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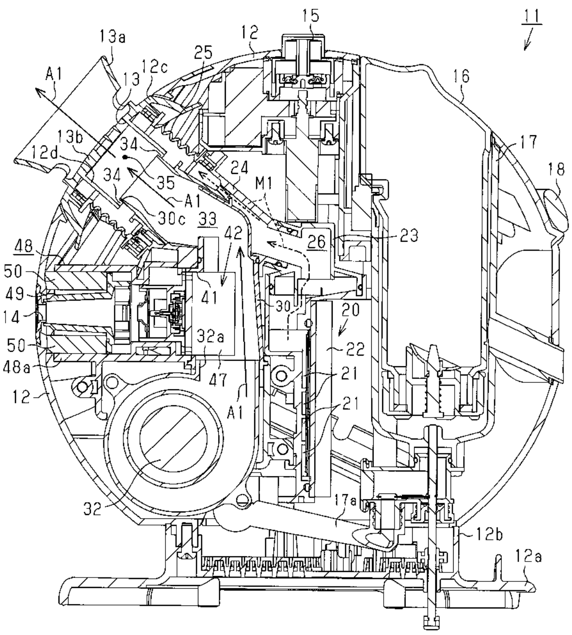
(54) Mist generator device

(57) A mist generator device (11) including a large-diameter droplet mist generation unit (20), which generates heated large-diameter droplet mist, and a small-diameter droplet mist generation unit (42), which generates small-diameter droplet mist. An air stream passes through a main air stream passage (33). A sub-air stream passage (43) is branched from the main air stream passage (33). A branched portion (43a, 40) branches the sub-air stream passage (43) from the main air stream passage (33) and lowers the flow rate of the air stream in the sub-air stream passage (43). A large-diameter droplet mist emission unit (13, 35) emits the large-diameter droplet mist. A small-diameter droplet mist emission unit emits the small-diameter droplet mist. The large-diameter droplet mist emission unit (13, 35) is arranged downstream from the branched portion (43a, 40), and the small-diameter droplet mist emission unit (14, 42, 49) downstream from the sub-air stream passage (43).

Fig.3



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Description

[0001] This application claims the benefit of Japanese Patent Application No. 2008-179126, filed on July 9, 2008, the entire contents of which are incorporated herein by reference.

[0002] The present invention relates to a mist generator device.

[0003] A mist generator device may be used as a humidifier or a facial steamer. A conventional mist generator device generates two-types of mist, one is large-diameter droplet mist formed by micro-size droplets and the other is small-diameter droplet mist formed by nano-size droplets that are smaller than the micro-size droplets of the large-diameter droplet mist. The mist generator device simultaneously emits the two types of mist having droplets of different sizes.

[0004] Japanese Laid-Open Patent Publication No. 2004-361009 describes a mist generator device including a large-diameter droplet mist generation unit, which generates large-diameter droplet mist by boiling water with a heater, and a small-diameter droplet mist generation unit, which generates small-diameter droplet mist with an electrostatic atomization mechanism. The mist generator device discharges the generated mists from a mist discharge port in a state suspended in an air stream, which is produced by a fan driven by a motor. The air stream produced by the fan is delivered through an air pipe to a large-diameter droplet mist outlet and to the small-diameter droplet mist generation unit.

[0005] However, in the ’009 publication, the air stream produced by the fan flows through the air pipe, which serves as a main air stream passage, and most of the air stream is delivered to the small-diameter droplet mist generation unit through an inlet. The small-diameter droplet mist generation unit generates the small-diameter droplet mist, which has a droplet size of about one to several tens of nanometers. The small-diameter droplet mist would be scattered if the air stream were to be delivered at a high flow rate to the small-diameter droplet mist generation unit. For this reason, it is difficult to increase the flow velocity of the small-diameter droplet mist. The mist generator device of the ’009 publication is used as a humidifier for slowly delivering the small-diameter droplet mist to a closed space such as the room of a dwelling. However, this mist generator device is not effective for use as a facial steamer that delivers small-diameter droplet mist to an extremely limited area such as a face.

[0006] The large-diameter droplet mist generated by heating liquid has a relatively high temperature. To cool the large-diameter droplet mist to an appropriate temperature, air stream is delivered at a high flow rate to the large-diameter droplet mist outlet. However, in the mist generator device of the ’009 publication, the flow rate of the air stream delivered to the large-diameter droplet mist outlet is lower than the flow rate of the air stream delivered to the small-diameter droplet mist generation unit. In the mist generator device of the ’009 publication, if the flow rate of the air stream produced by the motor fan were to be increased at the large-diameter droplet mist outlet, this would scatter the small-diameter droplet mist. On the other hand, if the flow rate of the air stream produced by the motor fan were to be decreased, this would reduce the scattering of the small-diameter droplet mist. However, due to the low flow rate of the air stream, the cooling of the large-diameter droplet mist would become insufficient.

[0007] It is an object of the present invention to provide a mist generator device that cools large-diameter droplet mist while stably discharging small-diameter droplet mist.

[0008] One aspect of the present invention is a mist generator device including a large-diameter droplet mist generation unit which generates heated large-diameter droplet mist from a liquid. A small-diameter droplet mist generation unit generates small-diameter droplet mist smaller than the large-diameter droplet mist by performing electrostatic atomization. An air stream produced by a fan passes through a main air stream passage. A sub-air stream passage is branched from the main air stream passage. A branched portion branches the sub-air stream passage from the main air stream passage and delivers to the sub-air stream passage an air stream having a flow rate lower than that of the air stream in the main air stream passage. A large-diameter droplet mist emission unit emits the large-diameter droplet mist generated in the large-diameter droplet mist generation unit out of the mist generator device. A small-diameter droplet mist emission unit emits the small-diameter droplet mist generated in the small-diameter droplet mist generation unit out of the mist generator device. The large-diameter droplet mist emission unit is arranged in the main air stream passage downstream from the branched portion, and the small-diameter droplet mist emission unit is arranged downstream from the sub-air stream passage.

Fig. 1 is a front view showing a preferred embodiment of a mist generator device;
Fig. 2 is a left side view showing the mist generator device of Fig. 1;
Fig. 3 is a cross-sectional view taken along line A-A in Fig. 1;
Fig. 4 is an enlarged partial view of Fig. 3;
Fig. 5 is a perspective view showing a fan motor, an air pipe, and an electrostatic atomization mechanism of Fig. 3; and
Fig. 6 is a cross-sectional view taken along line B-B in Fig. 4.

[0009] A preferred embodiment of a mist generator device according to the present invention will now be discussed. The mist generator device may be a cosmetic device such as an electric facial moisturizer which delivers a flow of mist toward a user. In the following description, the frame of reference for the directions of "front", "rear", "left", "right", "up", and "down" is the user of the cosmetic device (see Figs. 1 and 2).

[0010] Referring to Figs. 1 and 2, a cosmetic device 11 includes an annular base 12a, a cylindrical support 12b formed at the central part of the base 12a, and a spherical housing 12 fixed onto the support 12b. The housing 12 accommodates various types of mechanical and electrical components for the cosmetic device 11.

[0011] An angle adjustor 12c is fitted into the housing 12 and supported to be rotatable in vertical and horizontal directions. A large-diameter droplet mist emission port 13 is arranged in the middle of the angle adjustor 12c. Large-diameter droplet mist such as micro-size droplet mist is emitted out of the cosmetic device 11 through the large-diameter droplet mist emission port 13. The large-diameter droplet mist may be generated by boiling liquid such as water and may be warm mist having a relatively high temperature than the small-diameter droplet mist. The user rotates the angle adjustor 12c to adjust the direction in which the large-diameter droplet mist emission port 13 emits the large-diameter droplet mist. A hood 13a is arranged near the large-diameter droplet mist emission port 13 to guide and set the direction of the large-diameter droplet mist emitted from the large-diameter droplet mist emission port 13. The hood 13a also functions to prevent the user from inadvertently touching the large-diameter droplet mist emission port 13. The hood 13a has, for example, a conical shape. The large-diameter droplet mist emission port 13 includes a mesh lid 13b to prevent the user from inadvertently inserting his or her hand or finger into the large-diameter droplet mist emission port 13.

[0012] A small-diameter droplet mist emission port 14 is arranged below the large-diameter droplet mist emission port 13. The small-diameter droplet mist emission port 14 emits small-diameter droplet mist such as nano-size droplet mist, which droplet size is smaller than that of the large-diameter droplet mist. The small-diameter droplet mist may have a droplet size of about one to several tens of nanometers.

[0013] An operation button 15 operated by the user when operating the cosmetic device 11 is arranged at the top of the housing 12. A tank holder 17 is arranged at the rear of the operation button 15. A water storage tank 16 for storing water can be inserted to and removed from the tank holder 17 through an opening formed in the upper side of the tank holder 17 (see Fig. 3). A handle 18 for carrying the cosmetic device 11 is pivotally attached to the housing 12.

[0014] A mechanism for generating the large-diameter droplet mist by heating water supplied from the water storage tank 16 will now be described.

[0015] As shown in Fig. 3, a water supply pipe 17a has a basal end connected to the lower end of the tank holder 17 and a distal end connected to a warm mist generation mechanism 20. The warm mist generation mechanism 20 serves as a first mist generation unit, or a large-diameter droplet mist generation unit for generating large-diameter droplet mist by boiling the supplied water. The water supply pipe 17a supplies water from the water storage tank 16 to the warm mist generation mechanism 20. The warm mist generation mechanism 20 includes a boiler chamber 21, which accommodates a heater 22 for heating water. The heater 22 heats and boils the water that is supplied to the boiler chamber 21 to generate the large-diameter (warm) mist droplets.

[0016] A mist guide tube 23 ha a basal end connected to a location above the boiler chamber 21. The mist guide tube 23 guides the large-diameter droplet mist generated in the boiler chamber 21. A discharge pipe 24 includes a basal end connected to a distal end of the mist guide tube 23. The discharge pipe 24 guides the large-diameter droplet mist toward the front. The discharge pipe 24 is tapered so that its diameter increases from the basal end towards the distal end (front side). A corrugated member 25 has basal end connected to the distal end of the discharge pipe 24 and a distal end, which is fixed to the angle adjustor 12c in close contact with the inner surface of the angle adjustor 12c. The corrugated member 25 is formed from a resilient or soft material such as silicone rubber. The large-diameter droplet mist emission port 13 in the angle adjustor 12c is arranged in the corrugated member 25. The mist guide tube 23, the discharge pipe 24, and the corrugated member 25 defines a mist supply passage 26.

[0017] A mechanism for supplying the air stream for emitting the large-diameter droplet mist and the small-diameter droplet mist from the mist droplet emission ports 13 and 14 will now be described.

[0018] As shown in Figs. 3 and 4, a fan motor 32 is arranged in the housing 12 at the lower front side. The fan motor 32 draws in air from an air intake port (not shown) formed on the housing 12, generates an air stream, and forces out the air stream in an upward direction from an outlet 32a. The outlet 32a is connected to the basal end of an air pipe 30, which guides the air stream in an upward direction. The air pipe 30 defines a main air stream passage 33. The size of the air pipe 30, that is, the cross-sectional area of the main air stream passage 33 is set to be large enough so that it does not inhibit the flow of the air stream from the fan motor 32.

[0019] The air pipe 30 has a free end, which is opposite to the basal end, connected to the fan motor 32. The free end is arranged in the discharge pipe 24. In other words, the main air stream passage 33, through which the air stream passes, is arranged in and surrounded by the mist supply passage 26, through which the large-diameter droplet mist passes. The main air stream passage 33 and the mist supply passage 26 at least partially form a double-pipe structure. The main air stream passage 33 and the mist supply passage 26 are examples of an inner pipe and an outer pipe of a double-pipe structure. The temperature of the air stream passing through the main air stream passage 33 is lower than the large-diameter droplet mist. Thus, the large-diameter droplet mist in the mist supply passage 26 is cooled by the main air stream passage 33 (air pipe 30). Dew condenses on the outer surface of the air pipe 30 (in the mist supply passage 26) due to the temperature difference between the main air stream passage 33 and the mist supply passage 26. However, the dew condensed into water returns to the boiler chamber 21 through the mist supply passage 26.

[0020] The large-diameter droplet mist emission port 13 includes a cylindrical mist guide 12d extending into the housing 12. The free end of the air pipe 30 is arranged in the mist guide 12d. The surface of the free end of the air pipe 30 defines an air discharge port 30c. The air stream passing through the main air stream passage 33 is discharged from the air discharge port 30c of the air pipe 30 and flows through the mist guide 12d. This will be described in more detail. The outer diameter of the free end of the air pipe 30 is slightly smaller than the inner diameter of the mist guide 12d. The cylindrical free end of the air pipe 30 is slightly inserted into the cylindrical mist guide 12d. This forms an elongated narrow gap between the inner surface of the mist guide 12d and the outer surface of the free end of the air pipe 30. This gap defines an elongated narrow inlet 34. The elongated narrow inlet 34 is located near the air discharge port 30c. The elongated narrow inlet 34 has an open area set to be smaller than the open area of the air discharge port 30c. The elongated narrow inlet 34 is formed by overlapping the cylindrical free end of the air pipe 30 and the mist guide 12d. Thus, the elongated narrow inlet 34 is an annular slit extending in the circumferential direction so as to continuously surround the entire circumference of the air discharge port 30c. The air discharge port 30c and the elongated narrow inlet 34 function as a mixing portion 35 for mixing the air stream passing through the main air stream passage 33 and the large-diameter droplet mist. The large-diameter droplet mist emission port 13 and the mixing portion 35 form a large-diameter droplet mist emission unit. The elongated narrow inlet 34 is one example of a large-diameter droplet mist outlet for drawing in large-diameter droplet mist flowing through the mist supply passage to the mixing portion 35.

[0021] Since the free end of the air pipe 30 is inserted into the mist guide 12d, the dew condensed on the outer surface of the mist guide 12d does not enter the main air stream passage 33 from the air discharge port 30c. Thus, condensed water is not sprayed out of the large-diameter droplet mist emission port 13 by the air stream delivered from the fan motor 32.

[0022] An annular flange 30a projects radially outward from the outer surface of the air pipe 30 (Figs. 4 and 5). The annular flange 30a is arranged between the elongated narrow inlet 34 and the warm mist generation mechanism 20 in the mist supply passage 26. The annular flange 30a functions as a barrier for impeding the movement (flow) of the large-diameter droplet mist, which is generated by the warm mist generation mechanism 20, and prevents the large-diameter droplet mist from directly reaching the elongated narrow inlet 34. The large-diameter droplet mist generated in the warm mist generation mechanism 20 is first diffused when striking the annular flange 30a as they pass through the mist supply passage 26 and accumulate in the mist supply passage 26.

[0023] As shown in Figs. 5 and 6, a rectangular attachment hole 41 is formed in the front surface of the basal end of the air pipe 30. An electrostatic atomization mechanism 42, which serves as a second mist generation unit, or a small-diameter droplet mist generation unit for generating small-diameter droplet mist, is fixed to the air pipe 30 through the attachment hole 41. A side wall 30b extends towards the front of the cosmetic device 11 (in a direction substantially orthogonal to the direction in which the air stream flows through the air pipe 30) from one side of the attachment hole 41. The side wall 30b and a side surface of the electrostatic atomization mechanism 42 define a sub-air stream passage 43 branched from the main air stream passage 33. In the illustrated example, the sub-air stream passage 43 branches from the main air stream passage 33 and extends toward the front of the cosmetic device 11. The sub-air stream passage 43 is narrower than the main air stream passage 33.

[0024] An air guide 40, which is for guiding some of the air stream delivered from the fan motor 32 and flowing through the main air stream passage 33 to the sub-air stream passage 43, is arranged on the inner surface of the air pipe 30. The air guide 40 includes a guide rib 40a and is ladle-shaped. The air guide 40 is tapered and inclined from the rear toward the front so as to approach the sub-air stream passage 43 at the downstream side (upper side) of the air pipe 30. Some of the air stream from the fan motor 32 is guided by the air guide 40 toward and into the sub-air stream passage 43. The air guide 40 also guides (delivers) to the sub-air stream passage 43 an air stream of which the flow rate is lower than the flow rate of the air stream in the main air stream passage 33. This will now be described in detail. The air guide 40 slightly projects slightly into the air pipe 30 (main air stream passage 33) and has a shape set so that the proportion of the cross-sectional area of the air guide 40 occupying the cross-sectional area of the main air stream passage 33 becomes low. The air guide 40 forms a branched portion 43 a.

[0025] The electrostatic atomization mechanism 42 includes a needle-shaped discharge electrode 44 and an opposing electrode 45, which is located at a position facing the discharge electrode 44. The opposing electrode 45 is formed from a flat plate including a central vent hole 45a through which the air stream is passable. High voltage is applied between the discharge electrode 44 and the opposing electrode 45. A discharge area formed between the discharge electrode 44 and the opposing electrode 45 is located in the sub-air stream passage 43. The discharge electrode 44 has a basal end, which is in contact with a cooling surface of a Peltier unit (Peltier element) 46. The discharge electrode 44 is forcibly cooled by the Peltier unit 46. A heat radiating surface located opposite to the cooling surface of the Peltier unit 46 is arranged in the main air stream passage 33 (inner side of air pipe 30). Radiation fins 47 formed from metal (e.g., aluminum and copper) extend from the heat radiating surface of the Peltier unit 46. The radiation fins 47 are exposed to the interior of the main air stream passage 33. The air stream passing through the main air stream passage 33 promotes the radiation of heat from the heat radiating surface of the Peltier unit 46. The radiation fins 47 promote the radiation of heat from the heat radiating surface of the Peltier unit 46.

[0026] The heat radiating surface of the Peltier unit 46 and the radiation fins 47 are arranged at the branched portion 43a of the main air stream passage 33 and the sub-air stream passage 43. This increases the amount of the air stream that comes into contact with the radiation fins 47 and thereby promotes the radiation of heat from the heat radiating surface of the Peltier unit 46. The radiation fins 47 may be reduced in size. By promoting the radiation of heat from the heat radiating surface, the cooling of the cooling surface of the Peltier unit 46 is promoted. In this embodiment, the radiation of heat from the heat radiating surface (radiation fins 47) is promoted to promote the cooling of the discharge electrode 44 with the Peltier unit 46.

[0027] In the electrostatic atomization mechanism 42, dew condenses on the surface of the discharge electrode 44 when the discharge electrode 44 is cooled by the Peltier unit 46. When high voltage is applied between the discharge electrode 44 and the opposing electrode 45, the water condensed at the surface of the discharge electrode 44 undergoes a Rayleigh breakup and becomes electrostatically atomized. This generates small-diameter droplet mist. The size of the small-diameter droplet mist may be about one to several tens of nanometers and is known to apply moisture and elasticity to the human skin when permeating the voids in the corneum surface of the human body.

[0028] The electrostatic atomization mechanism 42 is covered by a sound deadening material holder 48 attached to the air pipe 30. The sound deadening material holder 48 includes a cylindrical holding portion 48a extending toward the front (small-diameter droplet mist emission port 14). A small-diameter droplet mist pipe 49, which is substantially cylindrical, is arranged in the holding portion 48a. The small-diameter droplet mist pipe 49 includes a basal end connected to the electrostatic atomization mechanism 42 and a distal end connected to the small-diameter droplet mist emission port 14. The small-diameter droplet mist pipe 49 guides the small-diameter droplet mist generated in the electrostatic atomization mechanism 42 to the small-diameter droplet mist emission port 14. The small-diameter droplet mist generated in the electrostatic atomization mechanism 42 mixes with the air stream passing through the sub-air stream passage 43 in the discharge area between the electrodes 44 and 45 and then passes through the small-diameter droplet mist pipe 49 to be emitted from the small-diameter droplet mist emission port 14. In this embodiment, the small-diameter droplet mist emission port 14, the electrostatic atomization mechanism 42, and the small-diameter droplet mist pipe 49 form a small-diameter droplet mist emission unit.

[0029] A substantially cylindrical sound deadening member 50, which is formed from a foam rubber, is press-fitted between the holding portion 48a of the sound deadening material holder 48 and the small-diameter droplet mist pipe 49. The sound deadening member 50 reduces the leakage of discharge noise produced by the discharge electrode 44 and the opposing electrode 45. The sound deadening member 50 has an inner end and an outer end that are in close contact with the small-diameter droplet mist pipe 49 and the inner surface of the housing 12. The sound deadening member 50 has an outer surface, which is in close contact with the inner surface of the holding portion 48a of the sound deadening material holder 48. The sound deadening member 50 thus fills the gap communicating the small-diameter droplet mist emission port 14 and the interior of the housing 12 (portion other than the flow passage through which the air stream and the mist pass) near the small-diameter droplet mist emission port 14. When the fan motor 32 is driven and the pressure in the housing 12 is thereby decreased, the sound deadening member 50 prevents air from being drawn into the housing 12 through the small-diameter droplet mist emission port 14. This prevents a reversed flow or scattering of the small-diameter droplet mist. In this embodiment, the sound deadening member 50 also functions as a reversed flow prevention member.

[0030] The operation of the cosmetic device 11 in this embodiment will now be discussed.

[0031] The water storage tank 16 supplies water to the boiler chamber 21 of the warm mist generation mechanism 20. The heater 22 heats and boils the water to generate the large-diameter droplet mist. As shown in Figs. 3 and 4, the large-diameter droplet mist is guided from the boiler chamber 21 to the corrugated member 25 through the mist supply passage 26, as indicated by the arrow M1.

[0032] In Figs. 3 and 4, the air stream generated by the fan motor 32 flows through the main air stream passage 33 and is discharged (ejected) from the air discharge port 30c, as indicated by the arrow A1. The air stream discharged from the air discharge port 30c produces a Venturi effect and generates negative pressure at the elongated narrow inlet 34 formed around the air discharge port 30c. The large-diameter droplet mist guided into the corrugated member 25 (mist supply passage 26) is forcibly drawn out of the mixing portion 35 by the negative pressure generated at the elongated narrow inlet 34 (as indicated by the arrow M2 in Fig. 4). The large-diameter droplet mist and the air stream are then mixed in the mixing portion 35 and emitted out of the housing 12 (cosmetic device 11) from the large-diameter droplet mist emission port 13. In this manner, the air stream discharged from the air discharge port 30c is mixed with the large-diameter droplet mist drawn from the elongated narrow inlet 34. The flow velocity of the large-diameter droplet mist passing through the elongated narrow inlet

34 increases. This prevents dew condensation at the vicinity of the elongated narrow inlet 34.

[0033] The elongated narrow inlet 34 extends continuously around the entire circumference of the air discharge port 30c. This uniformly delivers the large-diameter droplet mist around the air stream discharged from the air discharge port 30c. Thus, the air stream discharged from the air discharge port 30c and the large-diameter droplet mist are uniformly mixed in the mixing portion 35 and then emitted from the large-diameter droplet mist emission port 13.

[0034] The large-diameter droplet mist guided from the warm mist generation mechanism 20 is diffused when striking the annular flange 30a projecting from the outer surface of the air pipe 30. Thus, the large-diameter droplet mist accumulates in the corrugated member 25 (mist supply passage 26) and is drawn out of the elongated narrow inlet 34 and into the mixing portion 35 after its temperature slightly decreases. In other words, the large-diameter droplet mist having a relatively high temperature and generated in the warm mist generation mechanism 20 is not directly drawn out of the elongated narrow inlet 34.

[0035] Some of the air stream passing through the main air stream passage 33 is guided into the sub-air stream passage 43 by the air guide 40 (as indicated by the arrow A2 in Fig. 6 and the arrow A4 in Fig. 5). The sub-air stream passage 43 guides the air stream to the discharge area between the discharge electrode 44 and the opposing electrode 45 of the electrostatic atomization mechanism 42. The electrostatic atomization mechanism 42 generates the small-diameter droplet mist, which is mixed with the air stream. The small-diameter droplet mist and the air stream then pass through the small-diameter droplet mist pipe 49 and are emitted out of the housing 12 (cosmetic device 11) from the small-diameter droplet mist emission port 14 (as indicated by the arrow A3 in Figs. 4 and 6).

[0036] The present embodiment has the advantages described below.

(1) The branched portion 43a (air guide 40) delivers to the sub-air stream passage 43 an air stream of which flow rate is lower than the flow rate of the air stream delivered to the main air stream passage 33. Thus, most of the air stream from the fan motor 32 is delivered to the mixing portion 35, in which the air discharge port 30c opens. In this manner, the large-diameter droplet mist, which has a relatively high temperature, is cooled when mixing with the air stream, which is delivered to the mixing portion 35 with an increased flow rate, and emitted from the large-diameter droplet mist emission port 13.

(2) The branched portion 43a (air guide 40) delivers to the sub-air stream passage 43 an air stream of which flow rate is lower than the flow rate of the air stream delivered to the main air stream passage 33. Thus, the small-diameter droplet mist generated between the electrodes 44 and 45 in the electrostatic atomization mechanism 42 is stably emitted from the small-diameter droplet mist emission port 14 without being scattered by the air stream from the sub-air stream passage 43.

(3) The branched portion 43a delivers (distributes) most of the air stream from the fan motor 32 to the mixing portion 35 and a small amount of the air stream to the electrostatic atomization mechanism 42. Compared to when delivering uniform air streams, the fan may be reduced in size, the space occupied by the fan may be decreased, and the manufacturing cost of the cosmetic device 11 may be lowered.

(4) The mist supply passage 26 extends around the main air stream passage 33. The large-diameter droplet mist in the mist supply passage 26 is cooled through the wall surface of the air pipe 30 by the low temperature air stream passing through the main air stream passage 33. This increases the cooling efficiency of the large-diameter droplet mist. The air discharge port 30c of the main air stream passage 33 and the elongated narrow inlet 34 of the mist supply passage 26 are arranged at locations close to each other.

(5) The air discharged from the air discharge port 30c and the large-diameter droplet mist drawn from the elongated narrow inlet 34 are mixed in the mixing portion 35 and then emitted from the large-diameter droplet mist emission port 13. This emits an air stream uniformly mixed with the large-diameter droplet mist. Accordingly, the cooling of the large-diameter droplet mist is promoted, and non-uniform cooling of the large-diameter droplet mist (the occurrence of temperature differences) is suppressed.

(6) The elongated narrow inlet 34 (opening of mist supply passage 26) extends continuously around the entire circumference of the air discharge port 30c. This uniformly mixes the large-diameter droplet mist with the air stream discharged from the air discharge port 30c from around the air stream. In other words, by discharging (supplying) the air stream from the inside of the large-diameter droplet mist, the air stream discharged from the air discharge port 30c and the large-diameter droplet mist are easily mixed.

(7) The opening of the mist supply passage 26 is the elongated narrow inlet 34, or elongated narrow gap. Thus, the air stream discharged from the air discharge port 30c produces a Venturi effect that generates negative pressure at the elongated narrow inlet 34. This draws large-diameter droplet mist out of the mist supply passage 26 and into the mixing portion 35. Accordingly, the mixing of the air stream discharged from the air discharge port 30c with the large-diameter droplet mist is promoted.

(8) Since the elongated narrow inlet 34 function as the opening of the mist supply passage 26, the dew that condenses in the mist supply passage 26 does

not enter the air discharge port 30c (main air stream passage 33). Furthermore, even if the cosmetic device 11 were to be tilted, the high temperature water in the boiler chamber 21 would be prevented from flowing out of the large-diameter droplet mist emission port 13.

(9) The sound deadening member 50 is arranged in the small-diameter droplet mist emission port 14. This prevents a reversed flow of the small-diameter droplet mist from the small-diameter droplet mist emission port 14 even when the interior of the housing 12 is depressurized by driving the fan motor 32.

(10) The heat radiating surface (radiation fins 47) of the Peltier unit 46 is arranged in the main air stream passage 33 (air pipe 30). Thus, the air stream passing through the main air stream passage 33 promotes the radiation of heat from the heat radiating surface (radiation fins 47) of the Peltier unit 46. Since the heat of the radiation fins 47 is radiated by the air stream passing through the main air stream passage 33, a separate and exclusive fan for sending air to the radiation fins 47 is not necessary.

[0037] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the scope of the invention. Particularly, it should be understood that the present invention may be embodied in the following forms.

[0038] The radiation fins 47 may be arranged closer to the fan motor 32, that is, at the upstream side of the branched portion 43a of the main air stream passage 33 and the sub-air stream passage 43. This would increase the amount of air stream that comes into contact with the radiation fins 47.

[0039] The heat radiating surface of the Peltier unit 46 may be arranged so as only contact the outer surface of the air pipe 30 instead of being arranged so as to be inserted into the main air stream passage 33 from the attachment hole 41. Such a structure would also radiate heat from the heat radiating surface of the Peltier unit 46 through the air pipe 30 with the air stream passing through the main air stream passage 33. In this case, the air pipe 30 may entirely be formed by a metal having a superior heat transfer property, and the radiation fins 47 may be eliminated.

[0040] The radiation fins 47 may be eliminated. Such a structure would also radiate heat from the heat radiating surface of the Peltier unit 46 with the air stream passing through the main air stream passage 33.

[0041] The annular flange 30a may be eliminated. Such a structure would also deliver the large-diameter droplet mist from the mist supply passage 26 to the mixing portion 35.

[0042] The main air stream passage 33 may be arranged so as to surround the mist supply passage 26. Such a structure would also cool the large-diameter droplet mist in the mist supply passage 26 with the main air stream passage 33 (air pipe 30) through which the air stream having a temperature lower than the large-diameter droplet mist flows. Further, the air discharge port 30c and the elongated narrow inlet 34 may be arranged near each other. In other words, one of the main air stream passage 33 and the mist supply passage 26 may be arranged to surround the other one.

[0043] The air discharge port 30c may be arranged to surround a discharge port for discharging the large-diameter droplet mist out of the mist supply passage 26 and into the mixing portion 35. Such a structure would also mix the large-diameter droplet mist with the air stream discharged out of the air discharge port 30c from the inner side of the air stream. This uniformly mixes the air stream, which is discharged from the air discharge port 30c, with the large-diameter droplet mist.

[0044] It is preferable that the opening of the mist supply passage 26 be the elongated narrow inlet 34, which is an elongated narrow gap. However, an enlarged gap may be used in lieu of an elongated narrow gap. Such a structure would also mix the large-diameter droplet mist with the air stream, which is discharged from the air discharge port 30c, from around the air stream.

[0045] The gap communicating the small-diameter droplet mist emission port 14 and the interior of the housing 12 is filled with the sound deadening member 50. Instead, the gap may be filled with an O-ring or a packing, which is discrete from the sound deadening member 50. However, by filling the gap with the sound deadening member 50, there would be no need for a discrete component to fill the gap, and the number of components can be reduced.

[0046] The corrugated member 25 is formed from a flexible material such as silicone rubber. Instead, the corrugated member 25 may be formed from plastic or metal.

[0047] The mist guide 12d and the free end of the air pipe 30 need be cylindrical as long as they have conforming shapes. For example, the free end of the air pipe 30 and the mist guide 12d may be formed to have the shape of a polygonal or elliptical tube.

[0048] It is preferable that the elongated narrow inlet 34 extend continuously around the entire circumference of the air discharge port 30c. However, the elongated narrow inlet 34 may have any other form. For example, a plurality of elongated narrow inlets 34 may be arranged at equal intervals around the air discharge port 30c. Alternatively, the elongated narrow inlet 34 may be formed by fine holes formed at the wall surface on the free end of the air pipe 30. Such a structure would also mix the large-diameter droplet mist with the air stream passing through the main air stream passage 33.

[0049] The free end of the air pipe 30 may be spaced apart from the mist guide 12d such that the air pipe 30 is not inserted in the mist guide 12d. In such a case, the distance between the free end of the air pipe 30 and the open end of the mist guide 12d is set so as to form the elongated narrow inlet 34 between the ends. Such a structure would also mix the air stream discharged from the air discharge port 30c with the large-diameter droplet mist delivered through the mist supply passage 26 and emit the mixed air stream and large-diameter droplet mist from the large-diameter droplet mist emission port 13.

[0050] The warm mist generation mechanism 20 generates the large-diameter droplet mist with the heater 22. However, the large-diameter droplet mist may be generated by a different mechanism. For example, ultrasonic waves or a humidifier element may be used. In such a case, a separate heater may be used to heat the generated large-diameter droplet mist and generate warm mist.

Claims

1. A mist generator device (11) including:

   a large-diameter droplet mist generation unit (20) which generates heated large-diameter droplet mist from a liquid;
   a small-diameter droplet mist generation unit (42) which generates small-diameter droplet mist smaller than the large-diameter droplet mist by performing electrostatic atomization;
   a main air stream passage (33) through which an air stream produced by a fan (32) passes; and
   a sub-air stream passage (43) branched from the main air stream passage (33); the mist generator device being **characterized by**:

      a branched portion (43a, 40) which branches the sub-air stream passage (43) from the main air stream passage (33) and delivers to the sub-air stream passage (43) an air stream having a flow rate lower than that of the air stream in the main air stream passage (33);
      a large-diameter droplet mist emission unit (13, 35) which emits the large-diameter droplet mist generated in the large-diameter droplet mist generation unit (20) out of the mist generator device; and
      a small-diameter droplet mist emission unit (14, 42, 49) which emits the small-diameter droplet mist generated in the small-diameter droplet mist generation unit (42) out of the mist generator device;

   wherein the large-diameter droplet mist emission unit (13, 35) is arranged in the main air stream passage (33) downstream from the branched portion (43a, 40), and the small-diameter droplet mist emission unit (14, 42, 49) is arranged downstream from the sub-air stream passage (43).

2. The mist generator device (11) according to claim 1, being **characterized by**:

   a mist supply passage (23, 24, 25, 26) which supplies the large-diameter droplet mist generated in the large-diameter droplet mist generation unit (20) to the large-diameter droplet mist emission unit (13, 35);

   wherein the main air stream passage (33) and the mist supply passage (23, 24, 25, 26) form a double-pipe structure in which one of the main air stream passage (33) and the mist supply passage (23, 24, 25, 26) surrounds the other one.

3. The mist generator device (11) according to claim 2, being **characterized in that:**

   the mist supply passage (23, 24, 25, 26) is arranged to surround the main air stream passage (33).

4. The mist generator device (11) according to any one of claims 1 to 3, being **characterized in that:**

   the large-diameter droplet mist emission unit (13, 35) includes a mixing portion (35) which mixes the air stream passing through the main air stream passage (33) with the large-diameter droplet mist.

5. The mist generator device (11) according to claim 4, being **characterized by**:

   a large-diameter droplet mist outlet (34) which draws the large-diameter droplet mist from the mist supply passage into the mixing portion (35) and surrounds an air discharge port (30c) that draws the air stream from the main air stream passage (33) into the mixing portion (35).

6. The mist generator device (11) according to claim 5, being **characterized in that:**

   the large-diameter droplet mist outlet (34) has a cross-section that is smaller than that of the air discharge port (30c).

7. The mist generator device (11) according to any one of claims 1 to 6, being **characterized by**:

   a reversed flow prevention member (50) which is arranged in an emission port (14) of the small-diameter droplet mist emission unit (14, 42, 49) and prevents a reversed flow of the small-diameter droplet mist.

8. The mist generator device (11) according to any one of claims 1 to 7, being **characterized in that:**

   the small-diameter droplet mist generation unit

(42) includes an electrode (44), to which high voltage is applied, and a Peltier unit (46), which cools the electrode (44); and
the Peltier unit (46) includes a heat radiating surface (47) exposed to the main air stream passage (33).

9. The mist generator device (11) according to claim 5, being **characterized in that:**

the air discharge port (30c) is circular; and
the large-diameter droplet mist outlet (34) is an annular slit.

Fig.1

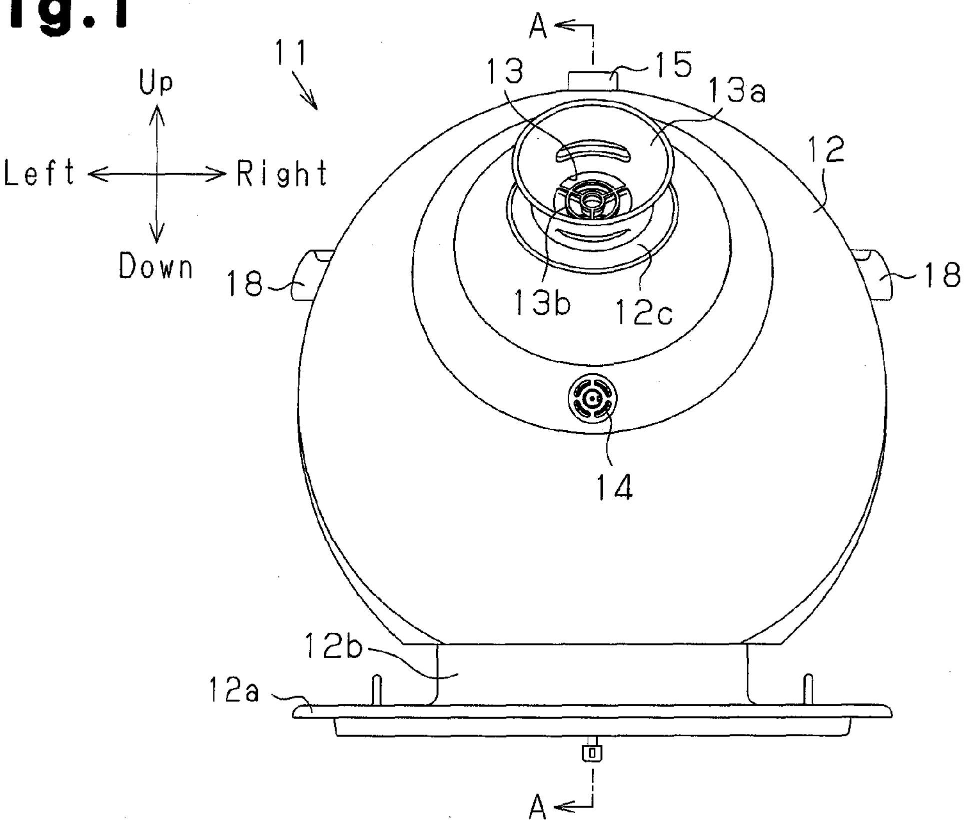
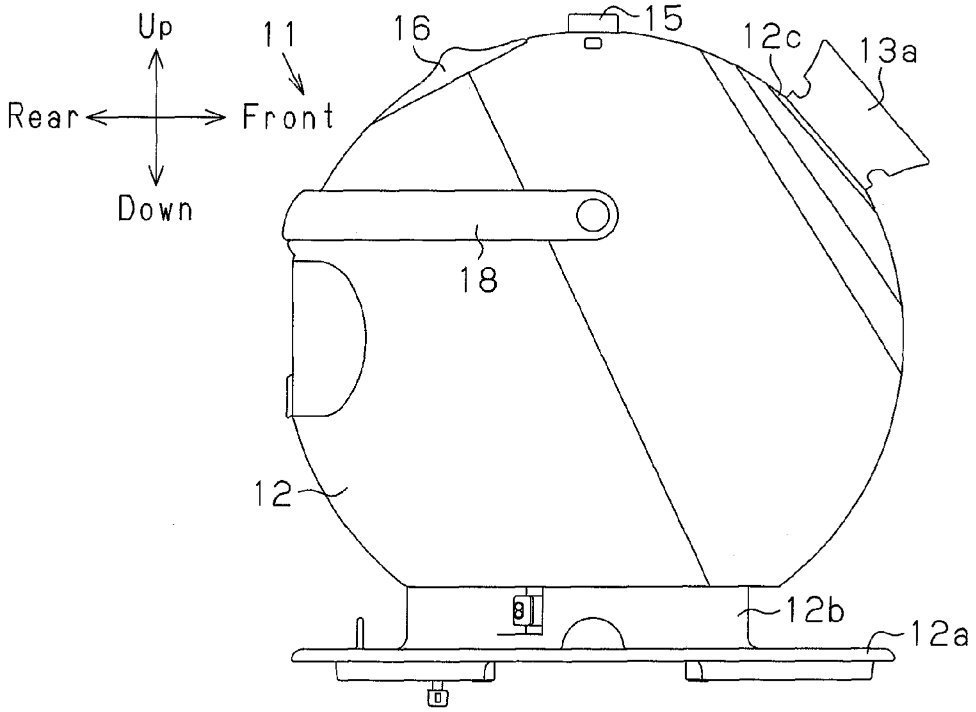

A
11
Up
Left
Right
Down
13
15
13a
12
18
18
13b
12c
14
12b
12a
A

Fig.2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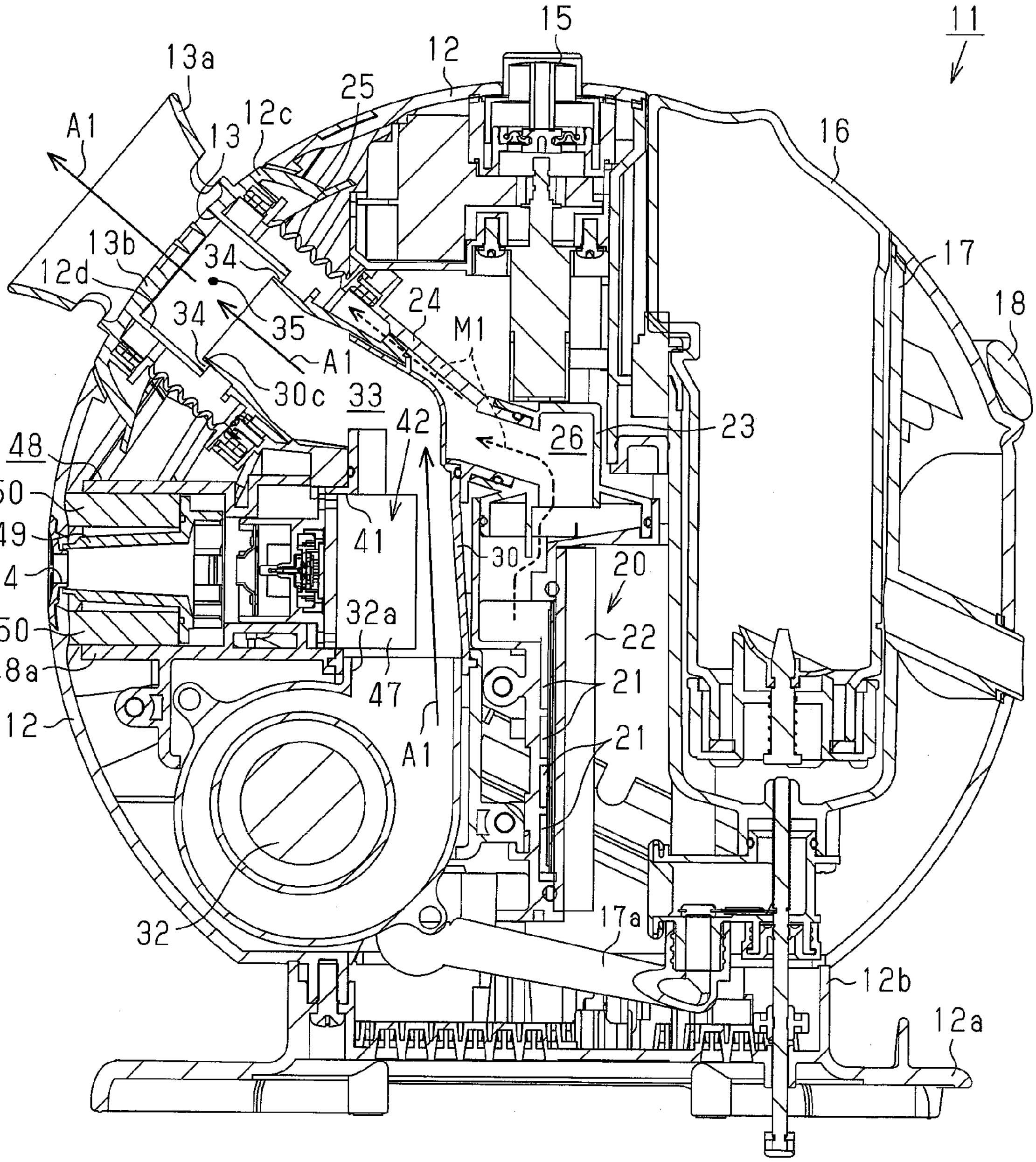
16
15
12c
13a
Rear
Front
Down
18
12
12b
12a

Fig.3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25
12c
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A1
16
17
18
13b
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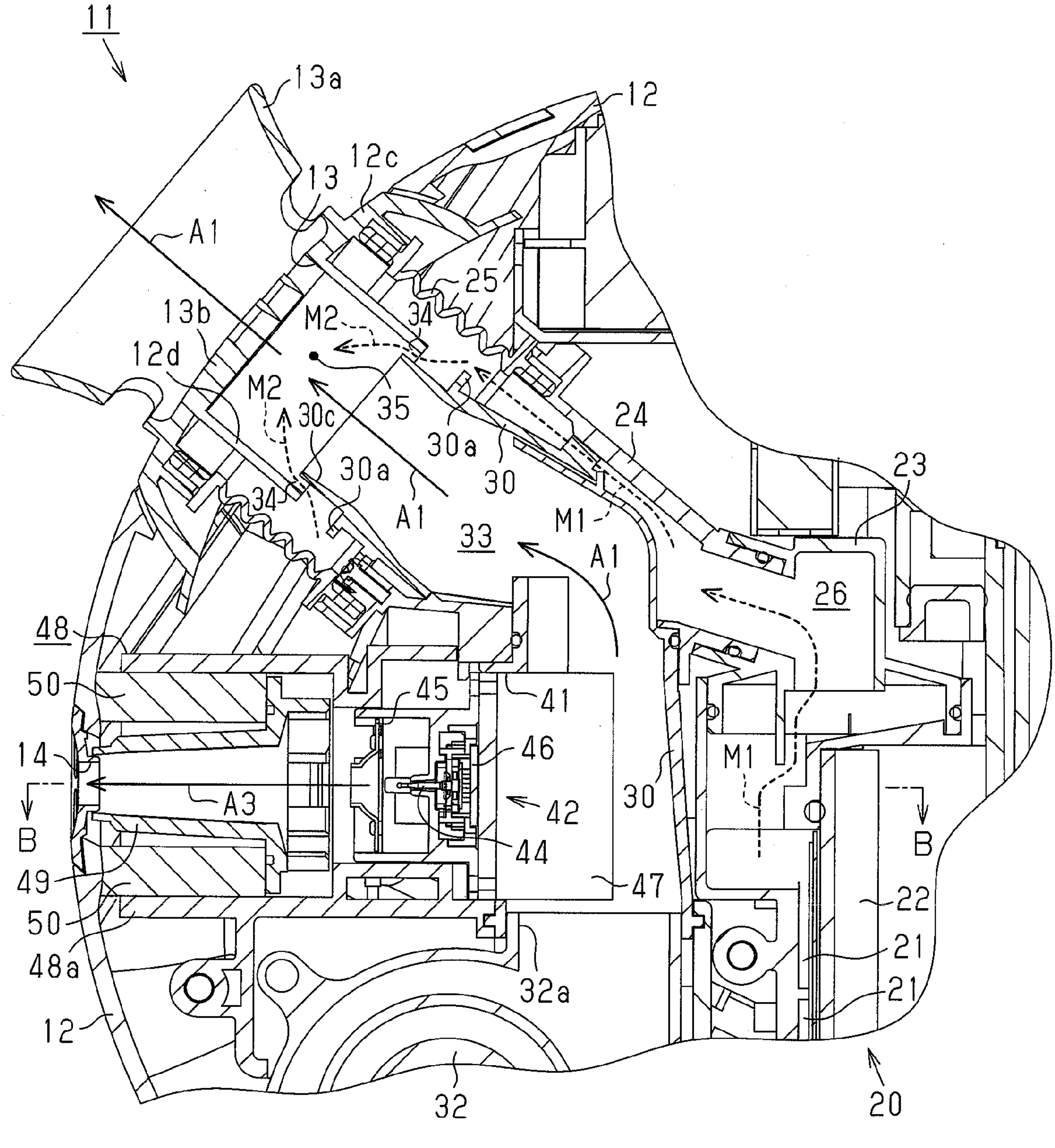
12d
35
24
34
M1
A1
30c
33
23
42
26
48
50
49
41
30
20
14
32a
22
50
48a
47
21
12
A1
21
32
17a
12b
12a

Fig.4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12c
13
A1
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13b
M2
34
12d
M2
35
30c
30a
24
30a
30
23
34
A1
M1
33
A1
26
48
50
45
41
46
14
A3
42
30
M1
B
B
44
49
47
22
50
21
48a
32a
21
12
32
20

Fig.5

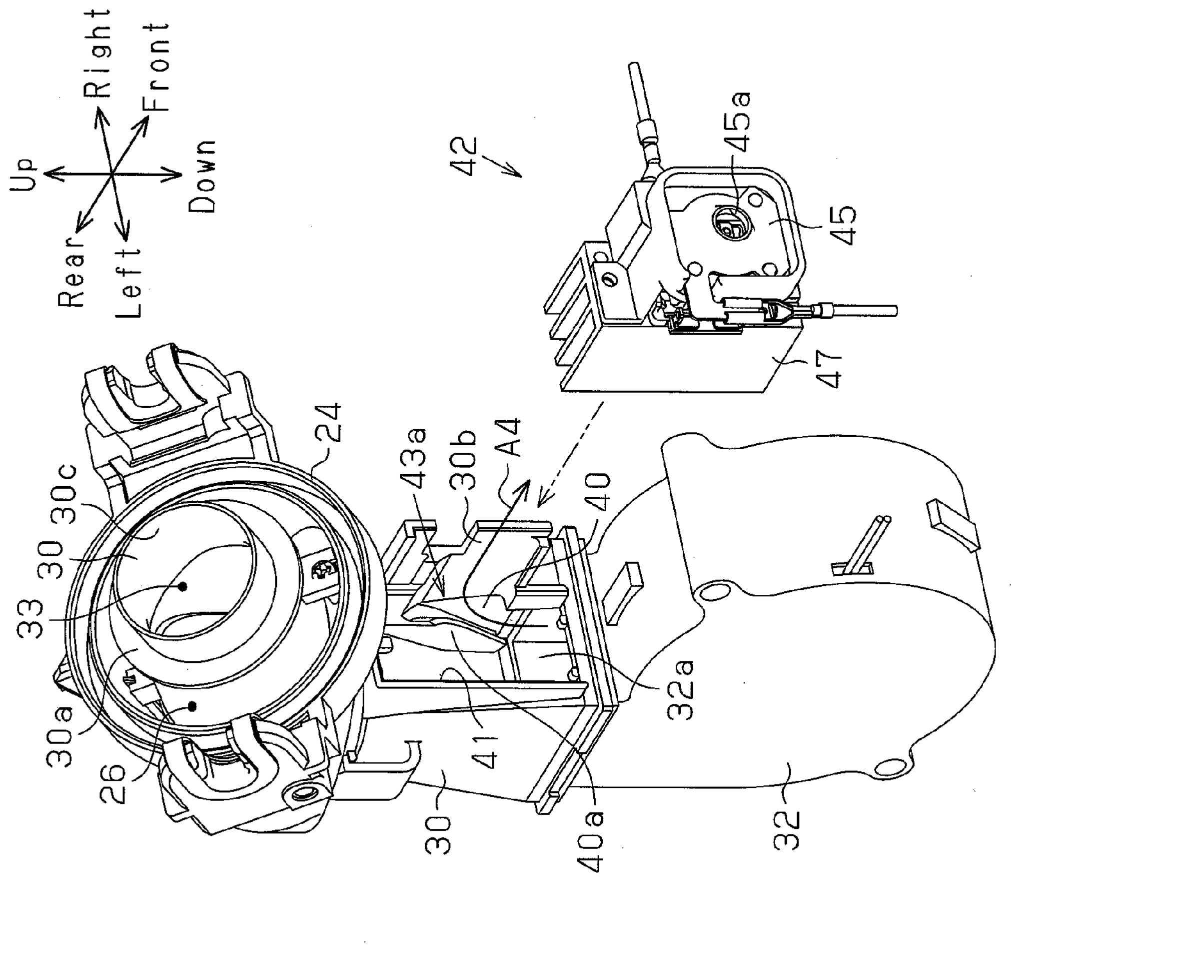
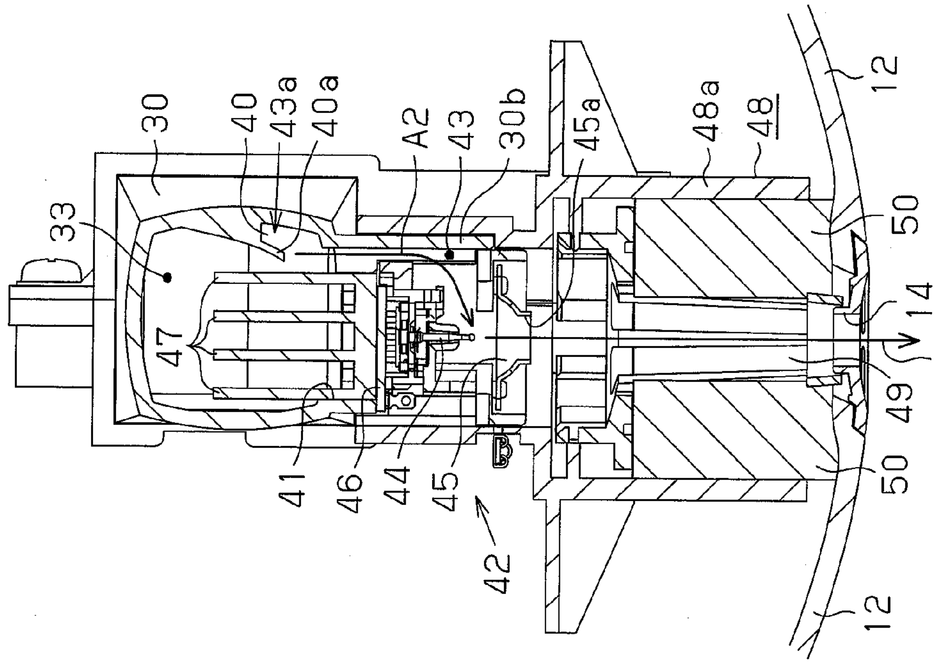

Up
Down
Right
Left
Front
Rear
24
30c
30
33
30a
26
30
41
40a
43a
30b
A4
40
32a
32
42
45a
45
47

Fig.6


33
30
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43a
40a
A2
43
30b
45a
48a
48
12
50
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A3
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50
12
47
41
46
44
45
42

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EUROPEAN SEARCH REPORT

Application Number
EP 09 16 4758

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F24F
A61H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 October 2009	Decking, Oliver

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19-10-2009

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