HEAT EXCHANGER SYSTEM

TECHNICAL FIELD

[0001] The present disclosure relates to a heat exchanger system. The heat exchanger system may include an air-conditioner.

BACKGROUND

[0002] The following discussion of the background is intended to facilitate an understanding of the present disclosure only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or is part of the common general knowledge of the person skilled in the art in any jurisdiction as of the priority date of the invention.

[0003] Heat exchanger systems such as air-conditioners or refrigerator systems typically comprise a compressor unit arranged in fluid communication with one or more evaporator and condenser units. However, current heat exchanger systems may generate undesirable amount of heat to the environment.

[0004] In view of the global push to reduce carbon footprint, there exists a need for improved heat exchanger systems to provide more efficient heat exchange with reduction of carbon footprint and pollutants.

SUMMARY

[0005] The disclosure was conceptualised to provide a compact and efficient heat exchanger system with a relatively lower carbon footprint and reduced pollutants.

[0006] The disclosure was also conceptualised for the application of one or more heat exchanger devices for a heat exchanger system to reduce the need for a conventional/chemical refrigerant by using water or other environmentally friendly fluid(s) as a secondary coolant in the heat exchanging cycle.

[0007] According to an aspect of the disclosure there is a heat exchanger

system comprising a first heat exchanger comprising at least one condenser unit and at least one first evaporator unit, the at least one condenser unit arranged adjacent to the at least one first evaporator unit; a second heat exchanger comprising a second evaporator unit; a central portion positioned between the first heat exchanger and the second heat exchanger; the central portion configured to house a ventilation device; a compressor unit adapted to direct refrigerant to the at least one condenser unit and to receive refrigerant from the first and second evaporator units.

[0008] In some embodiments, the heat exchanger system further comprises a water tank operable to direct water to a sprinkler mechanism, the sprinkler mechanism positioned in the proximity of the at least one condenser unit to cool the condenser unit; and a conduit to receive water from the at least one first evaporator unit, wherein the conduit directs water back to the water tank.

[0009] In some embodiments, the first condenser unit comprises a first condenser coil and a second condenser coil arranged adjoining the first condenser coil, and the second condenser coil is arranged adjoining the at least one first evaporator unit.

[0010] In some embodiments, the ratio of surface area between the first condenser coil and the second condenser coil is in the range from 1:3 to 1:1.

[0011] In some embodiments, the compressor is suited for relatively lower temperature and lower pressure applications. An example of such compressor is a R134a compressor. The compressor may utilize a HFC based refrigerant, wherein the HFC refrigerant is a R134 refrigerant.

[0012] In some embodiments, the central portion may be adapted to further house an exhaust unit.

[0013] In some embodiments, the heat exchanger system further comprises a timer arranged in communication with the compressor unit, the timer arranged to toggle the compressor between an on state and an off state. The timer may include a valve timing mechanism. The timer may be set to toggle the on state and the off

state based on a predetermined timing profile. The predetermined timing profile may comprise a ratio of on state to off state in the range of 2:1 to 9:1

[0014] In some embodiments, the water tank comprises a conduit connected externally for refill of the water tank by an external source.

[0015] According to another aspect of the disclosure there is a method for manufacturing a heat exchanger system comprising the steps of: (a.) providing a first heat exchanger, the first heat exchanger comprising at least one condenser unit and at least one first evaporator unit, the at least one condenser unit arranged adjacent to the at least one first evaporator unit; (b.) providing a second heat exchanger comprising a second evaporator unit; (c.) providing a central portion positioned between the first heat exchanger and the second heat exchanger; the central portion configured to house a ventilation device; and (d.) providing a compressor unit adapted to direct refrigerant to the at least one condenser unit and to receive refrigerant from the first and second evaporator units; wherein the compressor is suited for a relatively low temperature a relatively low pressure application.

[0016] The method may further comprise the step of providing a water tank operable to direct water to a sprinkler mechanism, the sprinkler mechanism positioned in the proximity of the at least one condenser unit to cool the condenser unit; and a conduit to receive water from the at least one first evaporator unit, wherein the conduit directs water back to the water tank.

[0017] The step of providing the first condenser unit may further comprise the sub-steps of providing a first condenser coil and a second condenser coil arranged adjoining the first condenser coil, and the second condenser coil is arranged adjoining the at least one first evaporator unit.

[0018] The sub-steps of providing the first condenser coil and the second condenser coil may be at a ratio of surface area between the first condenser coil and the second condenser coil is in the range from 1:3 to 1:1.

[0019] Other aspects and features of the present invention will become

apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF DRAWINGS

[0020] In the figures, which illustrate, by way of example only, embodiments of the present invention,

[0021] Figure 1 shows an embodiment of a heat exchanger system;

[0022] Figure 2 shows another embodiment of a heat exchanger system;

[0023] Figure 3 shows another embodiment of a heat exchanger system; and

[0024] Figure 4 shows a flowchart of a method for manufacturing a heat exchanger system.

DESCRIPTION OF EMBODIMENTS

[0025] Throughout the description, the term ‘heat exchanger’ may refer to a device to facilitate heat transfer between two or more fluids. Some heat exchangers described in the various embodiments can be utilized in both cooling and heating processes. It may be appreciated that a heat exchanger may include one or more interfaces. An interface of a heat exchanger may include medium to facilitate heat exchange, the interface may include a wall to achieve separation between the fluids. Such wall may be a solid wall. In some embodiments, the interface may allow the two or more fluids to be in direct contact with one another to facilitate heat exchange.

[0026] Throughout the description, the term ‘heat exchanger system’ refers broadly to any systems capable of utilizing one or more heat exchanger devices, including, but not limited to, refrigerator and air-conditioners.

[0027] Throughout the description, the term ‘refrigerant’ broadly includes heat exchange medium and/or fluid for facilitating heat exchange.

[0028] Throughout the description, the term ‘air-conditioner’ includes temperature regulators for heating or cooling an environment, such as within an enclosed space/area. The term ‘air-conditioner’ may also include an outdoor system having a compressor unit and an indoor device for the regulation of temperature and/or humidity in an enclosed area. The air-conditioner includes conventional systems wherein one or more compressors are placed outdoor and portable systems wherein compressors are integrated with the blowers to form a compact unit.

[0029] Figure 1 shows an embodiment of a heat exchanger system 10. The heat exchanger system 10 comprises a first heat exchanger 12 and a second heat exchanger 14.

[0030] The first heat exchanger 12 comprises at least one condenser unit 16 and at least one first evaporator unit 18. The at least one condenser unit 16 is arranged adjacent to the at least one first evaporator unit 18, and the at least one condenser unit 16 may be in thermal contact with the at least one first evaporator unit 18.

[0031] The second heat exchanger 14 comprises a second evaporator unit 20.

[0032] A central portion 22 is positioned between the first heat exchanger 12 and the second heat exchanger 14. The central portion 22 is configured to house a ventilation device 24, such as a fan or blower. The central portion 22 may further be configured to draw ambient air to pass the first heat exchanger 12 and second heat exchanger 14 so as to direct the treated air (e.g. cooled air) to be blowed out from the blower.

[0033] The heat exchanger system 10 also comprises a compressor unit 26 adapted to direct refrigerant to the at least one condenser unit 16 and to receive refrigerant from the first and second evaporator units 18, 20. The refrigerant may comprise a HFC (hydrofluorocarbon) refrigerant. The refrigerant may be regarded as a primary coolant.

[0034] The heat exchanger system 10 may further include a secondary coolant

container, such as a water tank 27, for maintaining the temperature of the first heat exchanger 12. The water tank 27 may be filled with water (or other suitable fluid coolant). The water (or other fluid) may be regarded as a secondary coolant.

[0035] The water tank 27 may be arranged in fluid communication with a sprinkler mechanism 28. The fluid communication may be via tubes, pipes, or other conduits as known by a skilled person. A control mechanism may be arranged to direct water from the water tank 27 to the sprinkler mechanism 28. The control mechanism may include one or more mechanical control mechanisms, one or more electronic controllers, valves, or other mechanisms as known by a skilled person.

[0036] The sprinkler mechanism 28 is suitably positioned in the proximity of the at least one condenser unit to cool the condenser unit during operation.

[0037] A fluid collector 30 may be placed in the proximity or vicinity of the first evaporator unit 18. The fluid collector 30 may be in the form of a tray, a tube, a pipe, a funnel, or combinations of the aforementioned for collection of condensed water in the proximity of the evaporator unit 18.

[0038] Most of the collected condensed water from the evaporator units 18/20 will be directed back to the water tank 27. As the water around the evaporator units 18 and/or 20 are condensed and fall into the fluid collector 30, which is then directed back to the water tank 27 via one or more conduits.

[0039] The first condenser unit 16 comprises a first condenser coil 32 and a second condenser coil 34 arranged adjoining the first condenser coil 32, and the second condenser coil 34 is arranged adjoining the at least one first evaporator unit 18. In some embodiments, the ratio of a surface area between the first condenser coil 32 and the second condenser coil 34 is in the range from 1:1 to 1:3. The second condenser coil 34 may comprise a plurality of coils inclined with respect to a transverse or longitudinal axis of the first heat exchanger unit 12.

[0040] In some embodiments, the HFC refrigerant used for the compressor 26 is a R134 refrigerant. Other refrigerants suitable for low pressure low temperature operations are contemplated.

[0041] In some embodiments, the central portion 22 further houses other components such as an exhaust unit, one or more suction pumps for drawing in air, one or more controller boards that may be in the form of printed circuit boards etc.

[0042] Figure 2 shows another embodiment of the heat exchanger system. In the embodiment shown in Figure 2, there is an additional fluid collector 36 may be placed in the proximity or vicinity of the second evaporator unit 20. The fluid collector 36 may be in the form of a tray, a tube, a pipe, a funnel, or combinations of the aforementioned for collection of condensed water in the proximity of the second evaporator unit 20.

[0043] Figure 3 is another embodiment of the heat exchanger system 10. The heat exchanger system 10 shown in Figure 3 comprises a timer 38 arranged in communication with the compressor unit, the timer 38 arranged to toggle the compressor between an on state and an off state. The timer may be set to toggle the on state and the off state based on a predetermined timing profile. The timer may include a valve timing mechanism. The predetermined timing profile comprises a ratio of on state to off state in the range of 1.5:1 to 9:1, preferably 2:1 to 9:1 and preferably 7:3. It is appreciable that the timer 38 may also be incorporated in the embodiment shown in Figure 1.

[0044] In some embodiments, the water tank 27 comprises a conduit connected externally for refill of the water tank by an external source. The refill of water tank may be performed manually by a user.

[0045] In some embodiments, the system 10 includes a water pump positioned between the water source 27 and the first heat exchanger 12 and/or the second heat exchanger 14 to facilitate the flow of water at a particular flow rate to the respective heat exchangers 12, 14. The water pump is configured to pump water from/to the water source 27.

[0046] The heat exchanger system 10 will next be described in the context of an air-conditioner unit and operation of the air-conditioner unit. The air-conditioner unit may be a portable air-conditioner unit the various components as described being housed in one housing.

[0047] The compressor 26 functions as a refrigerant source and pumps the refrigerant through the air conditioning system at a predetermined flow rate and pressure. When the refrigerant enters the compressor 26, it is typically in a relatively low-pressure vapour state at a temperature above room or ambient temperature. The refrigerant enters the compressor 26 under a suction force and is compressed into a relatively higher-pressure vapour. The compressed refrigerant exits the compressor 26 under a relatively higher temperature than when it enters the compressor 26.

[0048] The compressor 26 is arranged in fluid communication to send refrigerant to the condenser coils 32 and 34. The secondary coolant source (in the form of the water tank 27) is arranged in fluid communication with the condenser coils 32 and 34 to send water to the condenser coils 32 and 34. Such an arrangement is configured for heat exchange to take place between the relatively high-pressure high-temperature refrigerant vapour and the water, with the objective of cooling the refrigerant using water from the water source 27. Water that gains heat from the refrigerant is either evaporated or directed back to the water tank 27 due to condensation onto the evaporator coil 18 arranged adjacent (and in contact) with the condenser coil 34. As the refrigerant is cooled, it changes from the gaseous state to a liquid state.

[0049] The cooled refrigerant may be sent to the evaporator unit 18, 20 via one or more flow control devices. The one or more flow control devices may be in the form of capillary tubes. The flow control device is operable to control the flow of the liquid refrigerant to the evaporator coils 18, 20, such that as the refrigerant passes through the flow control device (which typically is equipped with pressure and/or temperature sensors), and into the evaporator coils 18, 20, the pressure of the refrigerant drops.

[0050] As the refrigerant enters the evaporator coils 18, 20 it begins to boil and change state back to a vapour. During this process of changing state from liquid to vapour, energy in the form of heat is removed from the ambient air passing over the evaporator coil(s) and the heat from the ambient environment is absorbed by the refrigerant. The heat that was in the ambient air is transferred into the

refrigerant, thereby cooling the ambient environment.

[0051] After the refrigerant (that has absorbed some heat energy from the ambient environment) passes through the evaporator coils 18, 20 and exit the evaporator coils, the temperature of the refrigerant may be relatively lower compared to the temperature of air in the vicinity of the evaporator coils 18, 20. As such, water may condense on the evaporator coils 18, 20 and is collected by the fluid collector 30.

[0052] In some embodiments, one or more connecting pipes (not shown) may be utilized to connect the different evaporator coils and/or condenser coils to the refrigerant source (e.g. compressor). The connecting pipes may be arranged to combine the flow of refrigerant to/from the refrigerant source.

[0053] According to another aspect of the disclosure and with reference to Figure 3 there is a method 100 for manufacturing a heat exchanger system comprising the steps of:

(a.) providing a first heat exchanger, the first heat exchanger comprising at least one condenser unit and at least one first evaporator unit, the at least one condenser unit arranged adjacent to the at least one first evaporator unit (step S102);

(b.) providing a second heat exchanger comprising a second evaporator unit (step S104);

(c.) providing a central portion positioned between the first heat exchanger and the second heat exchanger; the central portion configured to house a ventilation device (step S106);

(d.) providing a compressor unit adapted to direct refrigerant to the at least one condenser unit and to receive refrigerant from the first and second evaporator units; wherein the refrigerant comprises a HFC (hydrofluorocarbon) refrigerant (step S108).

[0054] The heat exchanger system may be the heat exchanger system 10 as described with reference to the embodiments shown in Figure 1 and Figure 2.

[0055] The method 100 may further include a step of providing a secondary coolant tank (step S110).

[0056] It is envisaged that the heat exchanger system 10 may be an air-conditioner, a refrigerant, an air ventilator, a de-humidifier.

[0057] It is envisaged that although the central portion 22 is described in the embodiments to be positioned between the first heat exchanger 12 and the second heat exchanger 14, the central portion 22 may be positioned adjacent to at least one of the first heat exchanger 12 and the second heat exchanger 14. In some embodiments, there may comprises additional portions similar to the central portion 22, each additional portion may comprise at least one fan mechanism operable to pushing treated air, such as cooled air, out to the ambient environment.

[0058] It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention.

CLAIMS

1. A heat exchanger system comprising

a first heat exchanger comprising at least one condenser unit and at least one first evaporator unit, the at least one condenser unit arranged adjacent to the at least one first evaporator unit;

a second heat exchanger comprising a second evaporator unit;

a central portion positioned adjacent at least one of the first heat exchanger and the second heat exchanger; the central portion configured to house a ventilation device;

a compressor unit adapted to direct refrigerant to the at least one condenser unit and to receive refrigerant from the first and second evaporator units;

wherein the compressor unit is suited for a low temperature and low-pressure application.

2. The heat exchanger system of claim 1, further comprises

a water tank operable to direct water to a sprinkler mechanism, the sprinkler mechanism positioned in the proximity of the at least one condenser unit to cool the condenser unit; and

a conduit to receive water from the at least one first evaporator unit, wherein the conduit directs water back to the water tank.

3. The heat exchanger system of claim 1 or 2, wherein the first condenser unit comprises a first condenser coil and a second condenser coil arranged adjoining the first condenser coil, and the second condenser coil is arranged adjoining the at least one first evaporator unit.

4. The heat exchanger system of claim 3, wherein the ratio of surface area between the first condenser coil and the second condenser coil is in the range from 1:3 to 1:1.

5. The heat exchanger system of any one of the preceding claims, wherein the compressor unit utilizes a HFC refrigerant, preferably a R134 refrigerant.

6. The heat exchanger system of any one of the preceding claims, wherein the central portion further houses an exhaust unit.

7. The heat exchanger system of any one of the preceding claims, further comprises a timer arranged in communication with the compressor unit, the timer arranged to toggle the compressor unit between an on state and an off state.

8. The heat exchanger system of claim 7, wherein the timer is set to toggle the on state and the off state based on a predetermined timing profile.

9. The heat exchanger system of claim 8, wherein the predetermined timing profile comprises a ratio of on state to off state in the range of 1.5:1 to 9:1.

10. The heat exchanger system of any one of the preceding claims, wherein the water tank comprises a conduit connected externally for refill of the water tank by an external source.

11. A method for manufacturing a heat exchanger system comprising the steps of:

(a.) providing a first heat exchanger, the first heat exchanger comprising at least one condenser unit and at least one first evaporator unit, the at least one condenser unit arranged adjacent to the at least one first evaporator unit;

(b.) providing a second heat exchanger comprising a second evaporator unit;

(c.) providing a central portion positioned adjacent at least one of the first heat exchanger and the second heat exchanger; the central portion configured to house a ventilation device;

(d.) providing a compressor unit adapted to direct refrigerant to the at least one condenser unit and to receive refrigerant from the first and second evaporator units; wherein the compressor unit is suited for a low temperature and low-pressure application.