 3 is depicted in figure 1. Supply channels for supplying liquid into rotation chamber 3 via inlet openings 4 open into rotation chamber 3. The inner walls of rotation chamber 3 widen in a conical extension from nozzle opening 2 in the direction of inlet opening 4, wherein rotation chamber 3 widens in this direction. Rotation chamber 3 has a curved bottom 5, which connects to the conical area. Bottom 5 has a convex curve, with respect to a plane defined by nozzle opening 2, the curve is thus curved away from nozzle opening 2. Rotation chamber 3 has its largest clear width between bottom area 5 and the conical area. Inlet opening 4 is arranged in this area. In a projection of the supply channels into the plane defined by the nozzle opening, the supply channels are arranged tangential to the preferably circular cross section of rotation chamber 3. By introducing a liquid, in particular water, this is set into rotation in rotation chamber 3 and accelerated by the convex curvature of bottom part 5 in the direction of nozzle opening 2. When the rotating fluid exits nozzle opening 2, it arrives in a fine nebulization of the fluid.

[0021] A projection of an atomization nozzle 1 onto the cross-sectional plane of rotation chamber 3 of atomization nozzle 1 is depicted in figure 2. Supply channels 6, 7 are arranged tangential to the rotationally-symmetrical cross section of rotation chamber 3 in a projection onto this plane. Supply channels 6, 7 open into rotation chamber 3 via inlet openings 4, 8. The flow direction of the liquid in both supply channels 6, 7 is directed opposite in the projection, so that the rotational direction of the liquid is supported by both supply channels 6, 7. Inlet openings 4, 8 are arranged spaced apart from one another by one half of the circumference of rotation chamber 3.

[0022] An atomizer nozzle 1, constructed in two parts, with a bottom part 9 and an opening part 10 is depicted in figure 3. Opening part 10 has a nozzle opening 2, from which a cylindrical, sleeve-shaped area 11 extends. A first conical area 12, which transitions into a second conical area 13, connects to cylindrical section 11. Rotation chamber 3 is formed by first conical area 12 and second area 13. With respect to the plane defined by nozzle opening 2, first conical area 12 has a smaller angle of inclination than second conical area 13. Second conical area 13 connects to bottom 5. Bottom 5 is formed by a curved recess in bottom part 9. The radius of the largest clear width of rotation chamber 3 corresponds to the radius of the recess, which forms bottom 5. At least one supply channel 6, 7 is designed in bottom part 9, for example, by a through passage. Supply channel 6 is formed, for example, by a bore hole in bottom part 9, wherein the bore hole is arranged on the end face of the substantially cylindrical bottom part. Supply channels 6, 7 are directed in the direction of bottom 5 and closely conform to the curvature of bottom 5 due to their tangential arrangement on the curvature of bottom 5. Inlet openings 4, 8 are arranged facing bottom 5. In addition, supply channels 6, 7 run tangentially to the circular cross section of rotation chamber 3, at least in one projection onto the plane defined by the edge of bottom 5 of rotation chamber 3. Supply channels 6, 7 thus run obliquely to the plane defined by the edge of bottom 5. A liquid introduced into rotation chamber 3 through supply channels 6, 7 is thus directed along curved bottom 5 and the inner wall of rotation chamber 3 in the direction of the nozzle opening. Due to the rotationally symmetrical design of rotation chamber 3, the fluid is set into rotation. Opening part 10 has a sleeve-shaped section 14, in which bottom part 9 is received. Bottom part 9 is designed to be substantially cylindrical. A gap 15 is formed between the outer walls of bottom part 9 and the walls of sleeve-shaped area 14 of the opening part. The liquid to be atomized may penetrate into supply channel 6 through gap 15 and may thus arrive into rotation chamber 3.

[0023] All features listed in the preceding description and in the claims are combinable in any selection with the features of the independent claim. The disclosure of the invention is thus not limited to the described or claimed combinations of features, but instead all logical combinations of features are considered to be disclosed in the context of the invention.

Patentkrav

1. Forstøverdyse til forstøvning af et fluid, især en væske, med en dyseåbning (2), med et rotationskammer (3) og med mindst én tilførselskanal (6, 7) til tilførsel af fluidet til rotationskammeret (3), hvor mindst én tilførselskanal (6, 7) åbner ind i rotationskammeret (3) via mindst én indløbsåbning (4, 8),
kendetegnet ved, at

rotationskammeret (3) omfatter en buet bund (5),
bunden (5) er buet væk fra dyseåbningen (2),
mindst én forsyningskanal (6, 7) er rettet i retning af bunden (5), og
mindst en tilførselskanal (6, 7) løber mindst sektionsvist skråt i forhold til det plan, der er defineret af kanten af bundområdet.

2. Forstøverdysen ifølge krav 1, **kendetegnet ved, at** rotationskammeret (3) mindst sektionsvist omfatter en konisk form, og at rotationskammeret (3) udvider sig, startende fra dyseåbningen (2), i retning af indløbsåbningen (4, 8).

3. Forstøverdyse ifølge et af kravene 1 eller 2, **kendetegnet ved, at** mindst en indløbsåbning (4, 8) er anbragt i området med den største frie bredde af rotationskammeret (3).

4. Forstøverdyse ifølge et af kravene 1 til 3, **kendetegnet ved, at** mindst én tilførselskanal (6, 7) er anbragt mindst sektionsvist tangentielt til krumningen af den buede bund (5).

5. Forstøverdyse ifølge et af kravene 1 til 4, **kendetegnet ved, at** kanten af bunden (5) definerer et plan, og at dette plan er anbragt parallelt med et plan, der er defineret af dyseåbningen (2).

6. Forstøverdyse ifølge et af kravene 1 til 5, **kendetegnet ved, at** forstøverdysen (1) er konstrueret i mindst to dele, at forstøverdysen (1) omfatter en første bunddel (9) med den buede bund (5) og en åbningsdel (10) med dyseåbningen (2), og at mindst én forsyningskanal (6, 7) er udformet i bunddelen (9).

7. Forstøverdysen ifølge krav 6, **kendetegnet ved, at** mindst én tilførselskanal (6, 7) er udformet mindst sektionsvist i form af en gennemgående passage i bunddelen (9).

8. Forstøverdyse ifølge et af kravene 1 til 7, **kendetegnet ved, at** forstøverdysen (1) har to konisk tilspidsede områder (12, 13), som er anbragt mellem planet der er defineret af kanterne af bunden (5), og planet der er defineret af dyseåbningen (2), og at de to konisk tilspidsende områder (12, 13) omfatter forskellige tilspidsningsvinkler.

9. Forstøverdyse ifølge et af kravene 1 til 8, **kendetegnet ved, at** forstøverdysen (1) omfatter mindst et cylindrisk tilspidset område (11), og at det cylindrisk tilspidsede område (11) er dannet mellem dyseåbningen (2) og et konisk tilspidsende område (12, 13).

10. Forstøverdyse ifølge et af kravene 6 til 9, **kendetegnet ved, at** åbningsdelen (10) mindst sektionsvist er udformet som ærmeformet, at den symmetriske midterakse af dyseåbningen (2) er sammenfaldende med den symmetriske midterakse af det ærmeformede område (14), at det ærmeformede område (14) er udformet mindst sektionsvist til at optage bunddelen (9), og at der mellem bunddelen (9) og åbningsdelen (10) er udformet en spalte (15) til at lede væske.

Fig. 1

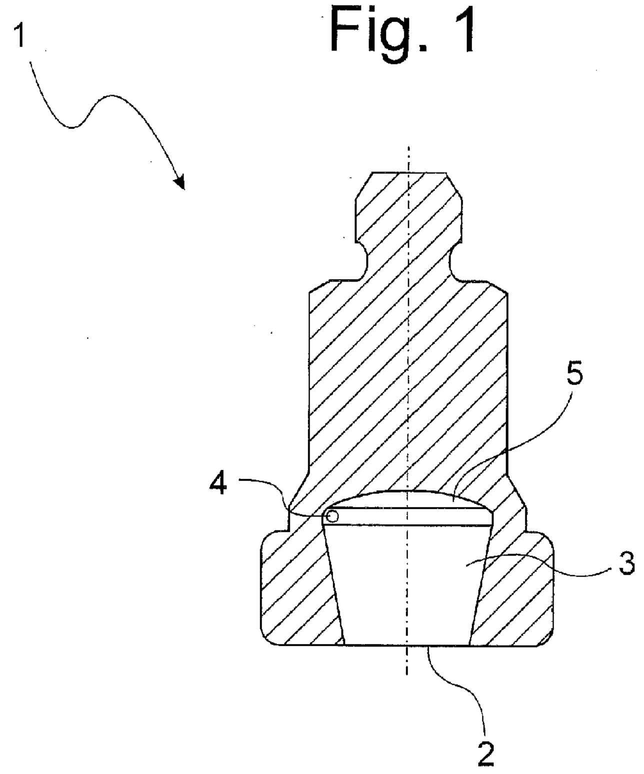

Fig. 2

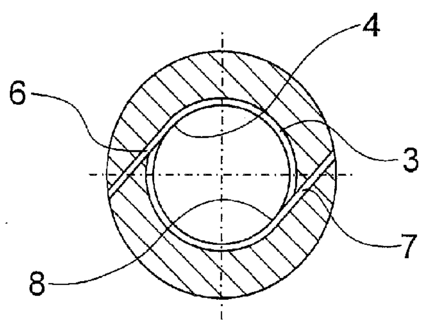

Fig. 3