

**ENERGY SAVING AND ENVIRONMENTALLY FRIENDLY
ATMOSPHERIC DEHUMIDIFIER CHILLER FOR DRINKING PURPOSES**

5 Field of the Invention

This invention related to an energy saving and environmentally friendly atmospheric dehumidifier chiller for drinking purposes. Fresh air is passed to an air duct of an air handling unit which installed several
10 evaporator coils to condensate the air to produce fresh water and cold air. Cold air and cold water are passed to the condensing coils separately to save the energy.

Background of the Invention

15 Water shortage which have been suffered to many countries in the world is a crisis. Many countries in the world also suffer for drinking water. Usable water supplies have reduced by pollution contamination and sewage waste. Water treatment such as with chemicals as
20 chorine or other halogens, however the by-products of such treatment may be toxic and the result in further contamination. Treated municipal water supplies may be contaminated, with may lead to health problems in such drinking water.

25 Various attempts have been made to overcome with a system for dehumidifying moisture of air and purifying the water produced in such systems for drinking purposes.

In Patent no. WO 2004/027165 A1, a device to condense the water to produce drinking water which
30 generated from the humidity of the air is a dehumidifier which provide an air cooled condensation surface and water production. But in this device there is no saving energy and the water produced is too cold and need a fan to produce fresh water.

In US Patent No. 5553459, a device is said to produce water from room air. A compressor is provided to compress the refrigerant, a condenser to condensate the refrigerant from the compressor. An evaporator coil is operated to evaporate the refrigerant and cool the water in a water reservoir. A water condensate generator coil is provided to condensate the moisture from room air by the cold drinking water from the water reservoir which is passed to the water condensate generator coil before return it to the water reservoir. There is no energy saving in this water generator device and this device just circulate the water to generate the drinking water which is cooled by evaporator coil.

WO 2007/009488A1 discloses of an air cooling method which the air is cooled first in a precooler and then cooled in the main cooler to boost the water condensation. This method haves a good energy saving and boost the water condensation and the cold air from the main cooler which is supplied to the precooler as a cooling medium. This method only talk about energy saving by cooling stages and not for a cooler to generate the drinking water.

So the objective of this invention is to save energy of an chiller and acting as well as water generator as mentioned above.

Brief Description of the Invention

The main objective of this invention is to provide a machine which be able to produce drinking water by condensating the moisture of the humid air and saving the energy by handling the air as a cooling medium of the condenser.

The water production machine of this invention consist of :

Air handling unit;

Several evaporator coils to condensate the moisture;

Drip pan to each evaporator coil to collect the water condensation;

Where the air handling unit is connected to fresh air, in the intake of the air handling unit is installed several
5 air filters and UV lights to sterilize and the health of air as the water supply, in the air handling unit is installed several evaporator coils to condensate the moisture, and at the bottom of the air handling unit
10 below each evaporator coil is installed drip pan of the condensate which is generate from each coil, a water pipe to collect the water which is connected to a condensate water tank and passed to condenser coil and then supplied to a water reservoir/storage tank.

The water production machine of this invention is in
15 a one unit with the chiller, where a heat exchanger to chill the brine by the expanded refrigerant from the condenser, a pump to circulate the brine to each evaporator coil to condensate the moisture and back to the heat exchanger.

20 The water production machine of this invention where all equipments of the air handling unit include all pipe, parts and water pump which is passed by the condensate water of this water production machine should made of foodgrade metal, preferable made of stainless steel.

25 The water production machine of this invention using brine as a cooling medium, is to save the refrigerant of the chiller and to ease a remote water treatment.

The water production machine of this invention using brine as a cooling medium, is to ease assembly if there
30 is any air or water capacity improvement.

The water production machine of this invention using brine as a cooling medium and an environmentally friendly refrigerant is to gain environmentally friendly substance application.

35 An energy saving chiller is consist of : main condenser which is cooled by the cooled room exhaust air,

secondary condenser which is in series with the main condenser, is further cooled by the cold air after passing the evaporator coils in air handling unit, tertiary condenser which is in series with the secondary
 5 condenser, is dipped to a cold condensate water which is produced by the evaporator coils, and by cooling the three condensers, the refrigerant will be subcooled, so after expanded by the expansion valve to the heat exchanger, and after compressed by the compressor to the
 10 condenser, the work of the compressor is decrease due to the handling of the cooling medium of the condenser which will save the energy.

A combine of a chiller and a water generator which save energy and environmentally friendly consist of : a
 15 water generator machine using evaporator coils of a chiller; and a chiller using air and condensate water of evaporator coils to cool the secondary and tertiary condenser; Where the refrigerant of the cooled condensers are passed to a expansion valve, will chill the brine as
 20 a secondary cooling medium in a heat exchanger and yet will be used to chill the air and condensate the moisture of the air passed the evaporator coils in air handling unit, the condensate will drip as a drinking water and the drinking water drip collected to a pan and circulate
 25 to a drinking water reservoir/storage tank.

A method to produce drinking water from fresh air using energy saving and environmentally friendly chiller, comprising of the following steps :
 Filtering and sterilize fresh air, then passed to several
 30 evaporator coils to condensate the moisture and the condensate collected to a pan.
 Passing secondary condenser by cold air after passing evaporator coils and dipping tertiary condenser to a cold condensate water tank, so the refrigerant after the
 35 condenser will be subcooled and after passing through the

expansion valve, will heat exchange with the brine as a secondary refrigerant in the heat exchanger.

Where brine is passed to several evaporator coils in air handling unit to cool and condensate the moisture passing through the air handling unit, a part of the air will condensate and the other part will passed to a cooled room where the cold air of the room then will exhaust and used to cool the main condenser through the exhaust air duct.

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Brief Description of the Drawing

To illustrate this invention, will be describe by the following drawing.

Figure 1, a schematic drawing of a drinking water production chiller from fresh air which energy save and environmentally friendly.

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Detailed Description of the Invention

The following description will describe in details of an energy saving and environmentally friendly drinking water production chiller.

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The description of the drawing, compressor (1) will compress refrigerant vapour to the main condenser (4) through discharge line (2) in high pressure and temperature. The main condenser (4) is cooled by cold air exhaust from the room (26), and not from the hot fresh air, so it will save the energy. Due to cold air exhaust from the room is not enough to cool the main condenser, it is necessary to have a back up air from the outside fresh air (27) which will be mixed to the cold air exhaust from the room. With the exhaust air duct (31) the mixing air is circulate to the main condenser by condenser fan (28) then exhaust to outdoor through exhaust air exit (29). After passing the main condenser (4), the refrigerant then passed to the second condenser (5) which is installed in series with the main condenser

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so that it is as a separate extension of the main condenser. In the second condenser (5) the refrigerant is further cooled by the cold air of the dehumidifier evaporator coils (14) of an air handling unit (30) so that can save further the energy. After passing the second condenser (5), the refrigerant is in a liquid state which then passed to a third condenser (6) which is installed in series with the second condenser so that it is as a further separate extension of the main condenser of a condenser liquid cooler so that the liquid refrigerant is being subcooled so that it can further save the energy. The refrigerant is then passed to the expansion valve (10) through the filter dryer (7) and sight glass (9) in the liquid line (8). After the refrigerant being expanded then the refrigerant pressure and temperature will drop significantly and enter to the heat exchanger (11) which the refrigerant will chill the brine (13). After passing the heat exchanger (11) the refrigerant will be back to the compressor (1) through the suction line (3).

In the mean time the brine (13) is pumped by the brine pump (12) to the dehumidifier evaporator coils (14) in the air handling unit (30). After passing the evaporator coils (14) the brine (13) will be back to the heat exchanger (11) to recooled.

In the air handling unit (30), the outdoor fresh air (15) will enter the air pre filter (16) and the medium filter (17) to be eliminated from the dust, dirt, and other pollutant. Then the fresh air (15) is passed to the ultraviolet lights (18) to kill the bacteria and pathogenic mold to sterilize the air then passed to the dehumidifier evaporator coils (14). In the dehumidifier evaporator coils (14), the moisture of the fresh air (15) will condense. The drip of the condensation will be collected to the drip pan (19) and then will be passed to the condenser liquid cooler (6) which is enough to cool

the separate further extended condenser. After passing the condenser liquid cooler (6), the condensed water or the pure drinking water is ready to be pumped by the water pump (22) to the storage tank (32). In the mean
 5 time the fresh air after being condensed in the evaporator coils (14) is re-radiated by the ultraviolet light (20) to be sterilized before circulated by the blower (21) of the air handling unit to the room (25) through air duct (23) so that the cold air (24) will
 10 enter the room.

It is important to control so that the fresh air is cooled at the dew point so that the moisture will condense at this point. It is also necessary to control the refrigerant pressure to a minimum and maximum
 15 allowable pressure to maintain the compressor (1) in a safe condition. Oil pressure control is also necessary to make sure that the oil is always present in the compressor (1). If the air pre and medium filters are dirty and need to be changed, so it is necessary to have
 20 a control to make a sign that those filters should have to be changed.

The water production machine of this invention consist of :

Air handling unit (30);
 25 Several evaporator coils to condense the moisture (14);
 Drip pan (19) to each evaporator coil (14) to collect the water condensation;
 Where the air handling unit (30) is connected to fresh air, in the intake (15) of the air handling unit is
 30 installed several air filters (16 & 17) and UV lights (18 & 20) to sterilize and the health of air as the water supply, in the air handling unit (30) is installed several evaporator coils (14) to condensate the moisture, and at the bottom of the air handling unit below each
 35 evaporator coil is installed drip pan (19) of the condensate which is generate from each coil, a water pipe

to collect the water which is connected to a condensate water tank and passed to condenser coil (6) and then supplied to a water reservoir/storage tank (32).

5 The water production machine of this invention is in a one unit with the chiller, where a heat exchanger (11) to chill the brine by the expanded refrigerant from the condenser, a pump (12) to circulate the brine to each evaporator coil (14) to condensate the moisture and back to the heat exchanger (11).

10 The water production machine of this invention where all equipments of the air handling unit (30) include all pipe, parts and water pump which is passed by the condensate water of this water production machine should made of foodgrade metal, preferable made of stainless steel.

The water production machine of this invention using brine as a cooling medium, is to save the refrigerant of the chiller and to ease a remote water treatment.

20 The water production machine of this invention using brine as a cooling medium, is to ease assembly if there is any air or water capacity improvement.

The water production machine of this invention using brine as a cooling medium and an environmentally friendly refrigerant is to gain environmentally friendly substance application.

25 An energy saving chiller is consist of : main condenser (4) which is cooled by the cooled room exhaust air, secondary condenser (5) which is in series with the main condenser (4), is further cooled by the cold air after passing the evaporator coils in air handling unit, tertiary condenser (6) which is in series with the secondary condenser, is dipped to a cold condensate water which is produced by the evaporator coils, and by cooling the three condensers, the refrigerant will be subcooled, so after expanded by the expansion valve to the heat exchanger, and after compressed by the compressor to the

condenser, the work of the compressor is decrease due to the handling of the cooling medium of the condenser which will save the energy.

A combine of an energy saving and environmentally friendly chiller and a water generator consist of : a water generator machine using evaporator coils of a chiller; and a chiller using air and condensate water of evaporator coils (14) to cool the secondary and tertiary condenser (5 and 6); Where the refrigerant of the cooled condensers (5 and 6) are passed to an expansion valve, will chill the brine as a secondary cooling medium in a heat exchanger (11) and yet will be used to chill the air and condensate the moisture of the air passed the evaporator coils (14) in air handling unit (30), the condensate will drip as a drinking water and the drinking water drip collected to a pan (19) and circulate to a storage tank (32).

A method to produce drinking water from fresh air using energy saving and environmentally friendly chiller, comprising of the following steps :

Filtering and sterilize fresh air, then passed to several evaporator coils (14) to condensate the moisture and the condensate collected to a pan.

Passing secondary condenser (5) by cold air after passing evaporator coils and dipping tertiary condenser (6) to a cold condensate water tank, so the refrigerant after the condenser will be subcooled and after passing through the expansion valve, will heat exchange with the brine as a secondary refrigerant in the heat exchanger (11).

Where brine is passed to several evaporator coils (14) in air handling unit (30) to cool and condensate the moisture passing through the air handling unit (30), a part of the air will condensate and the other part will passed to a cooled room (25) where the cold air of the room then will exhaust and used to cool the main condenser through the exhaust air duct.

While the necessary sensors are sensing the parameter of as follows : discharge pressure, suction pressure, discharge temperature, suction temperature, outdoor air temperature and relative humidity, before
5 evaporator coil air temperature and relative humidity, after evaporator coil air temperature and relative humidity, room air temperature and relative humidity, etc. The electrical sensors are as follows : electrical voltage, electrical frequency, electrical motor *cos phi*,
10 electrical motor rpm, compressor electrical current, condenser fan electrical current, air handling unit blower electrical current, total electrical current, ultraviolet lamp indicator, compressor lamp indicator, condenser fan lamp indicator, air handling unit blower
15 lamp indicator, system failure lamp indicator, etc.

Although a particular embodiment of the invention has been disclosed, variations thereof may occur to an artisan and the scope of the invention should only be
20 limited by the scope of the appended claims.

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Claims:

1. The water production machine of this invention consist of :
 - 5 Air handling unit;
Several evaporator coils to condensate the moisture;
Drip pan being installed at the bottom of each evaporator coil to collect the water condensation;
Where the air handling unit is connected to fresh
 - 10 air, in the intake of the air handling unit is installed several air filters and UV lights to sterilize and the health of air as the water supply, in the air handling unit is installed several evaporator coils to condensate the moisture, a water
 - 15 pipe to collect the water which is connected from the drip pan to a condensate water tank and passed to a condenser coil and then supplied to a water reservoir/storage tank.
- 20 2. The water production machine of claim 1, further comprising an energy saving chiller comprising: -
 - a main condenser which is cooled by room exhaust air;
 - a secondary condenser in series with the main
 - 25 condenser, which secondary condenser is cooled by cold air after passing through the evaporator coils in air handling unit;
 - a tertiary condenser in series with the secondary condenser, which tertiary condenser is dipped into
 - 30 the condensate water tank;
 - an expansion valve to expand a refrigerant after passing through the main, secondary and tertiary condensers; and
 - a compressor to compress the expanded refrigerant
 - 35 to the condensers.

3. The water production machine of claim 2, wherein the condenser coil comprises the tertiary condenser.

5 4. The water production machine of any one of the preceding claims, further comprising a heat exchanger to chill a cooling medium by the expanded refrigerant from the condensers; and a pump to circulate the cooling medium to each evaporator coil to condensate the moisture and back to the heat exchanger.

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5. The water production machine of claim 4, using brine as a cooling medium to save the refrigerant of the chiller and to ease a remote water treatment.

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6. The water production machine of claim 4 or 5, using brine as a cooling medium to ease assembly if there is any air or water capacity improvement.

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7. The water production machine of any one of claims 4 to 6, using brine as a cooling medium and an environmentally friendly refrigerant to gain environmentally friendly substance application.

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8. The water production machine of any one of the preceding claims, wherein all equipments of the air handling unit including all pipe, parts and water pump which is passed by the condensate water of this water production machine are made of foodgrade metal, preferable made of stainless steel.

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9. A method to produce drinking water from fresh air using energy saving and environmentally friendly water production machine, comprising of the following steps:

- Passing fresh air through several air filters and UV lights installed in an air handling unit to thereby filter and sterilize the fresh air;
- 5 - Passing the filtered and sterilized fresh air through several evaporator coils installed in the air handling unit to condense moisture in the fresh air;
- 10 - Passing a cooling medium in the evaporator coils to cool and condense the moisture passing through the air handling unit;
- Collecting the condensed moisture in drip pans each connected to the several evaporator coils; and
- 15 - Using a water pipe to connect the drip pans, a condensate water tank, and a water storage tank to thereby supply the condensed moisture to the water storage tank.