AIR DISTRIBUTION APPARATUS

Technical Field

The present invention generally relates to an air distribution apparatus. In particular, the present invention relates to an air distribution apparatus for projecting conditioned air along a plurality of discrete air flow paths.

Background

In non-enclosed spaces, it is difficult to target a specific area for efficient cooling or heating, especially when the target area is outdoors. The cooled or heated air is usually directed to a general area and is then allowed to diffuse into the surrounding areas. As such, there is lot of wastage in energy, which is both costly and harmful to the environment.

In hot weather, it is desirable to have a device that can cool an area and reduce the temperature to a comfortable level. Similarly, in cold weather, it is desirable to have device that can heat up the area.

One present method for cooling air is to use an air conditioning device comprising nozzles to atomize and spray water into the surrounding air to accomplish a cooling effect. However, a disadvantage of this system is that there is an unwelcome damping effect on the surroundings due to the moisture emitted. As such, people and objects in the surrounding vicinity of the device will be dampened by the spray.

Another method for cooling air is to employ an evaporative cooling tower which utilizes the evaporation of water to remove heat from the air. Due to the said

evaporation, the evaporative cooling tower also functions as a humidifier. Plainly, its humidifier function causes a problem in places where the air is already humid to begin with. As such, use of the evaporative cooling tower is for practical reasons limited to low humidity climates.

Accordingly, there is a need to provide an apparatus that can overcome, or at least ameliorate, one or more of the disadvantages described above.

Summary

According to a first aspect, there is provided an air distribution apparatus comprising:

a housing having a housing inlet at one end for receiving air into said housing and a housing outlet at another end for transmitting air from said housing;

air conditioning means for adjusting the condition of said air within said housing relative to ambient air conditions outside of said housing; and

an air distributor in fluid communication with the outlet of said housing and being configured to project said conditioned air along a plurality of discrete air flow paths.

Advantageously, the air distribution apparatus is capable of adjusting the conditions of ambient air to a more comfortable level. More advantageously, the air distribution apparatus is able to provide a specific pre-determined location with air that that has been conditioned to suit a specific need. The energy utilized by the air distribution apparatus is optimized because

only the specific pre-determined locations will be cooled or heated. In this way, energy wastage is minimized.

Definitions

The following words and terms used herein shall have the meaning indicated:

The term "air conditioning" as used herein refers to the adjustment of the temperature and/or humidity in an environment. In particular, it refers to the raising or lowering of the temperature and/or humidity in an environment to a pre-selected level.

The term "ambient air conditions" as used herein refers to the naturally occurring temperature and/or moisture content of the air of the surrounding environment. Of course it will be appreciated that the "ambient air conditions" of an indoor environment may differ from the "ambient air conditions" of an outdoor environment.

The term "humidity" as used herein generally refers to the amount of water vapour in the air. The term "humidity" is to be interpreted broadly to include any one of relative humidity, absolute humidity, specific humidity and percentage humidity.

The term "conditioned air" as used herein refers to air whose temperature and/or moisture content has been controlled and/or adjusted.

The term "air flow path" as used herein refers to the path that the air follows upon leaving the outlet.

The term "discrete air flow paths" as used herein means that the air flow paths are distinct from each other

and do not mix. However the air flow paths may cross over one another.

The term "upstream" as used herein refers to a location along the direction of flow that is closer to the beginning of the flow than another location. For example, if the housing inlet is upstream of the air conditioning means, the location of the housing inlet along the direction of flow, as compared to the location of the air conditioning means, is closer to the beginning of the flow. In other words, the air will first flow past the housing inlet, and then flow past the air conditioning means.

The term "downstream" as used herein refers to a location along the direction of flow that is closer to the end of the flow than another location. For example, if the housing outlet is downstream of the air conditioning means, the location of the housing outlet along the direction of flow, as compared to the location of the air conditioning means, is closer to the end of the flow. In other words, the air will first flow past the air conditioning means, and then flow pass the housing outlet.

The word "substantially" does not exclude "completely". Where necessary, the word "substantially" may be omitted from the definition of the invention.

Unless specified otherwise, the terms "comprising" and "comprise", and grammatical variants thereof, are intended to represent "open" or "inclusive" language such that they include recited elements but also permit inclusion of additional, unrecited elements.

As used herein, the term "about", typically means +/- 5% of the stated value, more typically +/- 4% of the stated value, more typically +/- 3% of the stated value,

more typically, +/- 2% of the stated value, even more typically +/- 1% of the stated value, and even more typically +/- 0.5% of the stated value.

Throughout this disclosure, certain embodiments may be disclosed in a range format. It should be understood that the description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the disclosed ranges. Accordingly, the description of a range should be considered to have specifically disclosed all the possible sub-ranges as well as individual numerical values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed sub-ranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 3, 4, 5, and 6. This applies regardless of the breadth of the range.

Disclosure of Optional Embodiments

Exemplary, non-limiting embodiments of an air distribution apparatus will now be disclosed.

The disclosed embodiments describe an air distribution apparatus comprising a housing having a housing inlet at one end for receiving air into the housing and a housing outlet at another end for transmitting air from the housing. The air distribution apparatus also comprises air conditioning means for adjusting the condition of the air within the housing relative to ambient air conditions outside of the housing, and an air distributor in fluid communication with the outlet of the housing, wherein the air distributor is

configured to project the conditioned air along a plurality of discrete air flow paths.

The housing may be a substantially elongate housing defining a hollow chamber disposed along a longitudinal axis of the housing. In one embodiment, the longitudinal axis of the housing is substantially perpendicular to the ground. The longitudinal axis may be straight or curved.

The outlet may further comprise a plurality of projecting arms that project at a plurality of offset angles from the longitudinal axis of the housing. The offset angle may be in the range of about 0° to about 180°. The offset angle may be selected from the group consisting of more than about 0° to about 30°, more than about 0° to about 60°, more than about 0° to about 90°, more than about 0° to about 120°, more than about 0° to about 150°, more than about 0° to about 180°, about 30° to about 60°, about 60° to about 90°, about 90° to about 120°, about 120° to about 150° and about 150° to about 180°. The offset angle may also be perpendicular (i.e. 90°) or parallel (i.e. 0°). In one embodiment, the offset angle is about 30°. In another embodiment, the offset angle is about 45°.

The projecting arms may be straight or curved. In one embodiment, the plurality of projecting arms are configured to provide the plurality of discrete air flow paths. Advantageously, air exiting the housing outlet is guided by the projecting arms. In this way, the air flows along the projecting arms to form the plurality of discrete air flow paths.

The plurality of projecting arms may be adjustable so as to allow an individual to fine tune the area to be heated or cooled. Advantageously, the direction of the air

flow can be adjusted and directed along specific air flow paths by adjusting the direction of the projecting arms of the housing outlet. The projecting arms may be adjusted by mechanical, electronic, electro-mechanical, pneumatic or hydraulic means. The mechanism for adjusting the plurality of projecting arms may be located remotely from the housing, or on the housing itself. In one embodiment, the direction of the projecting arms may be electronically adjusted by a remote control. In another embodiment, the direction of the projecting arms may be controlled by a mechanical switch located on the housing.

The housing may be of any configuration, shape or size. In one embodiment, the air distribution apparatus is configured to resemble a tree. The substantially elongate housing defining a hollow chamber may represent the trunk of the tree, and the plurality of projecting arms may represent the branches of the tree. Advantageously, when the air distribution apparatus has a tree-like appearance, the air distribution apparatus is more aesthetically pleasing. The housing may also comprise a removable panel for access to the hollow chamber within the housing. In the embodiment where the air conditioning means is disposed within the housing, the removable panel can allow access to the air conditioning means.

The housing of the air distribution apparatus may be customizable to make it more suitable for the surroundings. For example, the air distribution apparatus may be in a form of a palm tree when it is located on a beach. Advantageously, air distribution apparatus is able to blend in with its surrounding environment and as such, will not be viewed as an eyesore.

The housing and the projecting arms may be manufactured from any suitable material. Exemplary materials include cement with sand mix, paper with plaster, wood, polymeric materials, glass, fabric, paperboard, recycled materials and the like. Advantageously, cement with sand mix and paper with plastic are relatively easy to mould into a desired shape. More advantageously, these materials are resistant to water and fire. Accordingly, if the housing and projecting arms are manufactured from cement with sand mix or paper with plastic, the housing and projecting arms are waterproofed and fire-resistant.

In one embodiment, the housing outlet further comprises an air permeable chamber configured to exhaust air along the plurality of discrete air flow paths. The air permeable chambers may comprise a plurality of discrete apertures to permit the exhausting of air along the plurality of discrete air flow paths.

The air permeable chamber may be of any suitable shape and size. The air permeable chamber may have a substantially cuboid, cylindrical, frusto-conical or spherical configuration. In one embodiment, the air permeable chamber is substantially cylindrical in configuration.

Portions of the air permeable chamber may have reduced permeability to air compared to other portions of the air permeable chamber. For example, in the embodiment where the air permeable chamber is substantially cylindrical in configuration, the end of the cylindrical air permeable chamber distal to the housing outlet has a

substantially reduced air permeability relative to the wall of the cylindrical air permeable chamber.

The end of the cylindrical air permeable chamber distal to the housing outlet is usually the top portion of the air permeable chamber, whereas the wall of the cylindrical air permeable chamber is usually at the side. Advantageously, the conditioned air is preferably exhausted from the side of the chamber instead of the top of the chamber. In this way, the areas surrounding the side of the cylindrical chamber can be cooled or heated. Energy wastage is also minimized as the conditioned air is less likely to be released through the top of the chamber, where it is not required.

The air permeable chamber may be manufactured from any suitable material. Exemplary materials include any type of cement with sand mix, paper with plaster, textile, fabric or cloth. In one embodiment, the air permeable chamber is a fibre duct. The chamber may be a rigid structure or an inflatable or collapsible structure.

The air conditioning means comprises an air inlet for receiving ambient air and an air outlet for releasing conditioned air. The air conditioning means may be disposed within the housing or exteriorly of said housing. In one embodiment, the air conditioning means is disposed within the housing. In another embodiment, the air conditioning is disposed exteriorly of said housing.

The housing inlet may comprise a plurality of inlets disposed at an end of said housing. In one embodiment, the housing inlet comprises a plurality of inlets disposed at an end of said housing upstream of said air conditioning means. The housing outlet may comprise a plurality of outlets disposed at another end of said housing,

downstream of said housing inlets. In one embodiment, the housing outlet comprises a plurality of outlets disposed an end of said housing downstream of said air conditioning means. In this way, air enters the inlet or plurality of inlets, passes through the air conditioning means, and then exits through the outlet or plurality of outlets. Advantageously, the ambient air that enters the housing inlet is conditioned by the air conditioning means to a pre-selected level, before exiting the housing through the housing outlet. The pre-selected level may be determined by an individual to be a comfortable condition as compared to the prevailing ambient conditions.

The air conditioning means may be located upstream of said housing. In this embodiment, the outlet of the air conditioning means is in fluid communication with the housing inlet. Ambient air enters the inlet of the air conditioning means and conditioned air exits from the air conditioned means. The conditioned air then enters the housing inlet and the conditioned air is projected from the outlet of the housing along a plurality of discrete air flow paths.

The air conditioning means may also be disposed within the housing. The air conditioning means may be plugged into a power source located outside of said housing or within said housing. In one embodiment, the air conditioning means and its power source is located within the housing. In this embodiment, the power source is a movable power source. In one embodiment, the air conditioning means is solar powered. Advantageously, the air distribution apparatus is a self-contained mobile unit. More advantageously, the air distribution apparatus can be easily moved from one location to another. Yet

more advantageously, the air distribution apparatus can be placed at a location that does not have access to an external power source. For example, if the air distribution apparatus has its own power source, such as a solar power source, located on or within the housing, the air distribution apparatus can be placed on a beach. If the solar power source is located within the housing, the solar power source may have solar panels that are located on the exterior of the housing.

The air conditioning means may be any device or system capable of adjusting the conditions of ambient air. The air conditioning means may comprise of one or more of a humidifier, a dehumidifier, an adsorption system and an absorption system. The air conditioning means may also utilize a source of waste heat.

In one embodiment, the air conditioning means is a humidifier. The humidifier serves to increase the humidity level or moisture content of the air. In another embodiment, the air conditioning means is a dehumidifier. The dehumidifier serves to reduce humidity level or moisture content of the air. In one embodiment, the air conditioning means is an absorption system. The absorption system may be an absorption refrigerator that uses a heat source to provide the energy needed to drive the cooling system.

The air conditioning means may also be an adsorption system such as an adsorption chiller. In one embodiment, the adsorption system is a regenerative adsorption system. An exemplary regenerative adsorption system is the regenerative adsorption system disclosed in International Application Number PCT/SG2004/000127 (International Publication Number WO 2005/108880). The adsorption chiller

or the regenerative adsorption system utilizes water as a refrigerant and can chill water in an adsorption mode and then utilize a heat source to regenerate the adsorbent in a desorption mode. The heat source may be a waste heat source, a solar heat source or a geothermal heat source. Exemplary waste heat sources include flue gases from gas turbines in power plants and incinerators, process gases of chemical and metallurgical operations and waste heat from other industrial processes. Advantageously, using low-grade energy sources, such as waste heat and solar energy to drive the adsorption system provides makes it energy-efficient and environmentally friendly.

The temperature of the ambient air may be more than about 10°C, more than about 20°C, more than about 30°C or more than about 40°C, and the temperature of the conditioned air may be less than about 40°C, less than about 30°C, less than about 30°C, less than about 20°C or less than about 10°C. In one embodiment, the temperature of the ambient air is higher than the temperature of the conditioned air.

The temperature of the ambient air may also be less than about 40°C, less than about 30°C, less than about 30°C, less than about 20°C or less than about 10°C, and the temperature of the conditioned air may be more than about 10°C, more than about 20°C, more than about 30°C or more than about 40°C. In one embodiment, the temperature of the ambient air is lower than the temperature of the conditioned air.

The percentage humidity of the ambient air may be less than about 100%, less than about 90%, less than about 80%, less than about 70% less than about 60%, less than about 50%, less than about 40%, less than about 30%, less

than about 20% or less than about 10%, and the percentage humidity of the conditioned air may be more than about 0%, more than about 10%, more than about 20%, more than about 30%, more than about 40%, more than about 50%, more than about 60%, more than about 70%, more than about 80% or more than about 90%. In one embodiment, the percentage humidity of the ambient air is higher than the percentage humidity of the conditioned air. In another embodiment, the percentage humidity of the ambient air is lower than the percentage humidity of the conditioned air.

Brief Description Of Drawings

The accompanying drawings illustrate a disclosed embodiment and serves to explain the principles of the disclosed embodiment. It is to be understood, however, that the drawings are designed for purposes of illustration only, and not as a definition of the limits of the invention.

Fig. 1 shows a first embodiment of the air distribution apparatus.

Fig. 2 shows a second embodiment of the air distribution apparatus.

Fig. 3 shows a third embodiment of the air distribution apparatus.

Detailed Description

Exemplary, non-limiting embodiments of an air distribution apparatus will now be disclosed.

Referring to Fig. 1, there is shown an air distribution apparatus 100, in the form of a tree. The air

distribution apparatus 100 has a housing 102 having a housing inlet 104 for receiving air into the housing 102, and a housing outlet 106 for transmitting air from said housing 102. The housing 102 is substantially elongate and defines a hollow chamber 103 disposed along a longitudinal axis of said housing. The housing 102 is in the form of a tree trunk.

The air distribution apparatus 100 also comprises an air conditioning means 108 for adjusting the condition of the air within the housing 102 relative to ambient air conditions outside of said housing 102. The air distribution apparatus 100 further comprises an air distributor 110, in fluid communication with the housing outlet 106. The air distributor 110 is configured to project conditioned air along a plurality of discrete air flow paths. Two discrete air flow paths are shown as 112a and 112b.

The housing outlet 106 further comprises a plurality of projecting arms. For clarity, only three of the projecting arms have been labeled as 114a, 114b and 114c. The projecting arms 114a, 114b and 114c are curved, and project at a plurality of offset angles from the longitudinal axis. Each projecting arm may project at a different offset angle from the longitudinal axis. For example, projecting arm 114c projects at an offset angle θ_c from the longitudinal axis. The projecting arms 114a, 114b and 114c are in the form of branches of a tree.

The air conditioning means 108 is located exteriorly of the housing 102. The air conditioning means 108 is in the form of a solar cooling unit. The solar cooling unit has a plurality of solar panels located thereon, which

serves as a power source for powering the cooling unit. Ambient air from outside the housing enters the solar cooling unit to be cooled. In this way, the ambient air is conditioned by the air conditioned means 108. The conditioned air enters the housing 102 via the housing inlet 104 and travels through the hollow chamber 103 of the housing 102 until it reaches the air distributor 110. The air distributor 110 then projects the conditioned air out of the housing outlet 106. The conditioned air travels along the plurality of projecting arms (only 114a, 114b and 114c are labeled) in a plurality of discrete air flow paths (only 112a and 112b are shown). The plurality of projecting arms are configured to provide the plurality of discrete air flow paths. In particular, The projecting arm 114a provides the discrete air flow path 112a.

Referring to Fig. 2, there is shown a second embodiment of an air distribution apparatus 200, in the form of a tree. The air distribution apparatus 200 has a housing 202 having a plurality of housing inlets 204 for receiving air into the housing 202, and a housing outlet 206 for transmitting air from said housing 202. The housing 202 is substantially elongate and defines a hollow chamber 203 disposed along a longitudinal axis of said housing. The housing 202 is in the form of a tree trunk.

The air distribution apparatus 200 also comprises an air conditioning means 208 for adjusting the condition of the air within the housing 202 relative to ambient air conditions outside of said housing 202. The air distribution apparatus 200 further comprises an air distributor 210, in fluid communication with the housing outlet 206. The air distributor 210 is configured to

project conditioned air along a plurality of discrete air flow paths. Five discrete air flow paths are shown as 212a, 212b, 212c, 212d and 212e.

The housing outlet 206 further comprises a plurality of projecting arms. For clarity, only three of the projecting arms have been labeled as 214a, 214b and 214c. The projecting arms 214a, 214b and 214c are curved, and project at a plurality of offset angles from the longitudinal axis. The projecting arms 214a, 214b and 214c are in the form of branches of a tree. The external appearance of the air distribution apparatus 200 is similar to the air distribution apparatus 100 in Fig. 1. However, the air conditioning means 208 is disposed within the housing 202. The plurality of inlets 204 are disposed at an end of the housing 202, upstream of the air conditioning means 208, while the outlet 206 is disposed at an end of the housing 202, downstream of the air conditioning means 208.

The air conditioning means 208 is in the form of a cooling coil. The cooling coil is provided with chilled water via conduit 216. A fan 218 downstream of said air conditioning means 208 draws ambient air from outside the housing 202 into the housing 202 via the plurality of inlets 204. The air is then conditioned by the conditioning means 208. The conditioned air travels through the hollow chamber of the housing 202 until it reaches the air distributor 210. The air distributor 210 then projects the conditioned air out of the housing outlet 206. The conditioned air travels along the plurality of projecting arms (only 214a, 214b and 214c are labeled) in a plurality of discrete air flow paths (only

212a, 212b, 212c, 212d and 112e are shown). The plurality of projecting arms are configured to provide the plurality of discrete air flow paths. In particular, The projecting arm 214a provides the discrete air flow path 212a.

Referring to Fig. 3, there is shown a third embodiment of an air distribution apparatus 300. The air distribution apparatus 400 comprises a housing 302 having a housing inlet 304 for receiving air into the housing 302 and a housing outlet 306 for transmitting air from said housing 302. The air distribution apparatus 300 also comprises an air conditioning means 308 and an air distributor 310 in fluid communication with the housing outlet 306. The air distribution apparatus 300 further comprises an air permeable chamber 312. The air permeable chamber 312 is substantially cylindrical in configuration. The end 316 of the cylindrical air permeable chamber 312 distal to the housing outlet has a substantially reduced air permeability relative to the wall of the cylindrical air permeable chamber 312.

In use, ambient air enters the housing 302 via the housing inlet 304. The ambient air is conditioned by conditioning means 308 and projected from the housing outlet 306 and through the air permeable chamber 312, along a plurality of discrete air flow paths. Six discrete air flow paths are shown as 314a, 314b, 314c, 314d, 314e and 314f.

Applications

It should be appreciated that the air distribution apparatus disclosed herein can provide a means of conditioning ambient air to a pre-determined level and distributing the conditioned air in a useful and efficient manner.

Advantageously, the air distribution apparatus can be directed to cool or heat specific pre-determined locations such that energy wastage is minimized. More advantageously, the air distribution apparatus is both cost efficient and environmentally friendly.

Advantageously, there is no unwelcome damping effect such as that which occurs with an evaporation cooling system. More advantageously, the air distribution apparatus can be used both in places with high humidity levels and low humidity levels.

It will be apparent that various other modifications and adaptations of the invention will be apparent to the person skilled in the art after reading the foregoing disclosure without departing from the spirit and scope of the invention and it is intended that all such modifications and adaptations come within the scope of the appended claims.

Claims

1. An air distribution apparatus comprising:

a housing having a housing inlet at one end for receiving air into said housing and a housing outlet at another end for transmitting air from said housing;

air conditioning means for adjusting the condition of said air within said housing relative to ambient air conditions outside of said housing; and

an air distributor in fluid communication with the outlet of said housing and being configured to project said conditioned air along a plurality of discrete air flow paths.

2. An air distribution apparatus as claimed in claim 1, wherein said housing is a substantially elongate housing defining a hollow chamber disposed along a longitudinal axis of said housing.

3. An air distribution apparatus as claimed in claim 2, wherein said outlet further comprises a plurality of projecting arms that project at a plurality of offset angles from the longitudinal axis of said housing.

4. An air distribution apparatus as claimed in claim 3, wherein said plurality of projecting arms are configured to provide the plurality of discrete air flow paths.

5. An air distribution apparatus as claimed in any of claims 2 to 4, wherein the longitudinal axis of said housing is substantially perpendicular to the ground.

6. An air distribution apparatus as claimed in claim 1, wherein said housing outlet further comprises an air permeable chamber configured to exhaust air along said plurality of discrete air flow paths.

7. An air distribution apparatus as claimed in claim 6, wherein said air permeable chamber is substantially cylindrical in configuration.

8. An air distribution apparatus as claimed in claim 7, wherein the end of said cylindrical air permeable chamber distal to the housing outlet has a substantially reduced air permeability relative to the walls of said cylindrical air permeable chamber.

9. An air distribution apparatus as claimed in any of claims 1 to 8, wherein said air conditioning means comprises an air inlet for receiving ambient air and an air outlet for releasing conditioned air.

10. An air distribution apparatus as claimed in any of claims 1 to 9, wherein said air conditioning means is disposed within said housing.

11. An air distribution apparatus as claimed in any of claims 1 to 10, wherein said housing inlet comprises a plurality of inlets disposed at an end

of said housing, upstream of said air conditioning means.

12. An air distribution apparatus as claimed in any of claims 1 to 11, wherein said outlet comprises a plurality of outlets disposed at an end of said housing, downstream of said air conditioning means.

13. An air distribution apparatus as claimed in any of claims 1 to 9, wherein said air conditioning means is located upstream of said housing.

14. An air distribution apparatus as claimed in any of claims 1 to 13, wherein said air conditioning means is one of more of a humidifier, a dehumidifier, an adsorption system and an absorption system.

15. An air distribution apparatus as claimed in claim 14, wherein said adsorption system is a regenerative adsorption system.

16. An air distribution apparatus as claimed in any of claims 1 to 15, wherein said air conditioning means utilizes a source of waste heat.

17. An air distribution apparatus as claimed in any of claims 1 to 16, wherein the temperature of said ambient air is higher than the temperature of said conditioned air.

18. An air distribution apparatus as claimed in any of claims 1 to 16, wherein the temperature of said

ambient air is lower than the temperature of said conditioned air.

19. An air distribution apparatus as claimed in any of claims 1 to 18, wherein the percentage humidity of said ambient air is higher that the percentage humidity of said conditioned air.

20. An air distribution apparatus as claimed in any of claims 1 to 18, wherein the percentage humidity of said ambient air is lower than the percentage humidity of said conditioned air.