

ENERGY-SAVING HOT WATER-HEATING DEVICE AND SYSTEM APPLICABLE TO THE SAME

FIELD OF THE INVENTION

The present invention relates to energy-saving hot water-heating devices and systems applicable thereto, and more particularly, to an energy-saving hot water-heating device and a system applicable thereto which are for use in treating waste heat produced as a result of the operation of an air conditioning system and heating-producing hot water.

BACKGROUND OF THE INVENTION

Operation of an air conditioning system involves releasing heat and absorbing heat by the expansion and compression of a coolant, absorbing indoor heat, and discharging the absorbed indoor heat outdoors. The hardware for controlling coolant circulation essentially comprises four components, namely an evaporator, a compressor, a condenser, and a coolant controller. Regarding its working principle, coolant circulation entails turning an outdoor coolant into a high-temperature high-pressure gaseous coolant by the compressor, and then removing heat from the gaseous coolant by the condenser to turn the gaseous coolant into a moderate-temperature high-pressure liquid coolant. Afterward, the coolant controller turns the moderate-temperature high-pressure liquid coolant into a moderate-temperature low-pressure liquid coolant for working at the evaporation temperature of the evaporator. Then, the moderate-temperature low-pressure liquid coolant is conveyed to an indoor environment by a coolant conveying pipe, and in the indoor environment the evaporator absorbs indoor heat to turn the moderate-temperature low-pressure liquid coolant into a gaseous coolant. The gaseous coolant is introduced into the outdoor compressor by the coolant conveying pipe, such that the

outdoor compressor turns the gaseous coolant into a high-temperature high-pressure gaseous coolant for circulation.

The conventional condenser of an air conditioning system resorts to gas cooling and works by blowing the heat out of the air conditioning system by means of a fan and through the heat exchange that takes place between a coolant circulation coil pipe and a fin-like plate. Although heat can be removed by the aforesaid prior art, the heat thus removed contributes to accumulation of heat in a city, thereby exacerbating the greenhouse effect. On the other hand, although a cooling tower is effective in performing a cooling process by means of a cooling liquid, the temperature of the cooling liquid rises gradually because of heat exchange; as a result, it is necessary for a high-temperature cooling liquid to be turned into a mist by a spraying device, and then for cool air to be drawn by an exhaust fan to confront the mist of the cooling liquid undergo heat exchange therewith. Nevertheless, the resultant waste heat ends up being emitted to the atmosphere by the exhaust fan, thereby adding to the greenhouse effect.

In an attempt to solve the aforesaid problem, a conventional air conditioning system designed to treat waste heat and recycle cool air does overcome the problem with emission of waste heat to the atmosphere and is, in particular, effective in heating-producing hot water by means of a waste heat recovering and hot water producing device as well as lowering the coolant temperature by means of a high-temperature coolant. Nevertheless, the conversion efficiency of the heat exchange device employed by the conventional air conditioning system in heating-producing hot water is too low to enhance the performance of the conventional air conditioning system in waste heat recycling.

Accordingly, it is imperative to provide an energy-saving hot water-heating device and a system applicable thereto for

enhancing the performance of a conventional heat exchange device in heating-producing hot water and effecting waste heat recycling, power saving, and environmental protection.

SUMMARY OF THE INVENTION

In view of the drawbacks of the prior art, the inventor of the present invention conducted extensive researches and experiments according to the inventor's years of experience in the related industry, and finally developed an energy-saving hot water-heating device and a system applicable thereto as disclosed in the present invention to enhance heating efficiency as well as effectuate waste heat recycling, power saving, and environmental protection.

It is an objective of the present invention to provide an energy-saving hot water-heating device and a system applicable thereto for use in heating-producing hot water by means of waste heat generated from an air conditioning system, lowering the temperature of the coolant of the air conditioning system, enhancing heating efficiency, as well as effectuating waste heat recycling, power saving, and environmental protection.

In order to achieve the above and other objectives, the present invention provides an energy-saving hot water-heating device for heating-producing hot water from waste heat generated by an air conditioning system, the device comprising a casing, a coolant circulation coil pipe, a plurality of heating pipes, and a plurality of communicating pipes. The coolant circulation coil pipe is made of metal, disposed in the casing, curved, and comprises a coolant inlet, a coolant outlet, and a plurality of heat-dissipating pipes, the coolant inlet extending out of the casing and communicating with the air conditioning system, the coolant outlet extending out of the casing and communicating with the air conditioning system, and the heat-dissipating pipes being connected between the coolant inlet

and the coolant outlet. The heating pipes are water conveying pipes and are of a larger inner diameter than the coolant circulation coil pipe is, wherein each of the heat-dissipating pipes of the coolant circulation coil pipe fits inside a corresponding one of the heating pipes, thereby allowing a running water channel to be formed between an inner wall of each of the heating pipes and an outer wall of a corresponding one of the heat-dissipating pipes, wherein one of the heating pipes has a water inlet extending out of the casing, wherein another one of the heating pipes has a water outlet extending out of the casing. The communicating pipes are each connected between two adjacent ones of the heating pipes, such that the running water channels inside the heating pipes are in communication with each other through the communicating pipes.

In order to achieve the above and other objectives, the present invention provides a system applicable to an energy-saving hot water-heating device. The system, in a preferred embodiment thereof, comprises an energy-saving hot water-heating device, an automatic circulation water tank, a hot water canister, a heating boiler, a water feeding pipeline, a water returning pipeline, and a hot water discharging pipeline. The automatic circulation water tank stores water and has a first pumping motor and a temperature sensor, the first pumping motor drawing water from the automatic circulation water tank, and the temperature sensor having a controller and sensing temperature. The hot water canister provides thermal insulation for the stored hot water, and is independent of the automatic circulation water tank.

The heating boiler heats up the hot water in the hot water canister, wherein the heating boiler and the hot water canister are either integrally formed as a unitary structure or separate. The water feeding pipeline is connected between the water inlet

of the energy-saving hot water-heating device and the first pumping motor of the automatic circulation water tank for conveying water from the automatic circulation water tank to a running water channel of the energy-saving hot water-heating device through the first pumping motor, wherein a pressure reducing valve is disposed at the water feeding pipeline for regulating water pressure. The water returning pipeline is connected between the automatic circulation water tank and a water outlet of the energy-saving hot water-heating device for sending the hot water produced by the energy-saving hot water-heating device back to the automatic circulation water tank. The hot water discharging pipeline is connected between the automatic circulation water tank and the hot water canister and equipped with a second pumping motor adapted for delivering hot water from the automatic circulation water tank to the hot water canister and connected to the temperature sensor of the automatic circulation water tank.

In a preferred embodiment, the energy-saving hot water-heating device further comprises a temperature sensor equipped with a controller, adapted for sensing temperature, disposed at the coolant circulation coil pipe, and connected to the first pumping motor of the automatic circulation water tank.

In a preferred embodiment of the system applicable to the energy-saving hot water-heating device, a maintenance opening capable of being shut and opened is disposed at the automatic circulation water tank.

In a preferred embodiment of the system applicable to the energy-saving hot water-heating device, a drainage hole is disposed at a bottom of the automatic circulation water tank for removing impurities.

In a preferred embodiment of the system applicable to the energy-saving hot water-heating device, an exhaust vent is disposed at a top of the automatic circulation water tank for

relieving pressure.

In a preferred embodiment, the system applicable to the energy-saving hot water-heating device further comprises a raw water pipeline in communication with the automatic circulation water tank.

In a preferred embodiment of the system applicable to the energy-saving hot water-heating device, a pressure reducing valve is disposed at the water returning pipeline for regulating water pressure.

In a preferred embodiment of the system applicable to the energy-saving hot water-heating device, the pressure reducing valve is a spherical pressure reducing valve.

Accordingly, the present invention provides an energy-saving hot water-heating device and a system applicable thereto, such that a coolant inlet and a coolant outlet of a coolant circulation coil pipe are connected to a coolant pipe of an air conditioning system for introducing waste heat generated by the air conditioning system in operation into the coolant circulation coil pipe and delivering cool water from an automatic circulation water tank to a running water channel of the heating pipes so as to effectuate heat exchange, lower the temperature of the coolant of the air conditioning system, and produce hot water repeatedly, thereby enhancing heat exchange and heating efficiency. Afterward, the hot water thus produced returns to the automatic circulation water tank and a hot water canister for supplying hot water to serve household and industrial purposes. In doing so, the present invention dispenses with the need to heat up hot water by means of any other energy resources, so as to recycle waste heat, save energy, and protect the environment.

BRIEF DESCRIPTION OF THE DRAWINGS

Objectives, features, and advantages of the present invention are hereunder illustrated with specific embodiments in

conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic view of an energy-saving hot water-heating device according to a preferred embodiment of the present invention;

FIG. 2 is a first schematic perspective view of a system applicable to the energy-saving hot water-heating device according to a preferred embodiment of the present invention;

FIG. 3 is a second schematic perspective view of the system applicable to the energy-saving hot water-heating device according to a preferred embodiment of the present invention;

FIG. 4 is a cross-sectional view of a heating pipe taken along line A-A of FIG. 1 according to a preferred embodiment of the present invention; and

FIG. 5 is a schematic perspective view of a pressure reducing valve according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. 1, FIG. 2, and FIG. 4, an energy-saving hot water-heating device and a system applicable thereto of the present invention are for use in heating-producing hot water, using waste heat generated from an air conditioning system 10. The energy-saving hot water-heating device 1, in a preferred embodiment thereof, comprises a casing 11, a coolant circulation coil pipe 12, a plurality of heating pipes 13, and a plurality of communicating pipes 14.

The casing 11 which is hollow is rectangular or of any other shapes. The casing 11 accommodates the coolant circulation coil pipe 12, the heating pipes 13 and the communicating pipes 14. The coolant circulation coil pipe 12, which is curved, is made of metal, preferably a metal of a high thermal conductivity, such as copper, and is essentially disposed in the casing 11. The coolant

circulation coil pipe 12 comprises a coolant inlet 121, a coolant outlet 122, and a plurality of heat-dissipating pipes 123. The coolant inlet 121 is disposed at one end of the coolant circulation coil pipe 12. The coolant inlet 121 extends out of the casing 11 and communicates with the air conditioning system 10. The coolant outlet 122 is disposed at the other end of the coolant circulation coil pipe 12. The coolant outlet 122 extends out of the casing 11 and communicates with the air conditioning system 10. The heat-dissipating pipes 123 are connected between the coolant inlet 121 and the coolant outlet 122. The heat-dissipating pipes 123 are parallel. The heating pipes 13 are water conveying pipes and are of a larger inner diameter than the coolant circulation coil pipe 12 is. Each of the heat-dissipating pipes 123 of the coolant circulation coil pipe 12 fits inside a corresponding one of the heating pipes 13. The two ends of each of the heating pipes 13 are closed, such that a running water channel 131 (shown in FIG. 4) is formed between the inner wall of each of the heating pipes 13 and the outer wall of a corresponding one of the heat-dissipating pipes 123. One of the heating pipes 13 has a water inlet 132 extending out of the casing 11. Another one of the heating pipes 13 has a water outlet 133 extending out of the casing 11. The water inlet 132 is positioned proximate to the coolant outlet 122, and the water outlet 133 is positioned proximate to the coolant inlet 121, such that the coolant circulation coil pipe 12 and the running water channel 131 have opposite flow directions. Each of the communicating pipes 14 is connected between two adjacent ones of the heating pipes 13, such that the running water channels 131 inside the heating pipes 13 are in communication with each other through the communicating pipes 14.

The casing 11, the coolant circulation coil pipe 12, the heating pipes 13, and the communicating pipes 14 of the energy-saving hot water-heating device 1 of the present

invention together transfer waste heat generated from the air conditioning system 10 in operation to the coolant circulation coil pipe 12, introduce room-temperature cool water into the heating pipes 13, and thus enable heat exchange between the high-temperature coolant and the room-temperature cool water in the energy-saving hot water-heating device 1. Hence, the energy-saving hot water-heating device 1 of the present invention lowers the temperature of a coolant in the air conditioning system 10 and circulates the hot water thus produced to thereby optimize heat exchange and enhance heating efficiency.

As shown in FIG. 2 and FIG. 3, to optimize the energy-saving hot water-heating device 1 in producing usable hot water, the present invention proposes a system applicable to an energy-saving hot water-heating device. In a preferred embodiment, the energy-saving hot water-heating device 1 further comprises an automatic circulation water tank 2, a hot water canister 3, a heating boiler 4, a water feeding pipeline 5, a water returning pipeline 6, and a hot water discharging pipeline 7.

The energy-saving hot water-heating device 1 in this preferred embodiment is the same as that in the preceding preferred embodiment and thus is not described hereunder again for the sake of brevity. The automatic circulation water tank 2 is for storing water. A first pumping motor 21 is disposed at the automatic circulation water tank 2 for drawing water therefrom. A controller is disposed at the automatic circulation water tank 2 for operating in conjunction with a temperature sensor 22 for sensing temperature. The first pumping motor 21 can be a pumping motor positioned outside the automatic circulation water tank 2 or a submersible motor positioned inside the automatic circulation water tank 2. The temperature sensor 22 is positioned on top of the automatic circulation

water tank 2 in a manner that a temperature-sensing probe is inserted into the automatic circulation water tank 2. The hot water canister 3 provides thermal insulation for the stored hot water, and is independent of the automatic circulation water tank 2. A thermally insulating layer can be disposed on the wall of the hot water canister 3. The heating boiler 4 heats up the hot water in the hot water canister 3. The heating boiler 4 and the hot water canister 3 are either integrally formed as a unitary structure (shown in FIG. 2) or separate (shown in FIG. 3). The water feeding pipeline 5 is connected between the water inlet 132 of the energy-saving hot water-heating device 1 and the first pumping motor 21 of the automatic circulation water tank 2 for conveying room-temperature water from the automatic circulation water tank 2 to the running water channel 131 of the energy-saving hot water-heating device 1 through the first pumping motor 21. The water feeding pipeline 5 is equipped with a pressure reducing valve 51 for regulating water pressure. The pressure reducing valve 51 is a spherical pressure reducing valve (shown in FIG. 5) or the like. The water returning pipeline 6 is connected between the automatic circulation water tank 2 and the water outlet 133 of the energy-saving hot water-heating device 1 for sending the hot water produced by the energy-saving hot water-heating device 1 back to the automatic circulation water tank 2. The hot water discharging pipeline 7 is connected between the automatic circulation water tank 2 and the hot water canister 3 and equipped with a second pumping motor 71. The second pumping motor 71 delivers hot water from the automatic circulation water tank 2 to the hot water canister 3. The second pumping motor 71 is connected to the temperature sensor 22 of the automatic circulation water tank 2.

As shown in FIG. 1 and FIG. 2, in a preferred embodiment of the present invention, the energy-saving hot water-heating

device 1 further comprises a temperature sensor 15. The temperature sensor 15 is equipped with a controller and adapted for sensing temperature. The temperature sensor 15 is disposed at the coolant circulation coil pipe 12 or the heating pipes 13 and connected to the first pumping motor 21 of the automatic circulation water tank 2 for regulating the speed at which water flows from the automatic circulation water tank 2 to the energy-saving hot water-heating device 1 via the first pumping motor 21 and the water feeding pipeline 5, such that the energy-saving hot water-heating device 1 is allowed sufficient time to produce hot water.

As shown in FIG. 2 and FIG. 3, in a preferred embodiment of the present invention, a maintenance opening 23 that can be shut and opened as needed and an exhaust vent 24 for relieving pressure are disposed at the top of the automatic circulation water tank 2. The maintenance opening 23 caters for the need for maintenance and cleansing. The exhaust vent 24 precludes an elevating pressure that might otherwise be caused by a rising temperature and result in an explosion. A drainage hole 25 is disposed at the bottom of the automatic circulation water tank 2 for removing deposited impurities from the automatic circulation water tank 2 and thereby ensuring water quality. A pressure reducing valve 61 is disposed at the water returning pipeline 6 for regulating water pressure. The pressure reducing valve 61 is a spherical pressure reducing valve (shown in FIG. 5) or the like.

As shown in FIG. 2 and FIG. 3, in a preferred embodiment of the present invention, a raw water pipeline 8 has one end in communication with the automatic circulation water tank 2 and has another end in communication with a water source (not shown), such as a utility water pipe, such that raw water can be supplied to the automatic circulation water tank 2 and kept in reserve.

As shown in FIG. 2 and FIG. 3, in a preferred embodiment of the present invention, to put an energy-saving hot water-heating device and a system applicable thereto in use, it is necessary that the coolant inlet 121 and the coolant outlet 122 of the coolant circulation coil pipe 12 of the energy-saving hot water-heating device 1 are connected to a coolant pipe disposed on a heat-dissipating side of the air conditioning system 10 (especially suitable for a central air conditioning system). In doing so, a high-temperature coolant produced by the air conditioning system 10 in operation is introduced into the coolant circulation coil pipe 12 and thus circulated therein, thereby allowing the energy-saving hot water-heating device 1 to effectuate heat dissipation. Hence, once the user starts the air conditioning system 10, a system applicable to an energy-saving hot water-heating device of the present invention will start automatically such that room-temperature cool water will be discharged from the automatic circulation water tank 2 by the first pumping motor 21 and introduced into the running water channel 131 of the heating pipes 13 via the water feeding pipeline 5. Since the coolant circulation coil pipe 12 and the running water channel 131 have opposite flow directions, there is heat exchange between the high-temperature coolant in the coolant circulation coil pipe 12 and the cool water in the running water channel 131 so as to not only cool down the high-temperature coolant to become a low-temperature coolant but also heat up the cool water to become hot water. Hence, the present invention enhances heat exchange and heating efficiency.

As shown in FIG. 2 and FIG. 3, the hot water produced by the energy-saving hot water-heating device 1 returns to the automatic circulation water tank 2 via the water returning pipeline 6. The aforesaid cycle repeats until the hot water stored in the automatic circulation water tank 2 reaches a sufficiently

high temperature (such as 40~45°C suitable for showering). Afterward, the hot water can be conveyed by the hot water discharging pipeline 7 and the second pumping motor 71 to the hot water canister 3 and kept in reserve. The reserve hot water in the hot water canister 3 can be supplied to users as needed, for example, via a hot water pipeline installed in a building that accommodate the users, or can be delivered to the heating boiler 4 shown in FIG. 3 and further heated up to a higher temperature before being supplied to the users.

Hence, an energy-saving hot water-heating device and a system applicable thereto of the present invention automatically produce hot water for household or industrial purposes without using additional resources (such as electric power). Even though the heating boiler 4 is employed to further heat up the reserve hot water to a higher temperature, the power consumed by the heating boiler 4 is still less than the power required for heating that starts with cool water. Hence, the present invention is effective in recycling waste heat, saving energy, and protecting the environment.

The present invention is disclosed above by preferred embodiments. However, persons skilled in the art should understand that the preferred embodiments are illustrative of the present invention only, but should not be interpreted as restrictive of the scope of the present invention. Hence, all equivalent modifications and replacements made to the aforesaid embodiments should fall within the scope of the present invention. Accordingly, the legal protection for the present invention should be defined by the appended claims.

What is claimed is:

1. An energy-saving hot water-heating device for heating-producing hot water from waste heat generated by an air conditioning system, the device comprising a casing, a coolant circulation coil pipe, a plurality of heating pipes, and a plurality of communicating pipes, the device being characterized in that:

the coolant circulation coil pipe is made of metal, disposed in the casing, curved, and comprises a coolant inlet, a coolant outlet, and a plurality of heat-dissipating pipes, the coolant inlet extending out of the casing and communicating with the air conditioning system, the coolant outlet extending out of the casing and communicating with the air conditioning system, and the heat-dissipating pipes being connected between the coolant inlet and the coolant outlet;

the heating pipes are water conveying pipes and are of a larger inner diameter than the coolant circulation coil pipe is, wherein each of the heat-dissipating pipes of the coolant circulation coil pipe fits inside a corresponding one of the heating pipes, thereby allowing a running water channel to be formed between an inner wall of each of the heating pipes and an outer wall of a corresponding one of the heat-dissipating pipes, wherein one of the heating pipes has a water inlet extending out of the casing, wherein another one of the heating pipes has a water outlet extending out of the casing; and

the communicating pipes are each connected between two adjacent ones of the heating pipes, such that the running water channels inside the heating pipes are in communication with each other through the communicating pipes.

2. A system applicable to the device of claim 1, the system further comprising an automatic circulation water tank, a hot water canister, a heating boiler, a water feeding pipeline, a

water returning pipeline, and a hot water discharging pipeline, characterized in that:

the automatic circulation water tank stores water and has a first pumping motor and a temperature sensor, the first pumping motor drawing water from the automatic circulation water tank, and the temperature sensor having a controller and sensing temperature;

the hot water canister provides thermal insulation for the stored hot water, and is independent of the automatic circulation water tank;

the heating boiler heats up the hot water in the hot water canister, wherein the heating boiler and the hot water canister are either integrally formed as a unitary structure or separate;

the water feeding pipeline is connected between the water inlet of the energy-saving hot water-heating device and the first pumping motor of the automatic circulation water tank for conveying water from the automatic circulation water tank to a running water channel of the energy-saving hot water-heating device through the first pumping motor, wherein a pressure reducing valve is disposed at the water feeding pipeline for regulating water pressure;

the water returning pipeline is connected between the automatic circulation water tank and a water outlet of the energy-saving hot water-heating device for sending the hot water produced by the energy-saving hot water-heating device back to the automatic circulation water tank; and

the hot water discharging pipeline is connected between the automatic circulation water tank and the hot water canister and equipped with a second pumping motor adapted for delivering hot water from the automatic circulation water tank to the hot water canister and connected to the temperature sensor of the automatic circulation water tank.

3. The system of claim 2, wherein the energy-saving hot

water-heating device further comprises a temperature sensor equipped with a controller, adapted for sensing temperature, disposed at the coolant circulation coil pipe, and connected to the first pumping motor of the automatic circulation water tank.

4. The system of claim 3, wherein a maintenance opening capable of being shut and opened is disposed at the automatic circulation water tank.
5. The system of claim 4, wherein a drainage hole is disposed at a bottom of the automatic circulation water tank for removing impurities.
6. The system of claim 5, wherein an exhaust vent is disposed at a top of the automatic circulation water tank for relieving pressure.
7. The system of claim 2, further comprising a raw water pipeline in communication with the automatic circulation water tank.
8. The system of claim 2, wherein a pressure reducing valve is disposed at the water returning pipeline for regulating water pressure.
9. The system of claim 2, wherein the pressure reducing valve is a spherical pressure reducing valve.
10. The system of claim 8, wherein the pressure reducing valve is a spherical pressure reducing valve.