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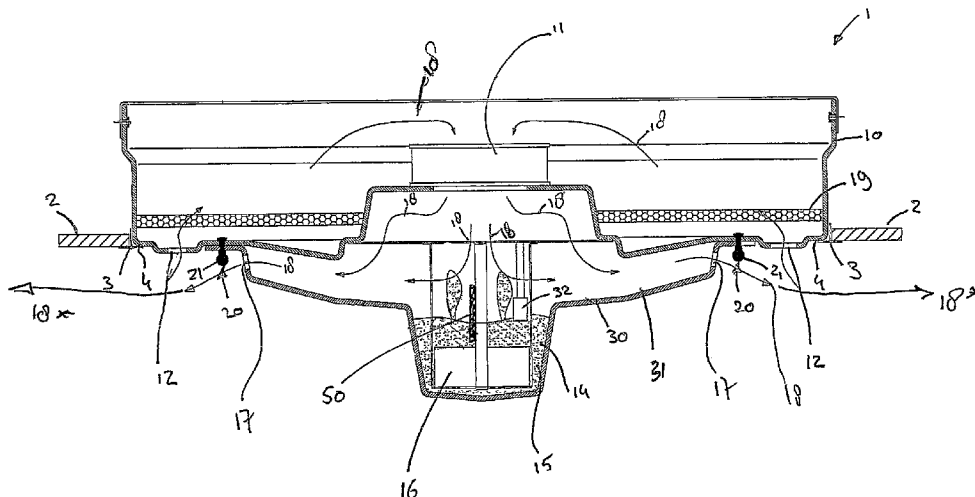
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(54) Title: AIR HUMIDIFIER



(57) Abstract: Air humidifier comprises a housing having at least one air inlet and at least one air outlet, support means for supporting the air humidifier on a suspended ceiling such that the air outlet is arranged below the level of the suspended ceiling, a reservoir for containing a liquid, and a vaporiser for vaporising liquid from the reservoir, the vaporiser and the reservoir being arranged such that in use the vapour is released into the air flow. The air humidifier comprises an upper housing part and a lower housing part, the lower housing part being adapted to extend below the ceiling when the air humidifier is mounted to the ceiling, the reservoir being arranged within the lower housing part, and in that the air humidifier further comprises connecting means for connecting the upper housing part and the lower housing part to each other, and the at least one air outlet is directed sideways such that in use the air flow leaves the air outlet substantially along the underside of the suspended ceiling.

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## Air humidifier

The invention pertains to an air humidifier of the type that is used in building such as offices, more in particular to an air humidifier according to the preamble of claim 1.

5 WO99/01702 pertains to an air humidifier for mounting to a ceiling. The known humidifier comprises a housing in which a fan is mounted. The fan draws air into the housing via an air inlet and creates an air flow in the housing from the air inlet to an air outlet, where the air leaves the housing again. The air humidifier further  
10 comprises an evaporative matrix which is present in the housing. The evaporative matrix evaporates water that is supplied to it, thus humidifying the air that passes by the evaporative matrix on its way to the air outlet.

15 The known humidifier is entirely arranged above the suspended ceiling. The air outlet of the humidifier unit is directed sideways, and from there the air flow is directed to one or more openings in the suspended ceiling to enter the room of for example an office.

20 The known humidifier has several disadvantages. Because it is entirely located above the suspended ceiling, it requires quite an effort to clean it or to perform maintenance. Moreover, air flowing from an opening in the suspended ceiling usually means that the air flow is directed downwards. Such a downwardly directed air flow is  
25 usually regarded as unpleasant by people in the room where the air is blown into.

It is the object of the present invention to provide an improved air humidifier.

30

This object is achieved by an air humidifier according to claim 1.

The humidifier according to the invention comprises a housing that has an upper housing part and a lower housing part. The upper housing part and the lower housing part are connectable to each other. The housing comprises an air inlet into which air from  
5 outside the housing is drawn. The housing also comprises an air outlet. In use, an air flow from the air inlet to the air outlet is generated in the housing.

10 In the lower housing part, a reservoir is provided for containing the liquid that is to be vaporised. The vaporised liquid humidifies the air flow in the housing, which humidified air flow leaves the housing via the air outlet.

15 The air outlets are directed such that the air flow leaves the air outlet substantially along the underside of the suspended ceiling. So, the air flow is not directed straight to the people in the room, so no unpleasant draft is created.

20 The lower housing part of the air humidifier extends below the suspended ceiling. Because the lower housing part can be disconnected from the upper housing part, inspection, cleaning and/or maintenance of the air humidifier is possible without the need to remove parts of the suspended ceiling.

25 In an advantageous embodiment, the vaporiser is easily accessible when the lower housing part is removed, for example because the vaporiser is located below the level of the suspended ceiling. The vaporiser is generally a part that requires replacement within the life span of the air humidifier, so it is advantageous if it can be  
30 reached without having to remove a part of the suspended ceiling first.

It is known that when a vapour is created, such vapour sometimes comprises droplets of liquid that are so large that they cannot be  
35 taken along by the air flow. The weight of such droplets is too high to allow that they remain airborne. If such droplets are formed in the known humidifier, they fall onto the bottom of the housing and

soil the housing from the inside. In the soiled housing, odours are formed and bacteria (such as the hazardous legionella bacteria) multiply rapidly.

5 In an advantageous embodiment, the lower housing part comprises a liquid collection surface that slants towards the reservoir. If the vapour that is created by the vaporiser contains droplets that are too large to be taken out of the housing by the air flow, these droplets fall back onto a slanting liquid collection surface. As the  
10 liquid collection surface slants towards the reservoir, any droplets of liquid falling from the air flow onto the liquid collection surface are directed to the reservoir.

This way, the liquid collection surface remains substantially dry.  
15 No odours are formed, nor can bacteria grow rapidly on the liquid collection surface due to the lack of moisture on the liquid collection surface. By directing the droplets back to the reservoir, the liquid can be vaporised again and no residues soil the housing.

20 In a further advantageous embodiment, the connecting means allow the upper housing part and the lower housing part to be connected to each other and disconnected from each other without the use of tools. As the lower housing part extends below the suspended ceiling, it can be removed for cleaning and inspection without  
25 having to remove the panels of the suspended ceiling. By allowing the lower housing part to be removed without the use of tools makes removing it, for example for the purposes of cleaning and inspection, even easier. In that case, no specialist personnel is required to open the air humidifier.

30 Such connection means can take any suitable form, such as click-fit means, pivotable rods with heads that cooperate with slots, a bayonet catch, elastic elements or magnetic fixing means.

35 In a further advantageous embodiment, the air humidifier further comprises liquid supply means. These liquid supply means fill the

reservoir when necessary. Preferably, these liquid supply means are adapted to fill the reservoirs of more than one humidifier.

In a further advantageous embodiment, the air humidifier further  
5 comprises a level gauge for detecting a low liquid level in the reservoir. The level gauge can trigger an alarm indicating a low liquid level. When combined with the embodiment comprising the liquid supply means, the level gauge can also trigger a  
10 replenishment of the liquid by the liquid supply means. This replenishment can be triggered instead of or in addition to the triggering of an alarm.

In a further advantageous embodiment, the air humidifier further  
15 comprises liquid treatment means. In an aqueous liquid that does not flow, bacteria are likely to multiply. This can lead to dangerous situations if the bacteria concerned are pathogenic, such as the legionella bacteria. Also, odours may be formed. Liquid treatment means can prevent these things from happening. Examples of suitable  
20 liquid treatment means are means for reversed osmosis, means for irradiation with UV-C rays and/or means for disinfecting. Preferably, the liquid treatment means are arranged inside the housing of the air humidifier.

In an advantageous embodiment, the liquid treatment means comprise a  
25 UV-lamp that is located in the lower housing part. Preferably, the UV-lamp is arranged such that when the air humidifier is in use, the UV-lamp is partly below the surface of the liquid in the reservoir. This way, both the liquid in the reservoir and the air in the direct vicinity of the reservoir are disinfected.

30  
The invention will be explained in more detail under referral to the drawing, in which a non-limiting embodiment of the invention is presented.

The drawing shows in:

35 Fig. 1 a cross section of an embodiment the air humidifier according to the invention,

Fig. 2 the embodiment of fig. 1, which the lower housing part and the upper housing part being disconnected,  
Fig. 3 a possible alternative for the connecting means  
Fig. 4 a cross section of an second embodiment the air  
5 humidifier according to the invention.

Figures 1 and 2 show an advantageous embodiment of an air humidifier 1 according to the invention.

10 Fig. 1 shows a suspended ceiling, that comprises panels 2 and a grid of metal profiles 3 that support the panels 2 of the ceiling. This type of ceiling is commonly used in for example offices.

The embodiment shown in figures 1 and 2 is supported by the grid of  
15 the ceiling. In this example, corners 4 of the air humidifier 1 act as support means.

The air humidifier according to the invention has an upper housing part 10 and a lower housing part 30. The upper housing part 10 and  
20 the lower housing part 30 are connectable to each other by connecting means 20.

In the example of fig. 1 and 2, the connecting means 20 comprise a plurality of elastic elements 21, that are supported by the upper  
25 housing part 10. The elastic elements 21 each have a rod-like part 22. The upper end of the rod-like part 22 is provided with a top section 24 that has a larger cross sectional dimension than the rod-like part 22. The top section 24 is supported by the upper housing part 10. The elastic elements 21 also each have a head 23 which is  
30 located at the lower end of the rod-like part 22. The head 23 has a larger cross sectional dimension than the rod-like part 22.

Each of the elastic elements 21 cooperates with a slot 25 in the lower housing part 30. The slot 25 is adapted to receive at least a  
35 part of the rod-like part 22. The slot 25 has a width that is narrower than the cross sectional dimension of the head 23. This way, the head 23 prevents the lower housing part from falling.

Instead of the use of elastic elements 21, pivotable rods 26 from a relatively rigid material such as metal or a rigid plastic can be used. Such rods 26 are provided with head 27. This is shown in fig. 3.

5

In alternative embodiments that are not shown, the connecting means can comprise magnetic fixing means, click-fit means and/or a bayonet catch. Different types of connecting means can also be used together in a single embodiment of the air humidifier according to the invention.

10

In the embodiment of fig. 1, the air humidifier 1 also comprises a fan 11. The fan 11 draws air from the room below the suspended ceiling into the housing of the air humidifier 1. In alternative embodiment, air can be drawn in from above the suspended ceiling. To allow the air to enter the housing of the air humidifier 1, the air humidifier is provided with one or more air inlets 12. In the example of fig. 1, the air inlets 12 are provided in the upper housing part 10, but located below the level of the suspended ceiling. It will be clear to the skilled person that the air inlets 12 can be located at any location in the air humidifier that is suitable for drawing air into the housing.

15

20

Instead of being provided with a fan 11, the air humidifier can be connectable to a ventilation system 40 of a building in which the air humidifier is to be arranged (see fig. 4). In that case, one air inlet 41 is provided, instead of the air inlets 12 in the housing.

25

The air humidifier also comprises air outlets 17. In the embodiment of fig. 1, the fan 11 creates an air flow 18 from the air inlets 12 to the air outlets 17. In the embodiment of fig. 4, the ventilation system 40 generates air flow 18.

30

In the air humidifier according to the invention, the air outlets 17 are arranged such that the air flow 18 leaving the air outlets 17 is directed along the ceiling (arrows 18\* in fig. 1). This way no

35

unpleasant draft is created in the room that is supplied with the humidified air.

It is envisaged that with the arrangement of the air outlets 17 in the housing, account is taken of the position of the air humidifier in the room, so that for example no outlets 17 are provided in that part of the housing that is to be arranged close to a wall of the room. This way, unpleasant draft of humidified air downwards along a wall is prevented.

It is envisaged that the air humidifier further comprises guide means (such as plate sections) within the housing in order to guide the air flow 18 along an advantageous path.

The air humidifier further comprises a reservoir 14 for containing liquid 15. Liquid 15 is the liquid that is to be vaporised for humidifying the air. Liquid 15 will generally be an aqueous liquid.

The reservoir 15 is designed as to contain a minimal amount of liquid 15. This way, the growth of bacteria in the still water is minimal. Preferably, the reservoir 14 in use holds less than 0.5 litres of liquid 15.

In the air humidifier according to the invention, the reservoir 14 is arranged in the lower housing part 30. This is advantageous because it allows easy cleaning, inspection and maintenance of the inside of the air humidifier. The lower housing part 30 extends below the suspended ceiling and is therefore easily accessible. The accessibility is even improved when no tools are required to disconnect the lower housing part 30 from the upper housing part 10. The accessibility of the lower housing part 30 makes that no specialised personnel is required to remove the lower housing part and to clean the reservoir 14.

The air humidifier further comprises a vaporiser 16. This vaporiser 16 is for vaporising liquid 15 from the reservoir 14. Vaporising



means that the liquid 15 is converted into vapour, for example by evaporation, by making a mist or by spraying.

5 The vapour that is obtained from the liquid 15 is released from the reservoir 14 into the air flow 18. The air flow 18 takes the vapour out of the housing via the air outlets 17 together with the air of the air flow. This way, humidified air is obtained.

10 In a possible embodiment, the vaporiser 16 is an ultrasonic vaporiser. Such a vaporiser has to be submerged in liquid in order to function well. Preferably, the ultrasonic vaporiser fits snugly into the reservoir 14, so that the reservoir in use only holds a minimal amount of liquid 15.

15 In the embodiments shown, the vaporiser is arranged below the level of the suspended ceiling. This way, the vaporiser 16 is easily accessible for replacement, maintenance, cleaning or inspection when the lower housing part 30 is removed.

20 In the exemplary embodiment shown in the drawings, the air humidifier also comprises a liquid collection surface 31. This surface 31 is arranged in the lower housing part 30 and slants towards the reservoir. Should any droplets of liquid be created in the vaporising process that are too large to remain afloat in the  
25 air flow 18, those non-airborne droplets will fall onto the liquid collection surface 31. The angle of this surface 31 with respect to the horizontal directs those droplets back to the reservoir 14.

30 In an advantageous embodiment the air humidifier is provided with liquid supply means (not shown). This can be for example a tubing system that supplies water from the mains to the reservoir of one or more (for example six) air humidifiers.

35 Preferably, the air humidifier comprises a level gauge 32 for detecting the level of the liquid 15 in the reservoir 14. Preferably, the level gauge is connected to a monitoring system that sets off an alarm if the level of liquid 15 in the reservoir 14 is

too low, and/or triggers the supply of liquid to the respective reservoir 14 from any available liquid supply means.

Preferably, the air humidifier is provided with a dust filter 19.

5 This reduces the soiling of the inside of the housing of the air humidifier upstream of the filter.

10 In an advantageous embodiment, the air humidifier comprises liquid treatment means, which are preferably arranged within the housing, for example in or near the reservoir 14. Examples of suitable liquid treatment means are means for reversed osmosis, means for irradiation with UV-C rays and/or means for disinfecting.

15 In an advantageous embodiment, a UV-lamp 50 is arranged in the vicinity of the reservoir 14, such that when the air humidifier is in use, the UV-lamp irradiates both liquid 15 in the reservoir and air in the direct vicinity of the liquid's surface. This can be achieved by arranging the liquid treatment means 50 as shown in fig. 1. The arrangement of the liquid treatment means 50 as shown in fig. 20 1 makes the liquid treatment means suitable for irradiating both liquid in the reservoir and air above the liquid surface at the same time.

25 Perfumes may be added to the liquid 15 in the reservoir, either before or after the liquid 15 is put into the reservoir.

## Claims

1. Air humidifier for arrangement in a suspended ceiling,  
which air humidifier comprises:

- a housing having at least one air inlet and at least one air  
outlet,

5 - support means for supporting the air humidifier on the suspended  
ceiling such that the air outlet is arranged below the level of  
the suspended ceiling,

- a reservoir for containing a liquid, and

10 - a vaporiser for vaporising liquid from the reservoir, the  
vaporiser and the reservoir being arranged such that in use the  
vapour is released into the air flow,

the air humidifier either comprising or being adapted to cooperate  
with means for providing an air flow in the housing between the at  
least one air inlet and the at least one air outlet,

15 characterised in that,  
the housing comprising an upper housing part and a lower housing  
part, the lower housing part being adapted to extend below the  
ceiling when the air humidifier is mounted to the ceiling, the  
20 reservoir being arranged within the lower housing part,  
and in that the air humidifier further comprises connecting means  
for connecting the upper housing part and the lower housing part to  
each other,  
and the at least one air outlet is directed sideways such that in  
25 use the air flow leaves the air outlet substantially along the  
underside of the suspended ceiling.

2. Air humidifier according to claim 1,

30 which in that the lower housing part comprises a liquid collection  
surface, which liquid collection surface slants towards the  
reservoir.

3. Air humidifier according to any of the preceding claims,

35 wherein the air humidifier is adapted for arrangement in a suspended  
ceiling which suspended ceiling has a grid,

wherein the support means are adapted to support the air humidifier on the ceiling grid.

4. Air humidifier according any of the preceding claims,  
5 wherein the connecting means allow the upper housing part and the lower housing part to be connected to each other and disconnected from each other without the use of tools.
5. Air humidifier according to claim 4,  
10 wherein the connecting means are click-fit means.
6. Air humidifier according to claim 4,  
wherein the connecting means comprise one or more rods, each of the rods having a head with a cross sectional dimension that is larger  
15 that the cross sectional dimension of the associated rod, each of the rods being pivotably connected to the upper housing part, the connecting means further comprising one or more slots in the lower housing part, each of the slots being adapted to cooperate with a pivotable rod, each of the slots having a width that is  
20 larger than the cross sectional dimension of the rod but smaller than the cross sectional dimension of the head of that rod.
7. Air humidifier according to claim 4,  
wherein the connecting means comprise a bayonet catch.  
25
8. Air humidifier according to claim 4,  
wherein the connecting means comprise one or more elastic elements.
9. Air humidifier according to claim 4,  
30 wherein the connecting means comprise magnetic fixing means.
10. Air humidifier according to any of the preceding claims,  
wherein the air humidifier further comprises liquid supply means for filling the reservoir.  
35
11. Air humidifier according to any of the preceding claims,  
wherein the upper housing part is arranged above the ceiling.

12. Air humidifier according to any of the preceding claims,  
wherein the air humidifier further comprises a dust filter.

5 13. Air humidifier according to any of the preceding claims,  
wherein the air humidifier further comprises guide means for guiding  
the air flow through the air humidifier.

10 14. Air humidifier according to any of the preceding claims,  
wherein the air humidifier further comprises liquid treatment means.

15. Air humidifier according to claim 14,  
wherein the liquid treatment means are arranged inside the housing.

15 16. Air humidifier according to claim 14 or 15,  
wherein the liquid treatment means comprise means for reversed  
osmosis.

20 17. Air humidifier according to any of the claims 14, 15 or 16  
wherein the liquid treatment means comprise irradiation with UV-C  
rays.

25 18. Air humidifier according to claim 17,  
wherein the arrangement of the liquid treatment means makes the  
liquid treatment means suitable for irradiating both liquid in the  
reservoir and air above the liquid surface at the same time.

30 19. Air humidifier according to any of the claims 14-18,  
wherein the liquid treatment means comprise means for disinfecting.

20. Air humidifier according to any of the preceding claims,  
wherein the air humidifier further comprises a level gauge for  
detecting low liquid levels in the reservoir.

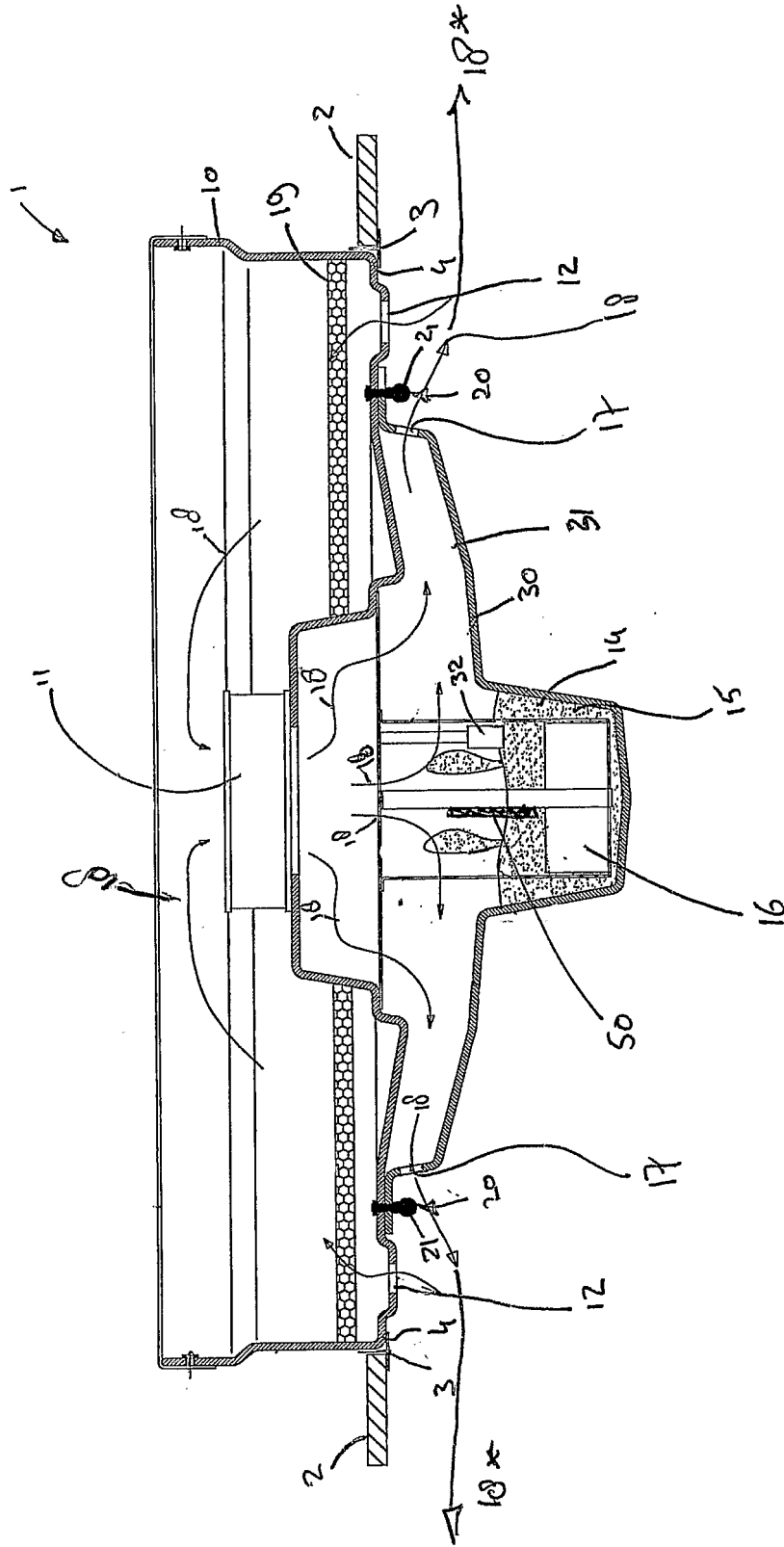


Fig. 1

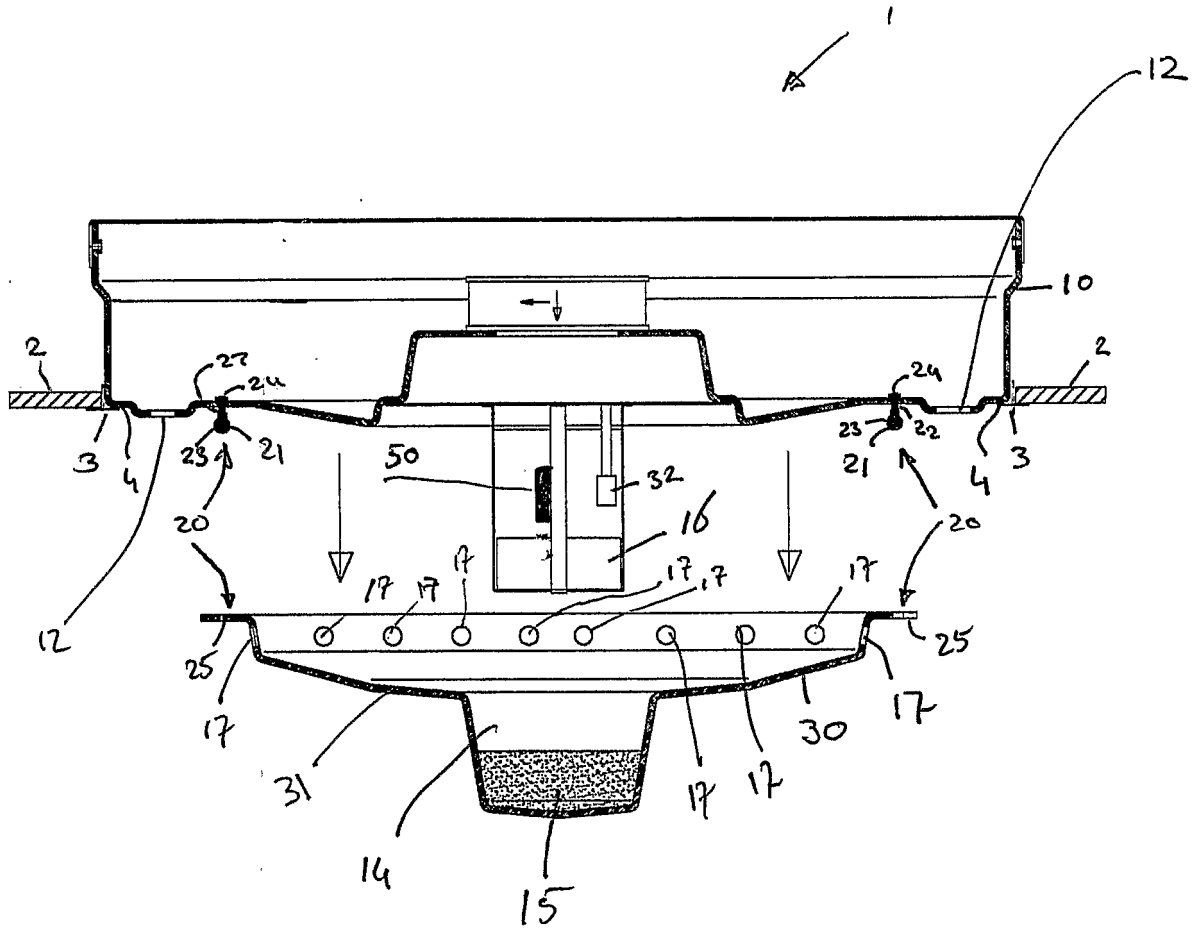
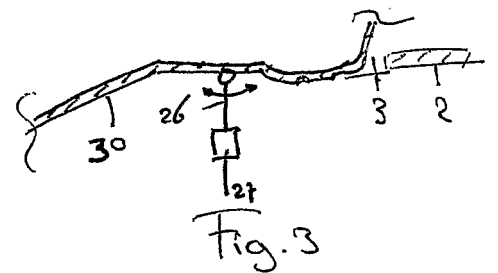


Fig. 2



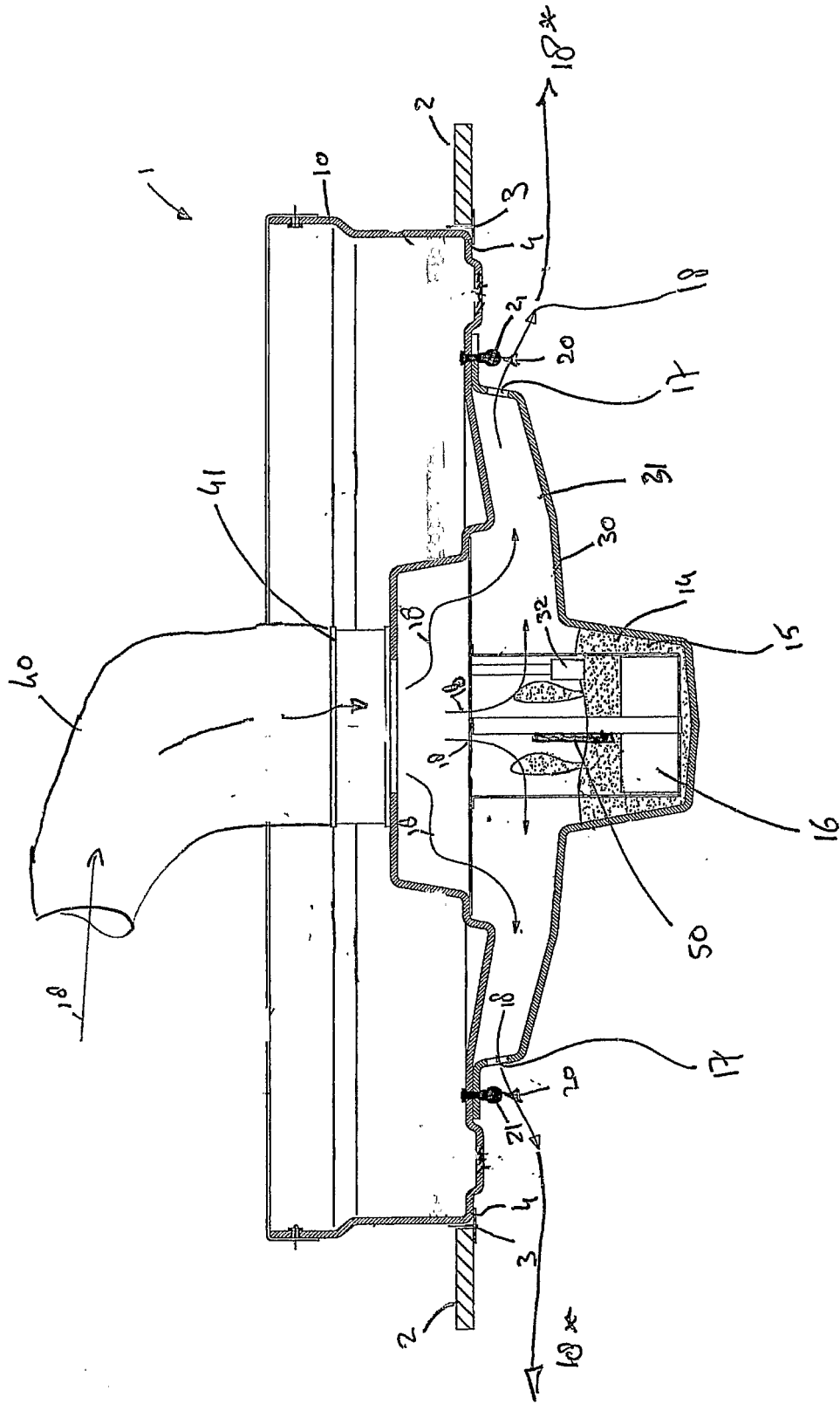


Fig. 4



**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/NL2006/000314

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. F24F6/02

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
F24F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)  
EPO-Internal, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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A	US 2 554 868 A (MILLS RALPH B) 29 May 1951 (1951-05-29) the whole document	1, 2, 10
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Further documents are listed in the continuation of Box C.

See patent family annex.

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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/NL2006/000314

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Information on patent family members

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