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(54) **Vaporizing humidifier**

Verdunstungsbefeuchter

Humidificateur à vaporisation

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(56) References cited:
WO-A1-2009/070902

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Description

[TECHNICAL FIELD]

[0001] The present invention relates to a vaporizing humidifier that humidifies air by passing it through a humidifying filter wet with water, and discharges the humidified air to the outside.

[BACKGROUND ART]

[0002] This type of vaporizing humidifier generally has a reservoir for storing water, a humidifying filter disposed inside the reservoir, a blowing fan for drawing in air from the outside, passing the drawn-in air through the humidifying filter, and discharging the air that was humidified by the humidifying filter to the outside, and a motor for rotating the blowing fan.

[0003] Since the humidifying filter is disposed inside the reservoir filled with water, the water in the reservoir is drawn up by the capillary action of the humidifying filter, and the humidifying filter becomes damp with water. The air drawn in by the blowing fan is humidified as it passes through the humidifying filter, and then is discharged to the outside, and thus the humidifying filter loses moisture.

[0004] The humidifying filter that lost moisture draws up more of the water in the reservoir, and thus the amount of water in the reservoir gradually decreases. The humidifying filter becomes dry when the water in the reservoir is completely gone, and the humidification ability is lost when the humidifying filter becomes dry. For this reason, it is necessary to replenish the water in the reservoir and dampen the humidifying filter before the humidifying filter loses its humidification ability.

[0005] In order to replenish the water in the reservoir and dampen the humidifying filter, there is a type of conventional humidifier in which a separate water storage tank is provided, and water is successively supplied from the water storage tank to the reservoir when the amount of water in the reservoir becomes low, and also a type of conventional humidifier in which a water filling opening is provided, and the water in the reservoir is directly replenished from the outside via the water filling opening when the amount of water becomes low.

[0006] With the type of humidifier in which a separate water storage tank is provided, there is no need to worry about water replenishment as long as water remains in the water storage tank, but the water storage tank will eventually run out of water if the humidifier is operated, and therefore the water in the water storage tank will need to be replenished at some point in time.

[0007] When replenishing the water in the water storage tank of this type of humidifier, it is necessary to remove the water storage tank from the humidifier, fill it with water, and then again set the water storage tank in the humidifier. However, this task is troublesome. Also, since the water storage tank filled with water is quite heavy, this task is difficult for someone who is not strong.

[0008] The above-described problem does not occur with the type of humidifier in which a water filling opening is provided, and the water in the reservoir is directly replenished from the outside via the water filling opening.

5 However, with this type of humidifier, the water filling opening is provided at a location that avoids the blowing fan, the motor, and the electrical system, and therefore it is difficult to form a large water filling opening, and the water filling opening ends up being small.

10 **[0009]** If the water filling opening is small, there is the risk of accidentally spilling water around the water filling opening and getting the floor wet during filling, and in the worst case, there is the risk of getting the motor or electrical system wet and causing a malfunction. It is therefore necessary to replenish the water while taking care to not spill water around the water filling opening, and thus water replenishment has been difficult.

[PRIOR ART DOCUMENT]

20 **[0010]** WO 2009/070902 (A1) describes an air humidifier with a two-part housing, which comprises inlet and outlet openings for the air, a fan, a water tank, air ducts, and a humidification mat. A central pouring funnel having a central opening for pouring in water is provided. WO 2009/070902 (A1) thereby describes an air humidifier according to the preamble of claim 1.

[PATENT DOCUMENT]

[0011]

[Patent Document 1] JP 2012-207863A

[Patent Document 1] JP 2008-082560A

35 [Patent Document 1] JP 2006-003042A

[SUMMARY OF THE INVENTION]

[TECHNICAL PROBLEM]

40 **[0012]** A problem to be solved by the present invention is to improve the ease of filling a water reservoir in a humidifier. Further, aspects of the invention seek to solve the problem that it has not been possible to form a large water filling opening for replenishing the water in the reservoir.

[MEANS FOR SOLVING THE PROBLEM]

50 **[0013]** The most important feature of the present invention is that, in order to make it possible to form a large water filling opening for replenishing the water in the reservoir, the motor is covered with a convex or dome-shaped upper cover, a peripheral gutter is formed so as to extend along the peripheral portion of the upper cover, intersecting gutters are formed so as to extend outward from the peripheral gutter and intersect the flow of the air that is to be discharged to the outside, and a water chan-

nel is formed so as to extend from the intersecting gutters to the reservoir.

[ADVANTAGEOUS EFFECTS OF THE INVENTION]

[0014] With the vaporizing humidifier of the present invention, the upper cover for the motor also serves as the water filling opening, thus making it possible to form a large water filling opening in the central region of the upper portion of the humidifier, and an advantage of the vaporizing humidifier of the present invention is that it is possible to form a large water filling opening and easily replenish the water in the reservoir.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0015]

[FIG. 1] FIG. 1 is a perspective view in which the upper outer shell of a vaporizing humidifier according to an embodiment of the present invention has been removed.

[FIG. 2] FIG. 2 is an exploded perspective view of the vaporizing humidifier according to an embodiment of the present invention.

[FIG. 3] FIG. 3 is a plan view of the vaporizing humidifier according to an embodiment of the present invention.

[FIG. 4] FIG. 4 is a cross-sectional diagram viewed along arrows A-A in FIG. 3.

[FIG. 5] FIG. 5 is an enlarged view of a main portion in FIG. 4.

[FIG. 6] FIG. 6 is a side view of the vaporizing humidifier according to an embodiment of the present invention.

[FIG. 7] FIG. 7 is a cross-sectional diagram viewed along arrows B-B in FIG. 6.

[MODE FOR CARRYING OUT THE INVENTION]

[0016] The object of making it possible to form a large water filling opening and easily replenish the water in the reservoir has been realized within the limited size of the humidifier, without impairing the humidifying function and blowing function.

[Embodiment 1]

[0017] FIG. 1 is a perspective view in which the upper outer shell of a vaporizing humidifier according to an embodiment of the present invention has been removed, FIG. 2 is an exploded perspective view of the vaporizing humidifier according to an embodiment of the present invention, FIG. 3 is a plan view of the vaporizing humidifier according to an embodiment of the present invention, FIG. 4 is a cross-sectional diagram viewed along arrows A-A in FIG. 3, and FIG. 5 is an enlarged view of a main portion in FIG. 4.

[0018] In these drawings, 10 indicates a humidifier according to an embodiment of the present invention, and the humidifier 10 is shaped as a vase. Also, 12 indicates a lower outer shell that forms the outer shell of the lower portion of the humidifier 10, and the lower outer shell 12 is shaped as the lower portion of a vase, that is to say shaped as a bowl.

[0019] Weight sensors and a control device that obtains a weight from the output of the weight sensors are provided on the bottom of the inner portion of the lower outer shell 12. Three of such weight sensors are provided horizontally at the vertex positions of an equilateral triangle, and a placing plate is placed evenly and horizontally on the weight sensors. In other embodiments a different number of weight sensors may be provided, for example, a single sensor, or a plurality (2, 4 or more) of sensors. An inlet 14 made up of a large number of vertical holes is provided over the entire circumference of the lower side of the lower outer shell 12. Also, a humidity sensor, a power switch, and an audio generation device (e.g., a speaker, buzzer, or bell) are attached to the lower outer shell 12.

[0020] A bowl-shaped reservoir 16 that is slightly smaller than the lower outer shell 12 is placed on the placing plate and stored inside the lower outer shell 12. A humidifying filter 22 shaped as a hollow column is provided upright on the bottom of the inner portion of the reservoir 16. The humidifying filter 22 is made of a hydrophilic porous material such as paper or non-woven cloth. If water is inside the reservoir 16, the humidifying filter 22 becomes damp with the water.

[0021] The upper end portion of the humidifying filter 22 is fixed to the upper edge portion of the reservoir 16 by a humidifying filter lock 24. Inside the humidifying filter 22, an antibacterial pellet portion 18 that generates silver ions so as to suppress the breeding of bacteria in the water in the reservoir 16 is attached to the central portion of the bottom portion of the reservoir 16. A bactericidal enzyme filter 26 that kills bacteria in outside air that has been drawn in is attached above the humidifying filter lock 24.

[0022] A lower partition wall 28, which has a recess in its upper surface which is concave towards a hole in the central portion, specifically which is shaped as an upside-down umbrella and has a hole in the central portion, is provided coaxially above the lower outer shell 12 and the reservoir 16, and the space between the lower outer shell 12 and the humidifying filter 22 is separated from the space above it by the lower partition wall 28.

[0023] An upper partition wall 30, which also has a recess in its upper surface which is concave towards a hole in the central portion, specifically which is shaped as an upside-down umbrella and has a hole in the central portion, is provided coaxially above the lower partition wall 28 with a gap of a predetermined length from the lower partition wall 28, and the gap formed between the lower partition wall 28 and the upper partition wall 30 forms a water channel 32. The water channel 32 extends down-

ward from the lower outer shell 12 toward the reservoir 16, that is to say toward the center of the lower partition wall 28. The diameters of the holes formed in the central portions of the lower partition wall 28 and the upper partition wall 30 are approximately the same as the diameter of the humidifying filter 22.

[0024] In the space above the upper partition wall 30, a blowing fan 34 is provided coaxially with the humidifying filter 22, directly above the humidifying filter 22, and a motor 36 is attached coaxially with the blowing fan 34 and above the blowing fan 34. A display unit 40, which is constituted by an organic EL display, and a control device 38 that controls the motor 36 and other electronic devices are provided above the motor 36. The display unit 40 is connected to the control device 38, and information output from the control device 38 is displayed on the display unit 40.

[0025] The motor 36, the control device 38, and the display unit 40 are covered by a dome-shaped upper cover 42. The upper cover 42 is made of transparent plastic, thus allowing viewing of the display of the display unit 40. A ring-shaped peripheral gutter 44 is formed so as to extend along the peripheral portion of the upper cover 42 in a turned-up manner, and a rising portion 46 is formed so as to extend upward on the upper edge of the peripheral gutter 44.

[0026] The rising portion 46 is ring-shaped, the upper edge of the rising portion 46 is formed so as to be higher than the central portion of the upper cover 42, and a water filling opening 48 is formed by the rising portion 46. The water filling opening 48 is formed with a diameter that is much larger than the diameter of the water filling opening of conventional humidifiers. Multiple intersecting gutters 50 in communication with the peripheral gutter 44 are provided on the outer side of the peripheral gutter 44 in a radiating manner so as to intersect the flow of air that is to be discharged to the outside, and the tip portions of the intersecting gutters 50 are connected to the upstream side of the water channel 32, that is to say the lower outer shell 12 side of the partition walls 28 and 30.

[0027] An upper outer shell 52 is connected above the lower outer shell 12 so as to enclose the blowing fan 34, the motor 36, and the other members in the space above the upper partition wall 30. A control ring 54 is attached to the upper end portion of the upper outer shell 52. A Hall IC, a roller, and a switch are attached to the upper end portion of the upper outer shell 52, a magnet is attached to the control ring 54, and the humidifier can be operated by rotating or pushing the control ring 54.

[0028] A ring-shaped air discharge opening 56 is formed between the upper edge portion of the rising portion 46 and the control ring 54. The upper outer shell 52 and the control ring 54 are shaped as the upper portion of a vase, and an overall vase shape is formed by the upper outer shell 52, the control ring 54, and the lower outer shell 12.

[0029] Next, the flow of air flowing through the humidifier and the mechanism by which flowing air is humidified

will be described with reference to FIG. 7. The bold arrows in FIG. 7 indicate the flow of air.

[0030] First, when the power is switched on by pressing the power switch provided on the lower outer shell 12, the motor 36 rotates, and the blowing fan 34 rotates. When the blowing fan 34 rotates, air in the space inside the humidifying filter 22 is drawn in by the blowing fan 34, and the pressure in the space inside the humidifying filter 22 decreases.

[0031] When the pressure in the space inside the humidifying filter 22 decreases, air in the space outside the humidifying filter 22 is drawn into the space inside the humidifying filter 22, and the pressure in the space outside the humidifying filter 22 decreases. When the pressure in the space outside the humidifying filter 22 decreases, outside air is drawn into the lower outer shell 12 through the inlet 14. The outside air that entered the lower outer shell 12 passes through the enzyme filter 26 and enters the space outside the humidifying filter 22. The outside air is sterilized by the enzymes attached to the enzyme filter.

[0032] The outside air that entered the space outside the humidifying filter 22 passes through the humidifying filter 22 and enters the humidifying filter 22. If water is inside the reservoir 16, the humidifying filter 22 is damp with the water inside the reservoir 16, and therefore the outside air is humidified by the humidifying filter 22 and rises in humidity.

[0033] The air that entered the humidifying filter 22 and rose in humidity is drawn in by the blowing fan 34 and discharged toward the space between the upper partition wall 30 and the upper cover 42. This air then moves along the upper partition wall 30 and the upper outer shell 52, reaches the air discharge opening 56, and is discharged upward from the air discharge opening 56.

[0034] Next, a procedure in the case where the amount of water in the reservoir 16 of the humidifier is low and water is poured into the water filling opening of the humidifier, and the flow of the poured water will be described with reference to FIGS. 4 and 5. The bold arrows in FIG. 4 indicate the flow of water.

[0035] First, the amount of water in the reservoir 16 is obtained by the weight sensors and the control device at the bottom of the interior of the humidifier 10, and the obtained water amount is displayed on the display unit 40. The person managing the humidifier 10 looks at the water amount displayed on the display unit 40 and determines whether or not the water needs to be replenished.

[0036] If the person determines that the water in the humidifier 10 needs to be replenished, the person fills a container such as a kettle with water, and pours the water toward the water filling opening 48, that is to say the upper cover 42, from above the humidifier 10. Since the water filling opening 48 is formed with a diameter that is much larger than the diameter of the water filling opening of conventional humidifiers, it is easy to pour the water without spilling.

[0037] The water poured from above the water filling opening 48, that is to say from above the upper cover 42, flows over the surface of the upper cover 42 toward the peripheral edge thereof, and accumulates in the peripheral gutter 44. The water that accumulated in the peripheral gutter 44 flows through the intersecting gutters 50 to the water channel 32 formed between the lower partition wall 28 and the upper partition wall 30, and flows down the water channel 32 and enters the reservoir 16.

[0038] Since the amount of water in the reservoir 16 is displayed on the display unit 40, the person continues to pour water while looking at the water amount displayed on the display unit 40, then stops pouring water when the display unit 40 displays "full" or an appropriate amount of water is reached. Note that even if the water amount displayed on the display unit 40 is overlooked, a speaker emits a warning sound when the reservoir 16 becomes full, and therefore the person can safely stop pouring water when this warning sound is emitted.

[INDUSTRIAL APPLICABILITY]

[0039] The present invention is applicable to the pouring of water into the reservoir of humidifiers that vaporize water using a heater and humidifiers that atomize water using ultrasound.

[REFERENCE SIGNS LIST]

[0040]

10 Humidifier
 12 Lower outer shell
 14 Inlet
 16 Reservoir
 18 Antibacterial pellet portion
 22 Humidifying filter
 24 Humidifying filter lock
 26 Enzyme filter
 28 Lower partition wall
 30 Upper partition wall
 32 Water channel
 34 Blowing fan
 36 Motor
 38 Control device
 40 Display unit
 42 Upper cover
 44 Peripheral gutter
 46 Rising portion
 48 Water filling opening
 50 Intersecting gutter
 52 Upper outer shell
 54 Control ring
 56 Air discharge opening

Claims

1. A vaporizing humidifier (10) including a reservoir (16) that stores water, a humidifying filter (22) disposed inside the reservoir (16), a blowing fan (34) that draws in outside air and discharges air humidified by passing through the humidifying filter (22) to the outside, and a motor (36) that rotates the blowing fan (34), the vaporizing humidifier (10) comprising:
 - a dome-shaped upper cover (42) that covers the motor (36) from above, wherein the upper cover (42) serves as a water filling opening (48);
 - characterized in that** the vaporizing humidifier (10) further comprises
 - a peripheral gutter (44) formed so as to extend along a peripheral portion of the upper cover (42);
 - an intersecting gutter (50) formed so as to extend outward from the peripheral gutter (44) and so as to intersect the flow of air that is to be discharged; and
 - a water channel (32) formed so as to extend from the intersecting gutter (50) toward the reservoir (16).
2. The vaporizing humidifier (10) according to claim 1, wherein the peripheral gutter (44) is ring-shaped and formed on the peripheral portion of the upper cover (42).
3. The vaporizing humidifier (10) according to claim 1 or 2, wherein a rising portion (46) is formed so as to extend upward from the peripheral gutter (44), the upper cover (42) is formed such that a central portion thereof is lower than an upper edge of the rising portion (46), and a water filling opening (48) is formed by the rising portion (46).
4. The vaporizing humidifier (10) according to claim 1, wherein a plurality of the intersecting gutters (50) are provided in a radiating manner on the peripheral gutter (44).
5. The vaporizing humidifier (10) according to any of claims 1 to 4, further comprising a control device (38) that controls the motor (36), the control device (38) being covered by the upper cover (42).
6. The vaporizing humidifier (10) according to any of claims 1 to 5, further comprising:
 - a weight sensor provided below the reservoir (16);
 - a control device (38) that obtains a stored water amount from information obtained by the weight sensor; and
 - a display unit (40) that displays the stored water

amount obtained by the control device.

7. The vaporizing humidifier (10) according to claim 6, wherein the upper cover is made of a transparent material, and the display unit (40) is covered by the upper cover (42).

8. The vaporizing humidifier (10) according to any of claims 1 to 7, further comprising:

a weight sensor provided below the reservoir (16);
a control device (38) that obtains a stored water amount from information obtained by the weight sensor; and
an audio generation device that emits a warning sound if the stored water amount obtained by the control device exceeds a set value.

Patentansprüche

1. Verdampfungsbefeuchter (10), der Folgendes umfasst: ein Reservoir (16), das Wasser speichert, einen Befeuchtungsfilter (22), der innerhalb des Reservoirs (16) angeordnet ist, einen Gebläselüfter (34), der Außenluft ansaugt und durch das Passieren des Befeuchtungsfilters (22) befeuchtete Luft nach außen abgibt, und einen Motor (36), der den Gebläselüfter (34) dreht, wobei der Verdampfungsbefeuchter (10) Folgendes umfasst:

eine kuppelförmige obere Abdeckung (42), die den Motor (36) von oben abdeckt, wobei die obere Abdeckung (42) als Wassereinfüllöffnung (48) dient;

dadurch gekennzeichnet, dass der Verdampfungsbefeuchter (10) ferner Folgendes umfasst:

eine periphere Rinne (44), die so gebildet ist, dass sie sich entlang eines Umfangsabschnitts der oberen Abdeckung (42) erstreckt;

eine überkreuzende Rinne (50), die so gebildet ist, dass sie sich von der peripheren Rinne (44) nach außen erstreckt, um den Luftstrom zu kreuzen, der entladen werden soll; und

einen Wasserkanal (32), der so gebildet ist, dass er sich von der überkreuzenden Rinne (50) zu dem Reservoir (16) erstreckt.

2. Verdampfungsbefeuchter (10) nach Anspruch 1, wobei die periphere Rinne (44) ringförmig ist und an dem Umfangsabschnitt der oberen Abdeckung (42) gebildet ist.

3. Verdampfungsbefeuchter (10) nach Anspruch 1

oder 2, wobei ein ansteigender Abschnitt (46) so gebildet ist, dass er sich von der peripheren Rinne (44) nach oben erstreckt, wobei die obere Abdeckung (42) derart gebildet ist, dass ein zentraler Abschnitt davon niedriger ist als eine obere Kante des ansteigenden Abschnitts (46), und eine Wassereinfüllöffnung (48) durch den ansteigenden Abschnitt (46) gebildet wird.

4. Verdampfungsbefeuchter (10) nach Anspruch 1, wobei eine Vielzahl der überkreuzenden Rinnen (50) in einer strahlenförmigen Weise an der peripheren Rinne (44) vorgesehen sind.

5. Verdampfungsbefeuchter (10) nach einem der Ansprüche 1 bis 4, der ferner eine Steuervorrichtung (38) umfasst, die den Motor (36) steuert, wobei die Steuervorrichtung (38) durch die obere Abdeckung (42) abgedeckt ist.

6. Verdampfungsbefeuchter (10) nach einem der Ansprüche 1 bis 5, der ferner Folgendes umfasst:

einen Gewichtssensor, der unterhalb des Reservoirs (16) vorgesehen ist;
eine Steuervorrichtung (38), die eine gespeicherte Wassermenge aus Informationen erhält, die von dem Gewichtssensor erhalten werden; und

eine Anzeigeeinheit (40), die die gespeicherte Wassermenge anzeigt, die von der Steuervorrichtung erhalten wird.

7. Verdampfungsbefeuchter (10) nach Anspruch 6, wobei die obere Abdeckung aus einem transparenten Material hergestellt ist und die Anzeigeeinheit (40) durch die obere Abdeckung (42) abgedeckt ist.

8. Verdampfungsbefeuchter (10) nach einem der Ansprüche 1 bis 7, der ferner Folgendes umfasst:

einen Gewichtssensor, der unterhalb des Reservoirs (16) vorgesehen ist;
eine Steuervorrichtung (38), die eine gespeicherte Wassermenge aus Informationen erhält, die von dem Gewichtssensor erhalten werden; und

eine Audioerzeugungsvorrichtung, die einen Warnton abgibt, wenn die von der Steuervorrichtung erhaltene gespeicherte Wassermenge einen eingestellten Wert überschreitet.

Revendications

1. Humidificateur à vaporisation (10) incluant un réservoir (16) qui stocke de l'eau, un filtre humidifiant (22) placé à l'intérieur du réservoir (16), un ventilateur

soufflant (34) qui fait entrer l'air extérieur et décharge l'air humidifié par un passage à travers le filtre humidifiant (22) vers l'extérieur et un moteur (36) qui fait tourner le ventilateur soufflant (34), l'humidificateur à vaporisation (10) comprenant:

une couverture supérieure en forme de dôme (42) qui couvre le moteur (36) par rapport à ce qui est dessus, dans lequel la couverture supérieure (42) sert d'ouverture de remplissage d'eau (48);

caractérisé en ce que l'humidificateur à vaporisation (10) comprend en outre:

une gouttière périphérique (44) formée de manière à s'étendre le long d'une portion périphérique de la couverture supérieure (42);

une gouttière d'intersection (50) formée de manière à s'étendre vers l'extérieur à partir de la gouttière périphérique (44) et de manière à couper le flux d'air qui doit être déchargé; et

un canal d'eau (32) formé de manière à s'étendre de la gouttière d'intersection (50) au réservoir (16).

2. Humidificateur à vaporisation (10) selon la revendication 1, dans lequel la gouttière périphérique (44) est en forme d'anneau et formée sur la portion périphérique de la couverture supérieure (42). 30
3. Humidificateur à vaporisation (10) selon la revendication 1 ou 2, dans lequel une portion montante (46) est formée de manière à s'étendre vers le haut à partir de la gouttière périphérique (44), la couverture supérieure (42) est formée de sorte qu'une portion centrale de celle-ci est plus basse qu'un bord supérieur de la portion montante (46) et une ouverture de remplissage d'eau (48) est formée par la portion montante (46). 40
4. Humidificateur à vaporisation (10) selon la revendication 1, dans lequel il est fourni une pluralité de gouttières d'intersection (50) d'une manière rayonnante sur la gouttière périphérique (44). 45
5. Humidificateur à vaporisation (10) selon l'une quelconque des revendications 1 à 4, comprenant en outre un dispositif directeur (38) qui dirige le moteur (36), le dispositif directeur (38) étant couvert par la couverture supérieure (42). 50
6. Humidificateur à vaporisation (10) selon l'une quelconque des revendications 1 à 5, comprenant en outre: 55

un détecteur de poids fourni en dessous du ré-

servoir (16);

un dispositif directeur (38) qui obtient une quantité d'eau stockée à partir d'une information obtenue par le détecteur de poids; et

une unité d'affichage (40) qui affiche la quantité d'eau stockée obtenue par le dispositif directeur.

7. Humidificateur à vaporisation (10) selon la revendication 6, dans lequel la couverture supérieure est composée d'un matériau transparent et l'unité d'affichage (40) est couverte par la couverture supérieure (42).
8. Humidificateur à vaporisation (10) selon l'une quelconque des revendications 1 à 7, comprenant en outre:

un détecteur de poids fourni en dessous du réservoir (16);

un dispositif directeur (38) qui obtient une quantité d'eau stockée à partir d'une information obtenue par le détecteur de poids; et

un dispositif de génération de sons qui émet un son d'alerte si la quantité d'eau stockée obtenue par le dispositif directeur dépasse une valeur fixée.

FIG 1

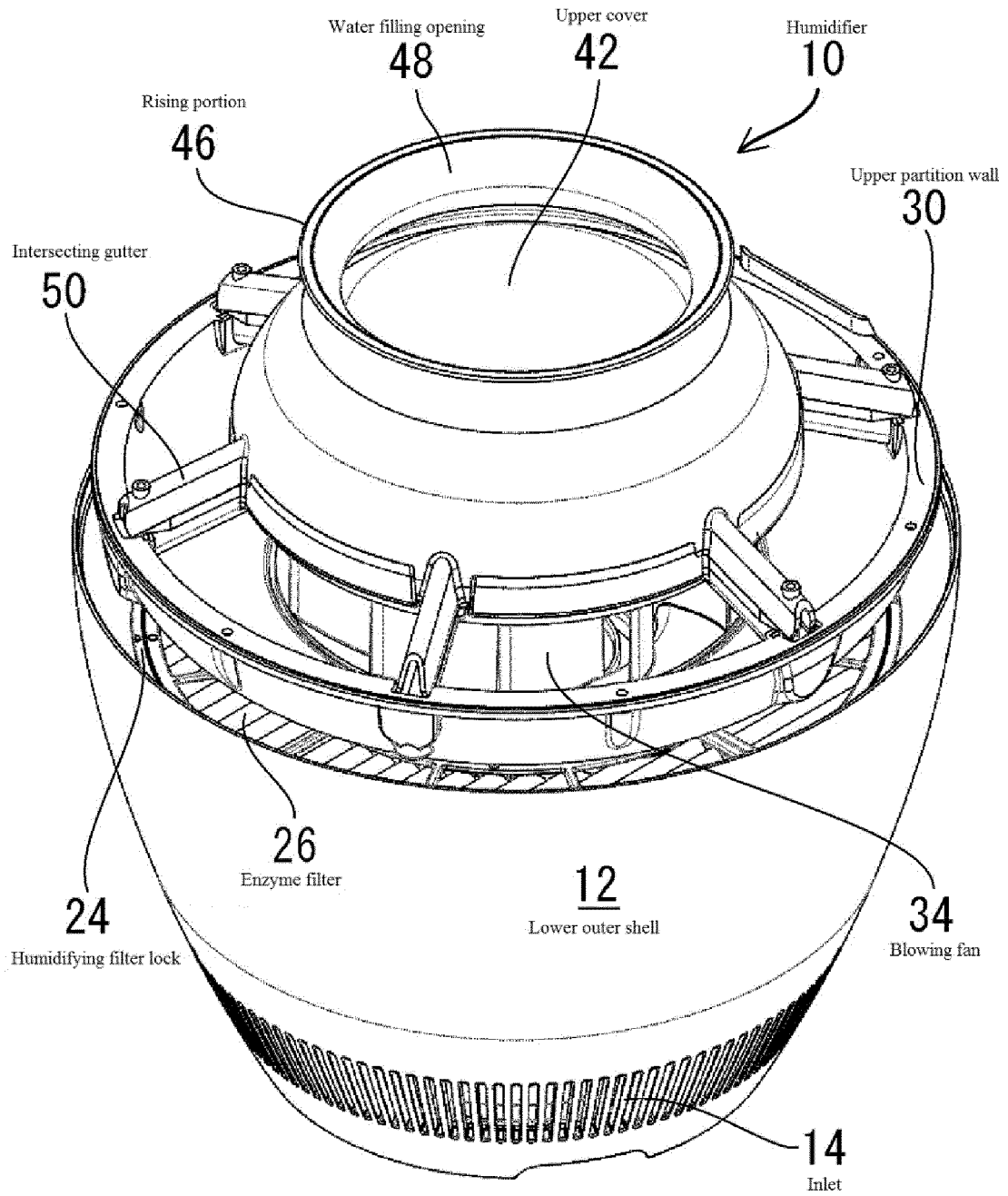


FIG 2

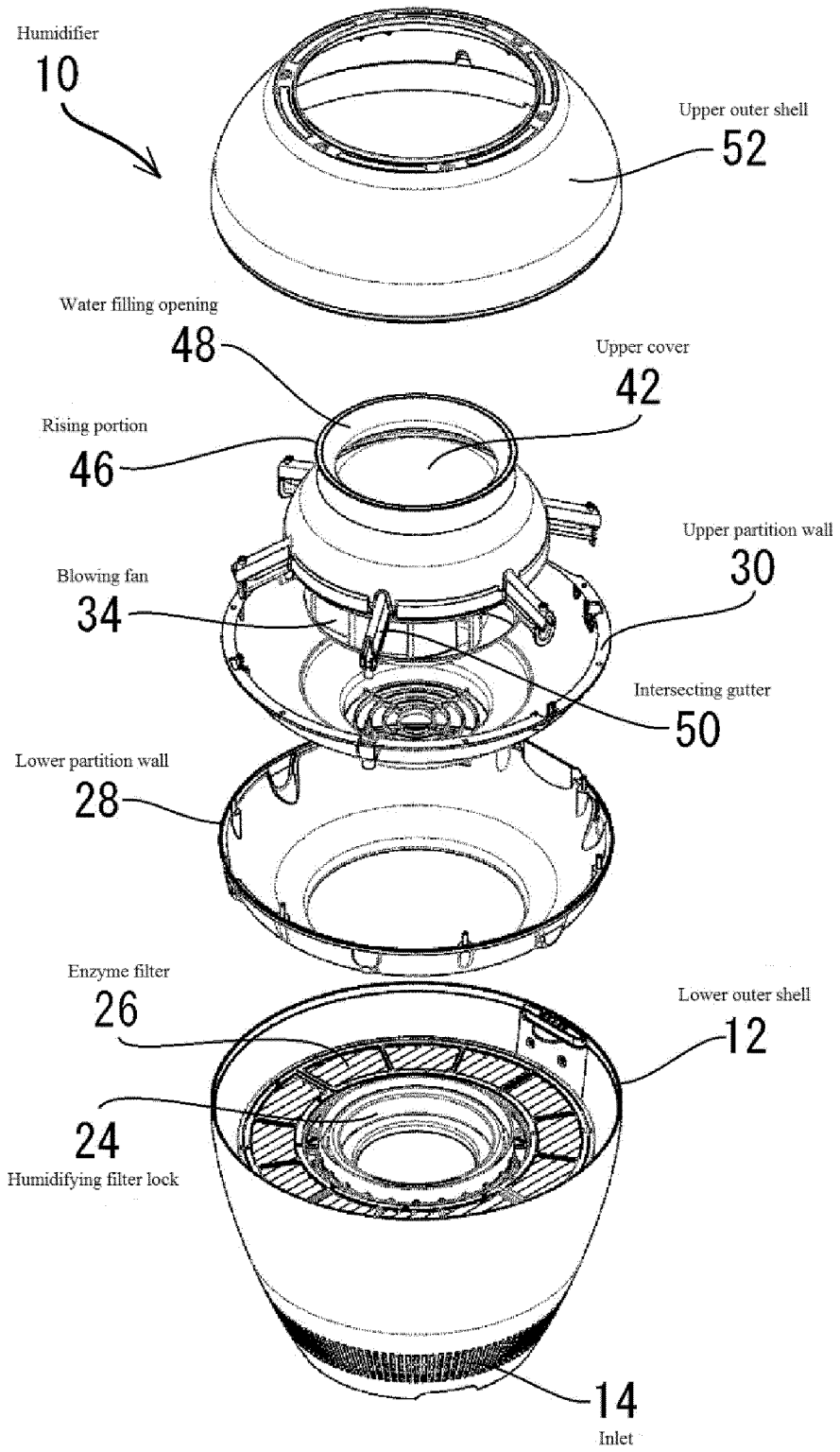


FIG 3

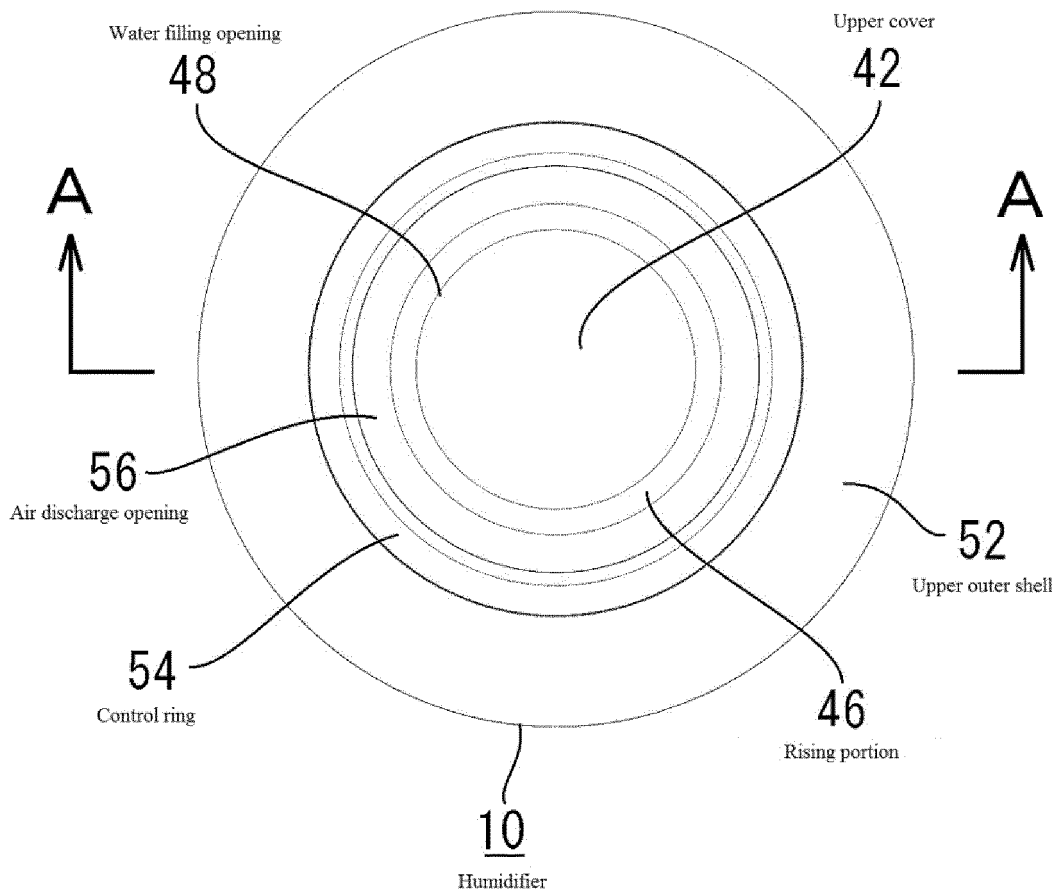


FIG 4

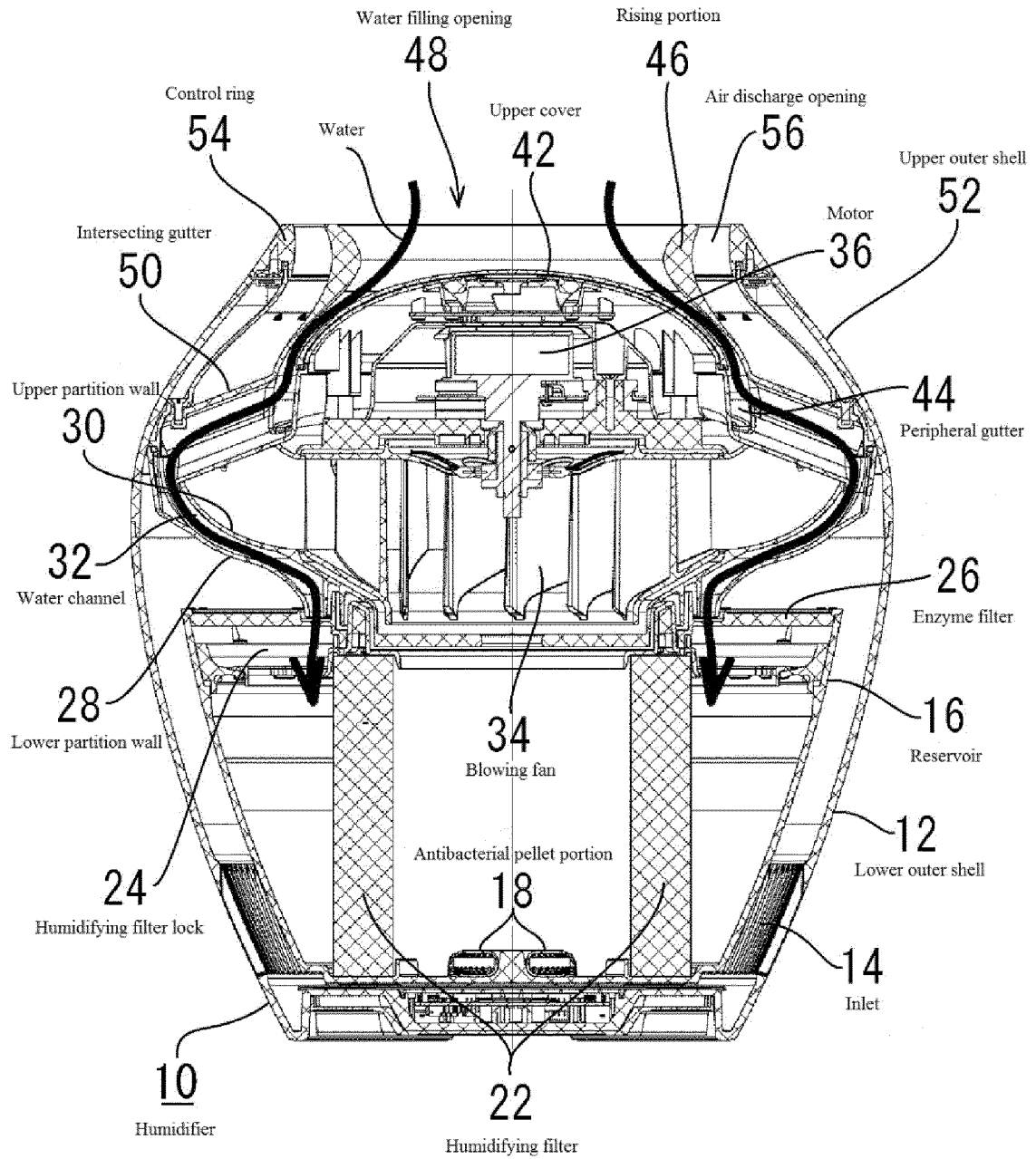


FIG 5

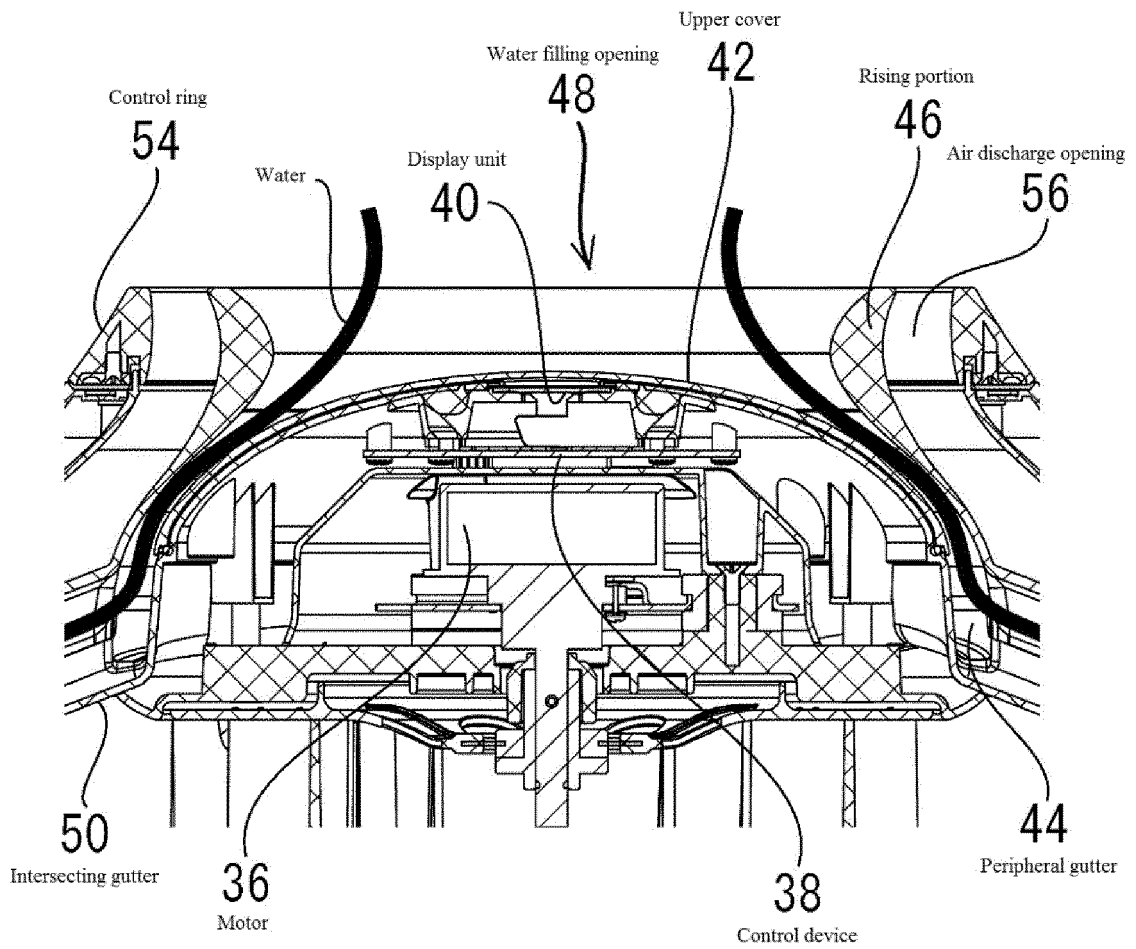


FIG 6

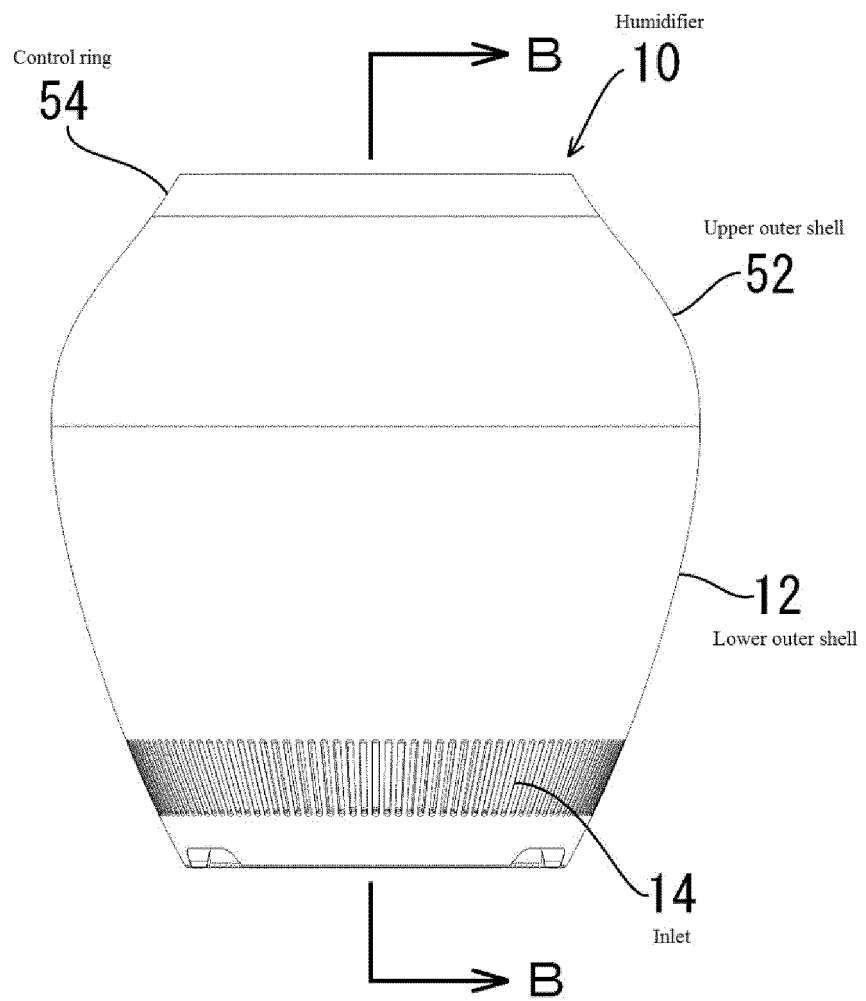
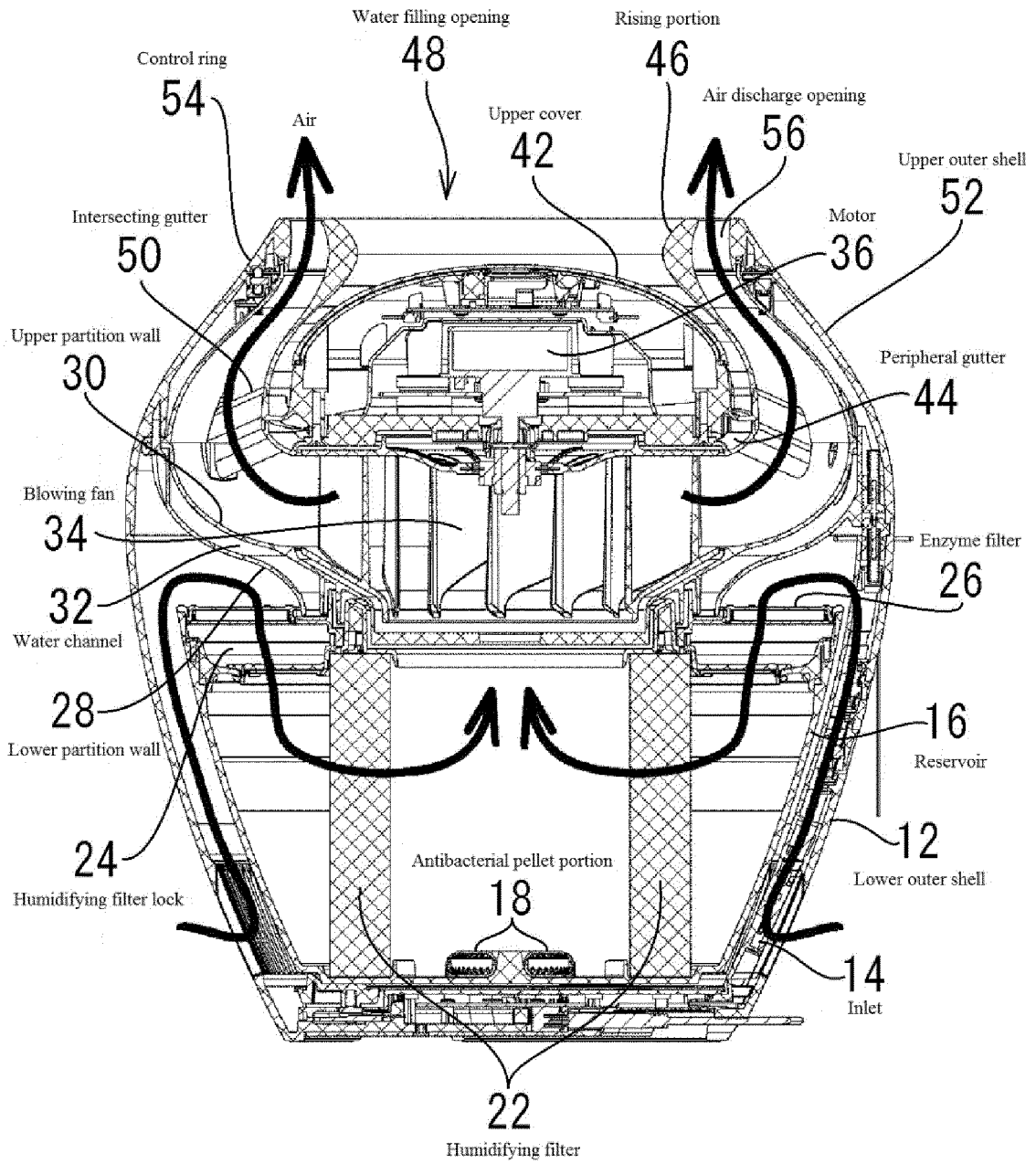


FIG 7



REFERENCES CITED IN THE DESCRIPTION

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