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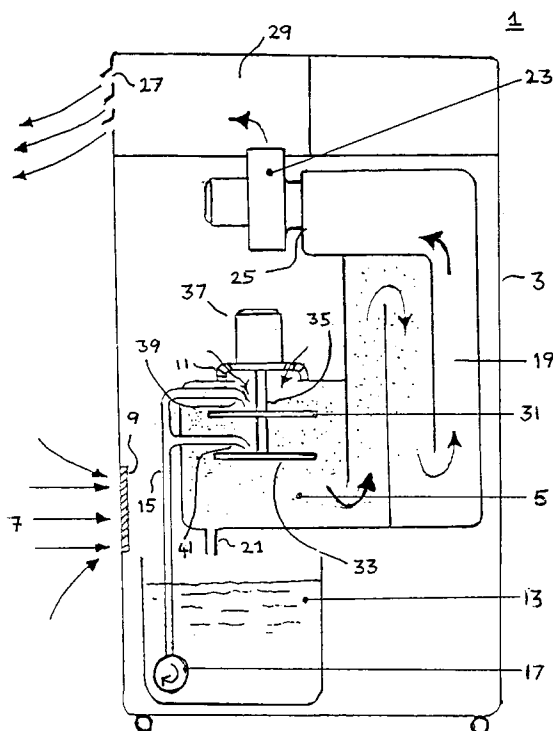
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W-8000 München 40 (DE)(54) **Ionizer.**

(57) An ionizer (1) is of the type comprising shear means for subjecting water to shear and air impulsion means (23) for bringing air into contact with the sheared water. Lower operating noise, less frequent maintenance and reduced water consumption are provided by fabricating the shear means with a plate (31/33), a drive (37) for rotating the plate (31/33) and means (39/41) for spraying water onto the plate (31/33) whilst it is rotating. As well as producing air rich in negative ions, the ionizer also humidifies the air.

**FIG 1****EP 0 554 591 A1**

The present invention relates to an ionizer, more particularly to a negative ion generator for improving indoor air quality.

A number of different techniques are known for improving the quality of air in indoor environments, especially air conditioners, humidifiers, air cleaners and ionizers.

Air conditioners function to cool the air but at the expense of humidity, so rendering the air drier. Humidifiers generally work by spraying nebulized water. However the resultant water droplets are too large to humidify the air efficiently. Air cleaners filter the air, to remove airborne particles, either using a physical filter or an electrostatic field. However, neither humidity nor air temperature are improved.

In recent years, there has been increased interest in ionizers. A high concentration of negative ions in breathed air is believed by many to have beneficial effects on both physical health and on mental well-being. It has been found that the ions neutralise the harmful effects of breathing in pollutants. This is especially important for those who are overly sensitive to poor air quality, eg asthmatics. The mechanism of effects on mood, wakefulness etc is generally not understood.

Negative ions are created in nature in the vicinity of waterfalls, on the sea shore and in the mountains. In the Alps, for instance, up to 4,000 negative ions per cu. cm. of air. An unpolluted country atmosphere might contain 2,000 negative ions per cu. cm.

Beside a busy open road, the negative ion concentration might drop to 1,000 per cu. cm. In a busy street in town the figure would be as low as 500. In factories it can even be as low as 200, whilst in the presence of smog (smoke + fog) it can drop right down to 50.

During breathing ions are taken up by the red blood corpuscles (erythrocytes), H_3O^+ ions are taken up by blood platelets (thrombocytes) and carried through the body. The thrombocytes react in different ways to ionization: positive ions induce them to release the hormone serotonin which induces an allergic reaction; negative ions inhibit serotonin release and promote its breakdown, thus making it harmless.

There are two known techniques for increasing the negative ion concentration in air. The first of these is corona discharge. However, a by-product of the discharge is the formation of ozone (O_3) from atmospheric oxygen. Ozone is a highly labile chemical species and as a result is toxic. Although it is only produced in small quantities by conventional discharge ionizers, it can still be sufficient to cause lung irritation, particularly in confined spaces, so outweighing the beneficial effects of the negative ions.

The second ionization technique involves subjecting water to shear. If water molecules, eg in a spray of water droplets, are subjected to a sufficiently large force, an electron in the outer molecular orbital is displaced, leaving behind a positively charged molecular ion. The electron readily interacts with a gas molecule in the surrounding air, resulting in the formation of a negative ion. This technique also enables the air to be humidified at the same time.

There have been several proposals for ionizing apparatus which uses this water-shear principle.

USSR patent specification SU 517 191 describes a device using a helical rotor to create a low-pressure vortex centre in an air column current to draw-up and shear a stream of water. The velocity of the air current is $20-25\text{ ms}^{-1}$, making the unit very noisy in operation (a typhoon has a minimum velocity of only 17 ms^{-1}).

In EP-A-153 122, there is described an apparatus which generates negative ions by spraying nebulised water through fine nozzles. Since fine nozzles tend to clog easily, eg because of water hardness, such units tend to require frequent maintenance.

Another device disclosed in SU 567 033 passes air over the surface of a body of water in which there is arranged a floating agitator. With prolonged use, the concentration of negative ions per unit volume output will gradually decline as the water level falls and the air outlet becomes progressively increased in area.

An ionizer apparatus of the water shear type but which is able to mitigate or overcome these disadvantages has now been devised. This new apparatus utilises a rotating plate for creating the shear.

Thus, the present invention provides an ionizer comprising shear means for subjecting water to shear and air impulsion means for bringing air into contact with the sheared water, wherein the shear means comprises a plate, a drive for rotating the plate and means for spraying water onto the plate whilst it is rotating.

In most embodiments, the plate will be a substantially flat disc of substantially circular circumference but the present invention does not exclude a device having a plate with a non-circular periphery.

Conveniently, the rotational motion is imparted to the plate by means of a motor, for example an electrically powered motor. Usually, the drive will be arranged to rotate the plate in the plane of its circumference, about its axis of symmetry.

Suitable revolution speeds are typically in the range of from 1000 rpm (revolutions per minute) to 5000 rpm, for example about 2500 rpm to 3000 rpm. However, optimum speeds will depend on

other parameters such as plate diameter, water delivery rate and the expected air temperature in the intended environment. Typical plate diameters are in the range of from 50 mm to 500 mm, for example from 100 mm to 200 mm. However, smaller or larger plates are also possible.

The means for spraying water onto the plate may comprise a nozzle, for example connected to a pipe or hose into which water is forced by means of a pump. Alternatively, a pump may be provided adjacent the plate to spray water directly onto same.

The water from the nozzle is preferably sprayed substantially axially onto a flat surface of the plate which could be mounted in any convenient orientation; for example horizontally or vertically. The water may be sprayed onto either or both of the flat surfaces.

The minimum number of plates is one but two or more plates may be used for applications where higher volumes of air are to be processed or if a higher negative ion concentration is required. In a specific embodiment described hereinbelow, two such plates are mounted horizontally, one above the other. In that embodiment, two separate nozzles are provided for respectively spraying water onto the upper surface of each plate. Whenever a plurality of plates is used, it is convenient to provide at least one separate nozzle for spraying water onto each.

Although the plate or plates may have any surface texture, an increased negative ion count is obtained if the surface contacted by the water is not smooth. The contact surface may be roughened, for example having blind holes along the circumference thereof, on the contact surface.

The plate or plates are preferably arranged inside a mist chamber and water is pumped from a tank to be sprayed onto the plate(s) within the chamber. The chamber may be provided with a return drain path for water which is not vapourised to be returned to the tank.

Typical rates of water delivery to the plates are in the order of a few litres per minute, eg from 1 litre per min. to 5 litres per min. However, if the non-vapourized water is recycled to the tank, the consumption of water which is vapourised and emitted with the ions is typically in the order of only a few hundred cc per hour.

Although the driving force of the circulation may be a pump, it would also be possible to fix a pumping element to the drive provided for rotating the plate. This pumping element could be an impeller and tube or just a tube of size sufficient to create a vortex for the water to flow up to the plate. With the latter arrangement, it is not necessary to provide a pump per se. However the flow of water would generally be lower than for a pumped sys-

tem, making it ideal for a smaller ionizer.

The impulsion means for bringing air into contact with the water spray is conveniently a fan or other blower. It is also preferred to provide a tortuous path for the air after it has contacted the spray, to enable efficient humidification and separation of non-vapourized water. However, a separate moisture separator could also be provided.

In the described specific embodiment, the blower is arranged in the outlet path (downstream of the mist chamber) so that air is sucked into the mist chamber and blown out via the blower, eg. through a grill. Another option is to place the blower before the mist chamber so that air is blown into the chamber. With the latter arrangement, the ionized air is prevented from coming into contact with the blower impeller, which at high revolution speeds can generate static charges which may neutralise the negative ions.

The optimum blower position will generally be dictated by the size of the apparatus, eg. taking into account the size of the mist chamber and tortuous outlet path. For a larger device, frictional losses are likely to be higher, making it advisable to mount the blower downstream of the mist chamber. This allows the required flow rate to be maintained, whereas in large ionizers, locating the blower to blow into the mist chamber could result in a significant loss of flow. Thus, the latter arrangement is more suited to the smaller apparatus.

Although the ionizer of the present invention is primarily intended for use with water, water being non-toxic and relatively inexpensive, it is possible that other liquids, eg having polar molecules, may give rise to negative ions in the same way when subjected to shear. Thus, the present invention does not exclude ionizers intended to work with such other liquids, eg for industrial use rather than for ionizing air to be breathed.

The present invention will now be explained in more detail by the following description of specific embodiments and with reference to the accompanying drawing in which:-

Figure 1 shows a schematic view of an ionizer according to the present invention;

Figure 2 shows an alternative impeller arrangement for spraying water onto the plate; and

Figure 3 shows an alternative vortex creation arrangement for spraying water onto the plate.

As shown in Figure 1, an ionizer 1 according to the present invention comprises a case 3. Within the case is arranged a mist chamber 5. Air 7 is able to enter the case through an inlet grill 9 and subsequently to enter the mist chamber through openings 11.

The mist chamber is also arranged to receive water from a tank 13 via a conduit 15. The water is transferred by means of a pump 17.

Air is able to leave the mist chamber via a duct 19 which is arranged to provide a tortuous path for the air. The mist chamber is also provided with a drain 21 situated above the tank.

A blower 23 is situated at the end 25 of the duct remote from the mist chamber. The blower is arranged to suck air from the duct and blow it out through an exit grill 27 via an outlet chamber 29.

Within the mist chamber are arranged two horizontal circular plates 31, 33, spaced apart with one above the other. At their centres, the plates are connected to a vertical drive shaft 35 which is connected to a motor 37. Two nozzles 39, 41 are respectively arranged above the flat top surfaces of the two plates.

The arrowed lines in the drawing indicate the direction of air flow during operation. In use, the motor causes the plates to spin. At the same time, the pump forces water from the tank to be sprayed via the nozzles onto the upper surfaces of the spinning plates. The resultant shear causes the generation of negative ions in the air in the mist chamber by the mechanism referred to previously. On contact with the plates, the shear nebulizes the water causing some of it to evaporate, thereby also humidifying the air.

Operation of the blower causes a constant supply of new air to be drawn into the mist chamber via the inlet grill 9 and the openings 11. The ionized and humidified air is then drawn into the tortuous duct. Droplets of non-vapourized water fall to the bottom of the duct and mist chamber and flow back into the tank via the drain 21.

The air then exits via the blower, outlet chamber 29 and the exit grill 27. Thus a constant stream of humidified air, rich in negative ions is pumped into the surroundings, thus improving the atmosphere.

An example of a unit according to this preferred embodiment was constructed having a plate diameter of 150 mm and a rotational speed of 2700 rpm. The blower provided an air flow rate of 2 cubic metres per minute. Under these conditions, the measured ion density was found to be about 3×10^5 ions per cc which is equivalent to an output of about 10^8 ions per second.

The consumption of water for humidification was found to be dependent upon ambient air humidity. At 50% humidity, consumption was about 400 cc per hour whilst at 70% humidity it was about 200 cc per hour, ambient temperature being 20°C.

Figure 2 shows as an alternative to the pump system, an impeller system for delivering water to a single plate.

The drive motor 101 is mounted on motor deck 103 and rotationally drives a single plate 105 by means of a drive shaft 107. An impeller 109 is

attached to the bottom of the drive shaft and is contained within a housing 111 which is contiguous with an upstanding conduit 113 which surrounds the drive shaft. The housing, which has an inlet 115 is located beneath the surface 117 of water in a holding vessel.

Rotation of the impeller causes water to be drawn into the housing via the inlet and up the conduit to be splashed outward towards the plate.

A modified vortex system somewhat analogous to that shown in Figure 2 is shown in Figure 3. Like components are denoted by the same reference numerals.

In this case, a lower plate 119 is arranged below and spaced apart from the main plate 105 to define a gap therebetween which has an opening 121 at the circumference of the plates. The gap communicates with a downwardly extending tube 123 having an open lower end 125 below the surface of the water.

Rotation of the assembly causes a partial vacuum in the gap, air being ejected via the opening 121 due to centripetal forces. The vacuum causes water to enter the opening and flow up the tube, whereupon, it is sprayed across the upper plate to be ejected at the opening.

Claims

1. An ionizer (1) comprising shear means for subjecting water to shear and air impulsion means (23) for bringing air into contact with the sheared water, characterised in that the shear means comprises a plate (31/33), a drive (37) for rotating the plate (31/33) and means (39/41) for spraying water onto the plate (31/33) whilst it is rotating.
2. An ionizer according to claim 1, further characterised in that the drive (37) is arranged to rotate the plate at a speed of from 1000 rpm to 5000 rpm.
3. An ionizer according to either preceding claim, further characterised in that the shear means comprises a pair of plates (31,33) and the means for spraying water onto the plates comprises respective nozzles (39,41).
4. An ionizer according to any preceding claim, further characterised in that the plate (31/33) has a non-smooth surface for contacting the water.
5. An ionizer according to any preceding claim, further characterised in that the water is supplied from a tank (13) and the plate (31/33) is arranged inside a mist chamber (5) provided

with a return drain path (21) for returning non-vapourised water to the tank (13).

6. An ionizer according to claim 5, further characterised in that a tortuous path (19) is provided for air leaving the mist chamber (5). 5
7. An apparatus according to claim 1 or claim 2, further characterised in that the means for spraying water comprises an impeller arranged to rotate with the plate (31/33) inside a housing (111) and means (113) for delivering water from the housing to the plate. 10
8. An apparatus according to claim 1 or claim 2, further characterised in that the means for spraying water comprises means (119) defining a gap with plate (31/33) and arranged to rotate with said plate (31/33) and with a tube (123) for creating a vortex to deliver water to the plate (31/33). 15 20
9. An ionizer according to claim 5 or 6, further characterised in that the air impulsion means (23) comprises a blower upstream of the mist chamber (5) to blow air into said mist chamber (5). 25
10. An ionizer according to claim 5 or 6, further characterised in that the air impulsion means comprises a blower downstream of the mist chamber (5) to suck air through said mist chamber (5). 30

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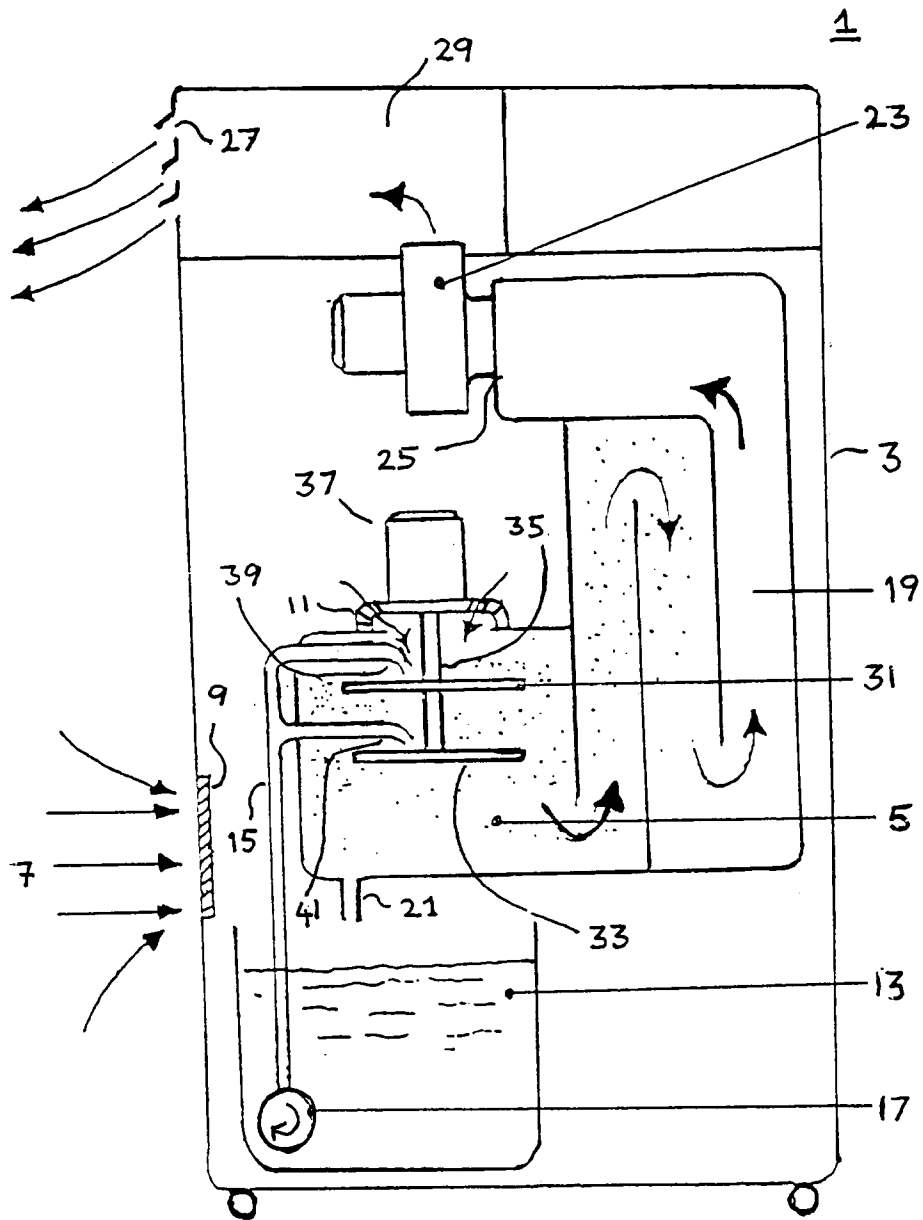


FIG 1

FIG 2

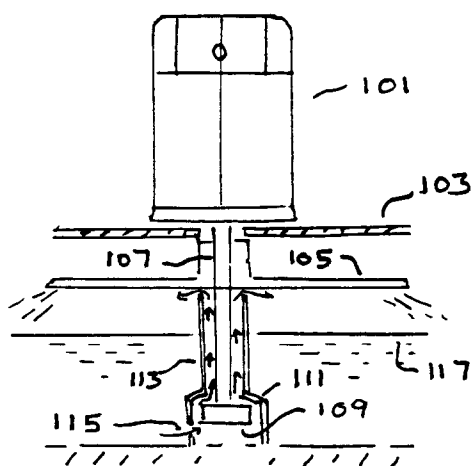
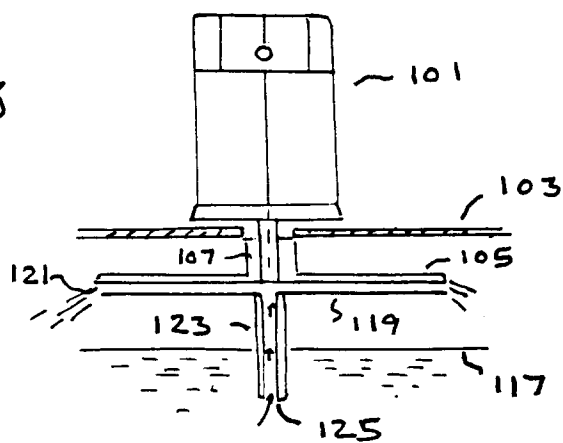


FIG 3





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EUROPEAN SEARCH REPORT

Application Number

EP 92 30 0927

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-B-1 279 915 (ALBIN SPRENGER KOMMANDIT-GESELLSCHAFT) * column 2, line 40 - column 3, line 10; figure 1 *	1,2,4,5, 7,10	F24F 6/16
X	DE-A-3 603 112 (DÜPRO AG) * column 5, line 43 - column 6, line 66 *	1,8	
X	DE-U-1 876 686 (GEBR. STUHLMANN) * page 5, paragraph 2 - page 6, paragraph 2 *	1,9	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F24F
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 23 SEPTEMBER 1992	Examiner PIEPER C.
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