

DESCRIPTION

Title of Invention

RADIANT COOLING AND HEATING APPARATUS

Technical Field

[0001]

The present invention relates to a radiant cooling and heating apparatus.

Background Art

[0002]

The present inventors have previously proposed a radiant cooling and heating apparatus with which sensible temperatures can be controlled by directly exerting far-infrared rays on human bodies using resonance between far-infrared radiation substances applied to, for example, the surfaces of radiators (cooling and heating radiant panels) and far-infrared radiation substances included in wall materials and/or ceiling materials (for example, PTL 1) and put the apparatus into practical use.

[0003]

In the above-described radiant cooling and heating apparatus, a cooling and/or heating surface is constituted of a radiator having a fin, and a drain outlet is provided in a water droplet-receiving portion below the radiator in

order to discharge water droplets generated on the surface of the radiator due to the condensation of moisture in the air during cooling operations outdoors.

[0004]

In addition, even in ordinary radiant cooling and heating apparatuses of the related art in which far-infrared radiation substances are not used, water droplets generated on the surfaces of radiators due to condensation during cooling operations are discharged outdoors from a drain outlet.

Citation List

Patent Literature

[0005]

[PTL 1] JP-A-2011-106808

Summary of Invention

Technical Problem

[0006]

The present inventors had an object of purifying and reusing water droplets generated on the surfaces of cooling and heating radiant panels due to the condensation of moisture in the air during cooling operations in radiant cooling and heating apparatuses and achieved the present invention.

Solution to Problem

[0007]

The present invention provides the following inventions in order to achieve the above-described object.

(1) A radiant cooling and heating apparatus, including: a cooling and/or heating surface which is constituted of a cooling and heating radiant panel; a drain outlet which is provided in a water droplet-receiving portion below the cooling and heating radiant panel in order to discharge water droplets generated on a surface of the cooling and heating radiant panel due to condensation of moisture in the air during cooling operations; and a storage tank for storing and reusing condensed water discharged from the drain outlet, in which the supplied condensed water comes into contact with a far-infrared radiation substance in the storage tank and/or comes into contact with a far-infrared radiation substance outside the storage tank and then circulates into the storage tank.

(2) The radiant cooling and heating apparatus according to (1), in which the surface of the cooling and heating radiant panel includes a far-infrared radiation substance.

(3) The radiant cooling and heating apparatus

according to (1) or (2), in which an inside surface of the storage tank includes a far-infrared radiation substance.

(4) The radiant cooling and heating apparatus according to any one of (1) to (3), in which a far-infrared radiation substance is provided in a bottom portion of the storage tank.

(5) The radiant cooling and heating apparatus according to any one of (1) to (4), in which a tank or a flow passage including a far-infrared radiation substance is provided outside the storage tank so as to bring the condensed water supplied to the storage tank into contact with the far-infrared radiation substance outside the storage tank and then circulate the condensed water into the storage tank.

(6) The radiant cooling and heating apparatus according to any one of (1) to (5), in which the condensed water discharged from the drain outlet is further brought into contact with a far-infrared radiation substance and then is supplied to the storage tank.

(7) The radiant cooling and heating apparatus according to any one of (1) to (6), in which the radiant cooling and heating apparatus has an indoor surface-constituting member constituted of a material including a far-infrared radiation substance which radiates and absorbs far-infrared rays and has a far-infrared

emissivity of 0.6 or higher, the surface of the cooling and heating radiant panel is constituted of a material including the same far-infrared radiation substance as the far-infrared radiation substance of the indoor surface-constituting member, and when the surface of the cooling and heating radiant panel is cooled, the far-infrared radiation substance on the surface absorbs far-infrared rays radiated by the far-infrared radiation substance of the indoor surface-constituting member, and/or, when the surface of the cooling and heating radiant panel is heated, the far-infrared radiation substance of the indoor surface-constituting member absorbs far-infrared rays radiated by the far-infrared radiation substance on the heated surface.

(8) A method for using condensed water, including: using condensed water purified by the radiant cooling and heating apparatus according to any one of (1) to (7) as purified water.

Advantageous Effects of Invention

[0008]

According to the present invention, it is possible to provide a radiant cooling and heating apparatus with which water droplets generated on the surface of a cooling and heating radiant panel due to the condensation of

moisture in the air during cooling operations can be purified and reused.

Brief Description of Drawings

[0009]

Fig. 1 is a schematic view illustrating an embodiment of a radiant cooling and heating apparatus of the present invention.

Description of Embodiments

[0010]

In a radiant cooling and heating apparatus of the present invention, a cooling and/or heating surface is constituted of a cooling and heating radiant panel, and a drain outlet is provided in a water droplet-receiving portion below the cooling and heating radiant panel in order to discharge water droplets generated on the surface of the cooling and heating radiant panel due to the condensation of moisture in the air during cooling operations. Furthermore, a storage tank for storing and reusing condensed water discharged from the drain outlet is provided, and the storage tank is constituted so that the supplied condensed water comes into contact with a far-infrared radiation substance in the storage tank and/or comes into contact with a far-infrared radiation

substance outside the storage tank and then circulates into the storage tank.

[0011]

The radiant cooling and heating apparatus is not particularly limited as long as cold water or hot water passes through the cooling and heating radiant panel; however, in the present invention, preferably, it is possible to employ a radiant cooling and heating apparatus having an indoor surface-constituting member constituted of a material including a far-infrared radiation substance which radiates and absorbs far-infrared rays and has a far-infrared emissivity of 0.6 or higher, in which the surface of the cooling and heating radiant panel is constituted of a material including the same far-infrared radiation substance as the far-infrared radiation substance of the indoor surface-constituting member, and when the surface of the cooling and heating radiant panel is cooled, the far-infrared radiation substance on the surface absorbs far-infrared rays radiated by the far-infrared radiation substance of the indoor surface-constituting member, and/or, when the surface of the cooling and heating radiant panel is heated, the far-infrared radiation substance of the indoor surface-constituting member absorbs far-infrared rays radiated by the far-infrared radiation substance on the heated surface.

Hereinafter, this example will be described as an aspect.

[0012]

The indoor surface-constituting member is constituted of a far-infrared radiation substance, is constituted of a material into which a far-infrared radiation substance is mixed, or has a membrane made of a far-infrared radiation substance. The cooling and/or heating surface of a cooling and/or heating source is constituted of a far-infrared radiation substance, is constituted of a material into which a far-infrared radiation substance is mixed, or is constituted of a membrane made of a far-infrared radiation substance.

[0013]

In the present invention, the indoor surface-constituting member refers to a member constituting surfaces exposed to enclosed spaces which are subjects of environmental adjustment. The enclosed space may include opening and closing means that enables communication between the inside and outside of the enclosed space such as doors or windows. The enclosed space is not particularly limited and, generally, refers to rooms, corridors, or the like in buildings in which human beings live and act. At least a part of the indoor surface-constituting member is constituted of a far-infrared radiation substance that radiates and absorbs far-infrared

rays necessary for the adjustment of indoor environments in the present invention, is constituted of a material into which a far-infrared radiation substance is mixed, or has a membrane made of a far-infrared radiation substance. In order to efficiently radiate and absorb far-infrared rays, the far-infrared radiation substance that is mixed into the indoor surface-constituting member is preferably exposed to indoor spaces. However, the far-infrared radiation substance in the indoor surface-constituting member does not need to be directly exposed to indoor spaces and may be covered with a protective layer (for example, a paint film, a varnish layer, a wallpaper, or the like having a thickness of approximately 1 mm or smaller) as long as the radiation and absorption of far-infrared rays by the far-infrared radiation substance is not significantly inhibited.

[0014]

Far-infrared radiation substances refer to substances that radiate and absorb far-infrared rays, but the far-infrared radiation substance used in the present invention is a far-infrared radiation substance having a far-infrared emissivity of 0.6 or higher and preferably 0.8 or higher.

[0015]

The above-described far-infrared radiation substance

is generally so-called inorganic materials, and examples thereof include natural and artificial minerals, oxides, nitrides, carbides, sulfides, hydroxides, and the like of metals and semimetals, salts such as carbonate and composites (double salts) thereof, coal, and the like, additionally, natural materials such as seashells, and the like. In addition, a majority of far-infrared radiation substances in the present invention are ceramic materials (referring to inorganic materials other than metal) in a broad sense, but organic substances or substances derived from organic substances can also be used as long as the above-described emissivity condition is satisfied.

[0016]

In the present invention, the form of the far-infrared radiation substance in members including the far-infrared radiation substance is not particularly limited as long as the members including the far-infrared radiation substance are capable of radiating and absorbing far-infrared rays and, typically, can be the form of single articles (stone materials) made of far-infrared radiation substances, members including the particles, powder, aggregates, and the like (these will also be referred to as particles) of far-infrared radiation substances, members including the membranes of far-infrared radiation substances, and the like. In the

present invention, "stone materials made of far-infrared radiation substances" refer to solid single articles made of natural or artificial inorganic materials and are, generally, used as panel or tile-shaped construction materials and the like. Examples of natural stone materials include granite, basalt, and the like. It is needless to say that the stone materials may be artificially-manufactured stone materials. Construction materials such as artificial panels or other single article members can be considered as stone materials.

[0017]

In the present invention, materials into which far-infrared radiation substances are mixed refer to materials including far-infrared radiation substances as part of the constituent components. In this case, typically, the far-infrared radiation substances are the particles of natural or artificial inorganic materials and are mixed into manufacturing materials for the indoor surface-constituting member.

[0018]

In the present invention, membranes made of far-infrared radiation substances refer to membranes of far-infrared substances formed on the surfaces of the indoor surface-constituting member or the cooling and/or heating source. These membranes can be formed by coating subject

surfaces with far-infrared radiation substances using appropriate membrane-forming techniques, for example, physical vapor deposition (PVD) techniques such as spraying and vapor deposition or chemical vapor deposition (CVD) techniques.

[0019]

In the present invention, the far-infrared radiation substance of the indoor surface-constituting member and the far-infrared radiation substance on the surface of the cooling and heating radiant panel are the same as each other. In the radiant cooling and heating apparatus of the present invention, indoor environments are adjusted by migrating heat at a high efficiency through thermal radiation between the indoor surface-constituting member and the surface of the cooling and heating radiant panel using a phenomenon in which heat migrates through thermal radiation at a higher efficiency between the same molecular species than between different molecular species. Therefore, in order to make the radiant cooling and heating apparatus of the present invention exhibit desired functions, it is necessary that substances of the same molecular species are present in the indoor surface-constituting member and the surface of the cooling and heating radiant panel between which heat migrates through thermal radiation. In the present invention, the far-

infrared radiation substance of the indoor surface-constituting member and the far-infrared radiation substance of the cooling and/or heating source which are constituted of the same molecular species will be referred to as the same substances. Here, "the same molecular species" means that one substance which exhibits properties of radiating and absorbing far-infrared rays and has a far-infrared emissivity of 0.6 or higher and preferably 0.8 or higher (for example, the far-infrared radiation substance used in the indoor surface-constituting member) and the other substance which exhibits properties of radiating and absorbing far-infrared rays and has a far-infrared emissivity of 0.6 or higher and preferably 0.8 or higher (for example, the far-infrared radiation substance used on the surface of the cooling and heating radiant panel) are the same as each other in the molecular level. Here, molecules refer to groups of atoms bonded by means of chemical bonds. Therefore, examples of molecules mentioned herein also include crystal and the like of minerals constituting natural stone materials. The same minerals in which similar elements are substituted or form solid solutions are considered as substances of the same molecular species. Natural minerals are generally constituted of a plurality of compounds, and furthermore, there are cases in which

the crystal structures of the compounds differ depending on portion in the minerals in a macroscopic level. However, in this case, minerals excavated from the same origin are aggregates of substances of substantially the same molecular species having substantially the same composition and may be considered as the same as substances of the same molecular species as a whole.

[0020]

In a case in which inorganic material particles are used as the above-described far-infrared radiation substance in the indoor surface-constituting member or the surface of the cooling and heating radiant panel, it is not unusual that substances other than inorganic material particles as the far-infrared radiation substance coexist in the indoor surface-constituting member or the surface of the cooling and heating radiant panel. For example, in a case in which the indoor surface-constituting member is formed of mortar including inorganic material particles as the far-infrared radiation substance or a case in which paint including inorganic material particles as the far-infrared radiation substance is applied onto the surface of the cooling and heating radiant panel, inorganic material particles as the above-described far-infrared radiation substance coexist with binder components and the like in aggregates or paint in mortar. In such a case,

the above-described substances other than inorganic material particles as the far-infrared radiation substance also have properties of radiating or absorbing far-infrared rays to a greater or lesser extent. However, in the present invention, since a phenomenon in which heat migrates through thermal radiation at a significantly higher efficiency between the same molecular species than between different molecular species, the roles of substances that are not commonly present in both the indoor surface-constituting member and the surface of the cooling and heating radiant panel in the present invention are extremely small or ignorable. Therefore, in the following description of the present invention, in a case in which "far-infrared radiation substances" are mentioned, they refer to the same substances which are commonly present in both the indoor surface-constituting member and the surface of the cooling and heating radiant panel and have a far-infrared emissivity of 0.6 or higher and preferably 0.8 or higher (substances causing resonance phenomena of molecular vibrations between the same molecules through electromagnetic waves).

[0021]

In a case in which inorganic material particles are used as the far-infrared radiation substance in both the indoor surface-constituting member and the surface of the

cooling and heating radiant panel, the particle diameters or shapes of both particles may be the same as or different from each other. The amounts of inorganic material particles blended into both the indoor surface-constituting member and the surface of the cooling and heating radiant panel also do not need to be the same as each other. In addition, in a case in which the indoor surface-constituting member forms wall surfaces or ceiling surfaces, and inorganic material particles are used as the far-infrared radiation substances, the particle diameters or shapes of the far-infrared radiation substances in wall surfaces and ceiling surfaces may be the same as or different from each other. In this case, inorganic material particles are blended into the indoor surface-constituting member (for example, construction materials forming wall surfaces or ceiling surfaces) in amounts at which desired heat migration by the present invention through thermal radiation between the same molecular species is enabled. At this time, as construction materials forming wall surfaces and construction materials forming ceiling surfaces, the amount of inorganic material particles blended may be the same as or different from each other. This fact also applies to inorganic material particles of far-infrared radiation substances in each of two or more wall surfaces.

[0022]

In the indoor surface-constituting member and the surface of the cooling and heating radiant panel, a plurality of kinds of far-infrared radiation substances may be used. In a case in which far-infrared radiation substances are stone materials, combinations of two or more kinds of stone materials can be used for the indoor surface-constituting member or the surface of the cooling and heating radiant panel. In a case in which far-infrared radiation substances are inorganic material particles, mixtures of two or more kinds of inorganic material particles can be used. In any cases, when the combination of inorganic material particles in the indoor surface-constituting member and the combination of inorganic material particles on the surface of the cooling and heating radiant panel are the same as each other (when the same combinations are included), these combinations are considered as "the same substances".

[0023]

Inorganic material particles as the far-infrared radiation substances included in the indoor surface-constituting member and the surface of the cooling and heating radiant panel are present in amounts at which desired heat migration through thermal radiation between the same molecular species is enabled. Generally, it is

considered that, in many cases, the indoor surface-constituting member and the surface of the cooling and heating radiant panel are produced by different makers at places other than construction sites and are transported into construction sites or installed at construction sites. Therefore, it is considered that, in many cases, common inorganic material particles as the far-infrared radiation substances are mixed into the indoor surface-constituting member and the surface of the cooling and heating radiant panel by different makers or installers. In such cases, the contents of inorganic material particles as the far-infrared radiation substance refer to the amounts of common inorganic material particles included in individual manufacturing materials for the indoor surface-constituting member and the surface of the cooling and heating radiant panel by different makers. The contents of inorganic material particles in the indoor surface-constituting member and materials for forming the surface of the cooling and heating radiant panel can be determined as amounts at which heat migration by the present invention through thermal radiation is made effective. Those amounts are dependent on the amounts of heat migration necessary for desired cooling and/or heating, the areas of the indoor surface-constituting member and the cooling and/or heating surface which can be used for

heat migration through thermal radiation, the thermal radiation characteristics of far-infrared radiation substances being used, and the like. In measurement tests described below, effective effects are admitted in a case in which 1% by weight or more of inorganic material particles as the far-infrared radiation substance are present in materials for the indoor surface-constituting member or materials forming the surface of the cooling and heating radiant panel, and preferred effects can be obtained in a case in which 3% by weight or more of inorganic material particles as the far-infrared radiation substance are present. Meanwhile, in a case in which inorganic material particles are used as the far-infrared radiation substance, the upper limit of the contents thereof is determined by the maximum amount of inorganic material particles that can be actually included in materials forming the indoor surface-constituting member and the surface of the cooling and heating radiant panel and is not particularly limited (theoretically, may be, for example, even 90% by weight).

[0024]

In the present invention, as inorganic material particles as the far-infrared radiation substance, a plurality of kinds of substances may be used (a plurality of kinds of the above-described substances that are "the

same as each other in the molecular level" may be used). In this case, it is possible to use the same mixtures of inorganic material particles in the indoor surface-constituting member and the surface of the cooling and heating radiant panel. In this case, the contents of inorganic material particle in materials for the indoor surface-constituting member and materials forming the surface of the cooling and heating radiant panel are expressed using the total amount of a plurality of kinds of the same substances in mixtures.

[0025]

In order to efficiently radiate and absorb far-infrared rays, the far-infrared radiation substances are preferably exposed to indoor spaces in which environment adjustment is carried out as much as possible. However, even when the far-infrared radiation substances are not directly exposed to indoor spaces, there are no significant problems as long as the far-infrared radiation substances are covered with approximately 1 mm or thinner protective layers (for example, paint films, varnish layers, wallpapers, or the like).

[0026]

The far-infrared emissivity of the far-infrared radiation substance being used in the present invention is 0.6 or higher, preferably 0.8 or higher, and more

preferably 0.9 or higher. Far-infrared rays refer to electromagnetic waves having wavelengths in a range of 3 μm to 1,000 μm . The emissivity of materials is defined as W/W_0 in a case in which, under the same conditions, the far-infrared radiation energy of an ideal black body is represented by W_0 , and the far-infrared radiation energy of the material is represented by W . The value of the emissivity is preferably the emissivity at room temperature (for example, 25°C) near the actual operation temperature of the system of the present invention, and, for example, values at near 10 μm at which thermal actions to human bodies are significant are employed.

[0027]

In an aspect of the present invention, the surface of the fin in the cooling and heating radiant panel is coated by mixing a crushed substance of the far-infrared radiation substance and a binder and applying and drying the mixture in a lamellar shape. For example, on the surface of the fin, an approximately 200 μm -thick coating layer constituted of white paint into which a crushed substance of granite having a far-infrared emissivity exhibiting numeric values exceeding 0.9 (hereinafter, referred to as stone powder) is mixed is formed. The particle diameter of stone powder in the coating layer is 50 μm or smaller. The content ratio of the stone powder

in the coating layer is set to 20% by weight in a cured state (dried state) of the paint. Here, the cooling and heating radiant panel having the cooling and/or heating surface is constituted of a radiator having a fin coated with the far-infrared radiation substance, and a drainage system reaching from the drain outlet in the water droplet-receiving portion below the radiator to an outdoor drain exit is provided in order to discharge water droplets generated on the surface of the radiator due to the condensation of moisture in the air during cooling operations outdoors.

[0028]

The radiator includes, for example, a plurality of aluminum fins having coated surfaces. These fins have thin plate shapes and vertically extend. The fins can also be produced using other metals or alloy materials having favorable thermal conductivity, for example, iron, copper, or alloys thereof. The surface of the fin is coated by mixing a crushed substance of the far-infrared radiation substance and a binder and applying and drying the mixture in a lamellar shape.

[0029]

The fins are integrally formed with an aluminum supporting plate. The rear surface side of the supporting plate is exposed to a coolant passage. In the coolant

passage, cold water circulates as a coolant. This coolant is cooled using a coolant cooling apparatus which is a cooling source. The cooling mechanism of the coolant cooling apparatus is the same as that used in ordinary air conditioning apparatuses or refrigerators.

[0030]

Below a cooling surface, a drain outlet is provided. When cooling water circulates in the coolant passage, the fins are cooled, the far-infrared radiation substances on the surfaces of the fins are also cooled, and far-infrared rays radiated from the indoor surface-constituting member included in floor surfaces, wall surfaces, and ceiling surfaces are absorbed, thereby cooling the environment in rooms. In addition, moisture included in the air in indoor spaces is condensed on the surface of the cooling surface. The condensed water drops into the drain outlet, migrates from the drain outlet to the drain exit, and is discharged outdoors.

[0031]

Due to the cooling and/or heating source, the cooling and heating radiant apparatus is preferably used, and it is possible to switch cold radiation and thermal radiation. Cold radiation refers to an action of the cooling and heating radiant apparatus absorbing thermal radiation from the periphery when being cooled, and

thermal radiation refers to an action of the cooling and heating radiant apparatus performing thermal radiation toward the periphery when being heated.

[0032]

The above-described cooling and heating radiant apparatus is connected to a cold and hot water generation apparatus which is an outdoor device. The cold and hot water generation apparatus has a heat pump function and generates cold water or hot water. This heat pump function works in the same principle as that used in ordinary air conditioners and the like. Meanwhile, when only a cooling effect is required, the apparatus may have only a cold water generation function. In addition, when only a heating effect is required, the apparatus may have only a hot water generation function.

[0033]

When cold water is supplied from the cold and hot water generation apparatus to the cooling and heating radiant apparatus, the fins are cooled, and dehumidification by means of condensation is carried out. In addition, when cooled, the surfaces of the fins function as cooling surfaces that carry out cold radiation. In addition, when hot water is supplied from the cold and hot water generation apparatus to the cooling and heating radiant apparatus, the fins are warmed, and the surfaces

of the fins function as heating surfaces (thermal radiation surfaces). Meanwhile, cold water refers to water cooled using the cooling function of the cold and hot water generation apparatus, and hot water refers to water heated using the heating function of the cold and hot water generation apparatus. As described above, water droplets condensed on the fins are dropped and collected in a tray below and are discharged outdoors from the drain outlet.

[0034]

In an aspect of the present invention, on the surface of the fin, an approximately 200 μm -thick coating layer constituted of white paint into which a crushed substance of granite having a far-infrared emissivity exhibiting numeric values exceeding 0.9 (hereinafter, referred to as stone powder) is mixed is formed. The particle diameter of stone powder in the coating layer is 50 μm or smaller. The content ratio of the stone powder in the coating layer is set to 20% by weight in a cured state (dried state) of the paint. This coating layer functions as a cooling and dehumidification surface and a heating surface.

[0035]

In addition, in the radiant cooling and heating apparatus of the present invention, a storage tank for

supplying condensed water discharged from the drain outlet is provided. The storage tank is generally installed outdoors and is constituted so that the supplied condensed water comes into contact with a far-infrared radiation substance in the storage tank. The far-infrared radiation substance may be the same as or different from the far-infrared radiation substance included in the surface of the cooling and heating radiant panel.

[0036]

The storage tank is constituted so that the supplied condensed water comes into contact with a far-infrared radiation substance. For example, the inside surface of the storage tank may be coated with a far-infrared radiation substance, or a far-infrared radiation substance may be provide on the bottom portion and the like of the storage tank. The form of the far-infrared radiation substance disposed in the storage tank is not particularly limited and, typically, can be the form of single articles having a panel or tile shape which are made of far-infrared radiation substances, members including the particles, powder, aggregates, and the like (these will also be collectively referred to as particles) of far-infrared radiation substances, members having the membranes of far-infrared radiation substances, and the like. In the case of particles, the diameters thereof are

generally selected from a range of approximately 5 μm to 500 μm . The membranes can be formed by coating subject surfaces with far-infrared radiation substances using appropriate membrane-forming techniques, for example, PVD techniques such as spraying and vapor deposition or CVD techniques.

[0037]

In the present invention, it is also possible to further bring condensed water discharged from the drain outlet into contact with a far-infrared radiation substance and then supply the condensed water to the storage tank. That is, condensed water is supplied to the storage tank through a flow passage including a far-infrared radiation substance-filled layer.

[0038]

Furthermore, in the present invention, it is also possible to provide a tank or a flow passage (preferably including a far-infrared radiation substance-filled layer) including a far-infrared radiation substance outside the storage tank so that condensed water supplied to the storage tank comes into contact with the far-infrared radiation substance outside the storage tank and then circulates into the storage tank.

[0039]

In the present invention, temperatures at which

condensed water is brought into contact with the far-infrared radiation substance is not particularly limited, but is generally in a range of 5°C to 25°C. The contact duration is also not particularly limited, can be appropriately selected depending on the temperature and the use intention, but is generally in a range of 1 hour to 72 hours. Water obtained as described above can be reused as domestic water and gardening water. Since water supplied to the storage tank is condensed water generated on the surface of radiators due to the condensation of moisture in the air and is further subjected to the above-described purification treatment, the water can also be used as potable water.

[0040]

Fig. 1 is a schematic view illustrating an embodiment of the radiant cooling and heating apparatus of the present invention. In Fig. 1, condensed water which drops from the surface of a cooling and heating radiant panel 1 and is discharged from a drain outlet 3 in a water droplet-receiving portion 2 is sent to a storage tank 5 through a flow passage 4, comes into contact with a far-infrared radiation substance 6 disposed on the bottom portion of the storage tank and a far-infrared radiation substance 7 applied onto an inside surface of the storage tank 5, and is purified. The form of the far-infrared

radiation substance 6 is not particularly limited. Purified condensed water is appropriately discharged through an exit 8 and is used according to the purposes.

Industrial Applicability

[0041]

According to the present invention, it is possible to provide a radiant cooling and heating apparatus with which water droplets generated on the surface of a cooling and heating radiant panel due to the condensation of moisture in the air during cooling operations can be purified and used.

Reference Signs List

[0042]

- 1 cooling and heating radiant panel
- 2 water droplet-receiving portion
- 3 drain outlet
- 4 flow passage
- 5 storage tank
- 6, 7 far-infrared radiation substance
- 8 exit

Claims

[Claim 1]

A radiant cooling and heating apparatus, comprising:
a cooling and/or heating surface which is constituted of a cooling and heating radiant panel;
a drain outlet which is provided in a water droplet-receiving portion below the cooling and heating radiant panel in order to discharge water droplets generated on a surface of the cooling and heating radiant panel due to condensation of moisture in the air during cooling operations; and
a storage tank for storing and reusing condensed water discharged from the drain outlet,
wherein the supplied condensed water comes into contact with a far-infrared radiation substance in the storage tank and/or comes into contact with a far-infrared radiation substance outside the storage tank and then circulates into the storage tank.

[Claim 2]

The radiant cooling and heating apparatus according to Claim 1,
wherein the surface of the cooling and heating radiant panel includes a far-infrared radiation substance.

[Claim 3]

The radiant cooling and heating apparatus according to Claim 1 or 2,

wherein an inside surface of the storage tank includes a far-infrared radiation substance.

[Claim 4]

The radiant cooling and heating apparatus according to any one of Claims 1 to 3,

wherein a far-infrared radiation substance is provided in a bottom portion of the storage tank.

[Claim 5]

The radiant cooling and heating apparatus according to any one of Claims 1 to 4,

wherein a tank or a flow passage including a far-infrared radiation substance is provided outside the storage tank so as to bring the condensed water supplied to the storage tank into contact with the far-infrared radiation substance outside the storage tank and then circulate the condensed water into the storage tank.

[Claim 6]

The radiant cooling and heating apparatus according

to any one of Claims 1 to 5,

wherein the condensed water discharged from the drain outlet is further brought into contact with a far-infrared radiation substance and then is supplied to the storage tank.

[Claim 7]

The radiant cooling and heating apparatus according to any one of Claims 1 to 6,

wherein the radiant cooling and heating apparatus has an indoor surface-constituting member constituted of a material including a far-infrared radiation substance which radiates and absorbs far-infrared rays and has a far-infrared emissivity of 0.6 or higher,

the surface of the cooling and heating radiant panel is constituted of a material including the same far-infrared radiation substance as the far-infrared radiation substance of the indoor surface-constituting member,

when the surface of the cooling and heating radiant panel is cooled, the far-infrared radiation substance on the surface absorbs far-infrared rays radiated by the far-infrared radiation substance of the indoor surface-constituting member, and/or,

when the surface of the cooling and heating radiant panel is heated, the far-infrared radiation substance of

the indoor surface-constituting member absorbs far-infrared rays radiated by the far-infrared radiation substance on the heated surface.

[Claim 8]

A method for using condensed water, comprising:

using condensed water purified by the radiant cooling and heating apparatus according to any one of Claims 1 to 7 as purified water.