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(54) EQUIPMENT AND METHOD

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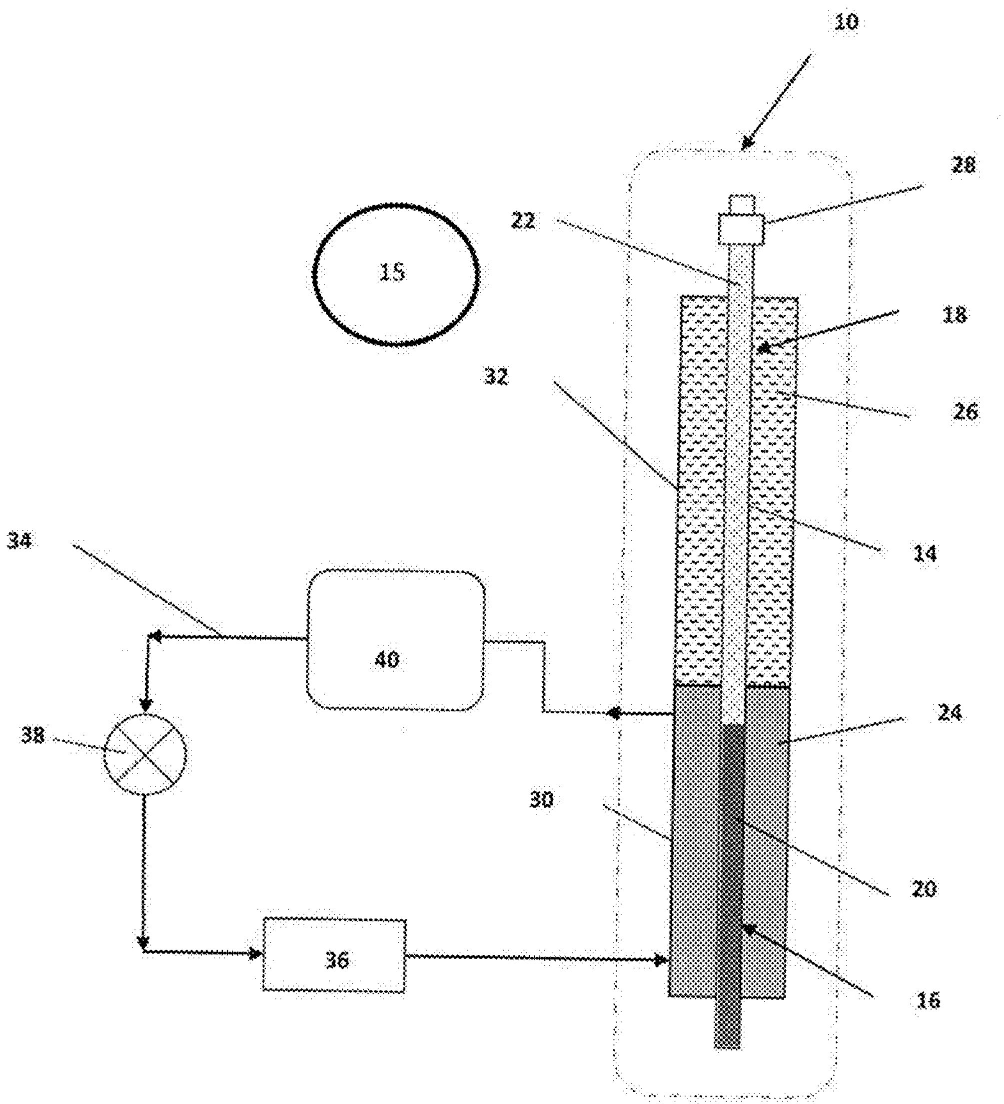
(57) ABSTRACT

Disclosed herein is a heat transfer system comprising a vessel comprising an inner chamber comprising a first end separated from, and in fluid communication with a second end, the inner chamber partially filled with a heat transfer medium having a normal boiling point below 60° C., which is present at a pressure and in an amount sufficient to allow boiling of the heat transfer medium at a first temperature and condensation of a vapor of the heat transfer medium at a second temperature below the first temperature. Systems comprising the heat transfer system and methods of using the heat transfer system are also disclosed.



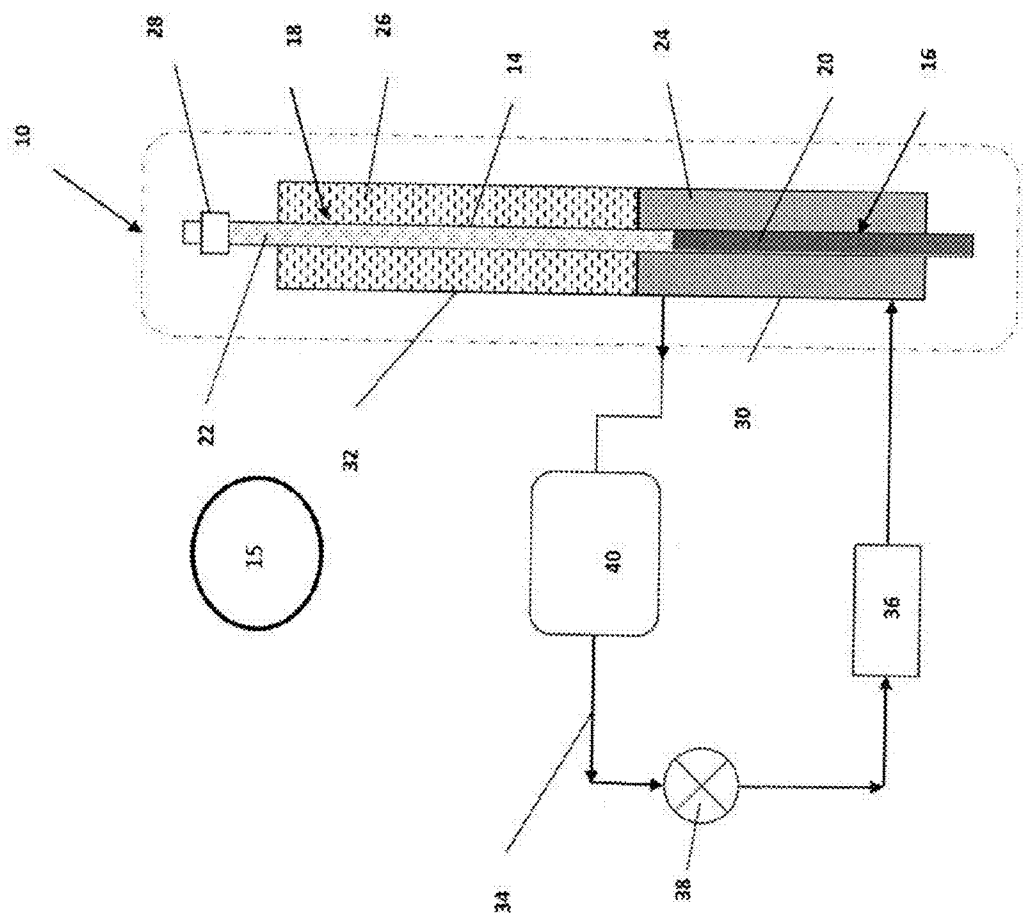


FIG. 1

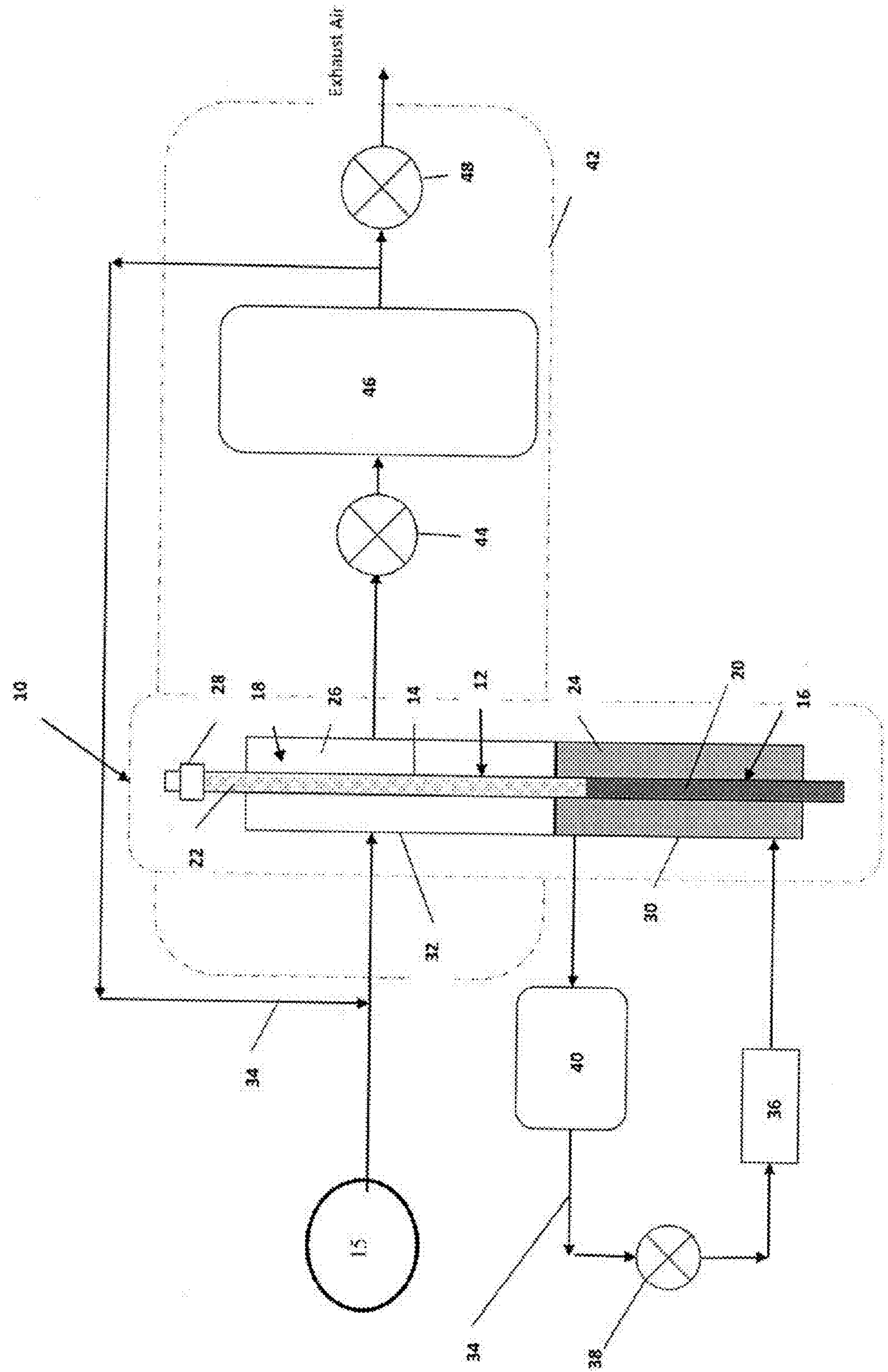

Exhaust Air
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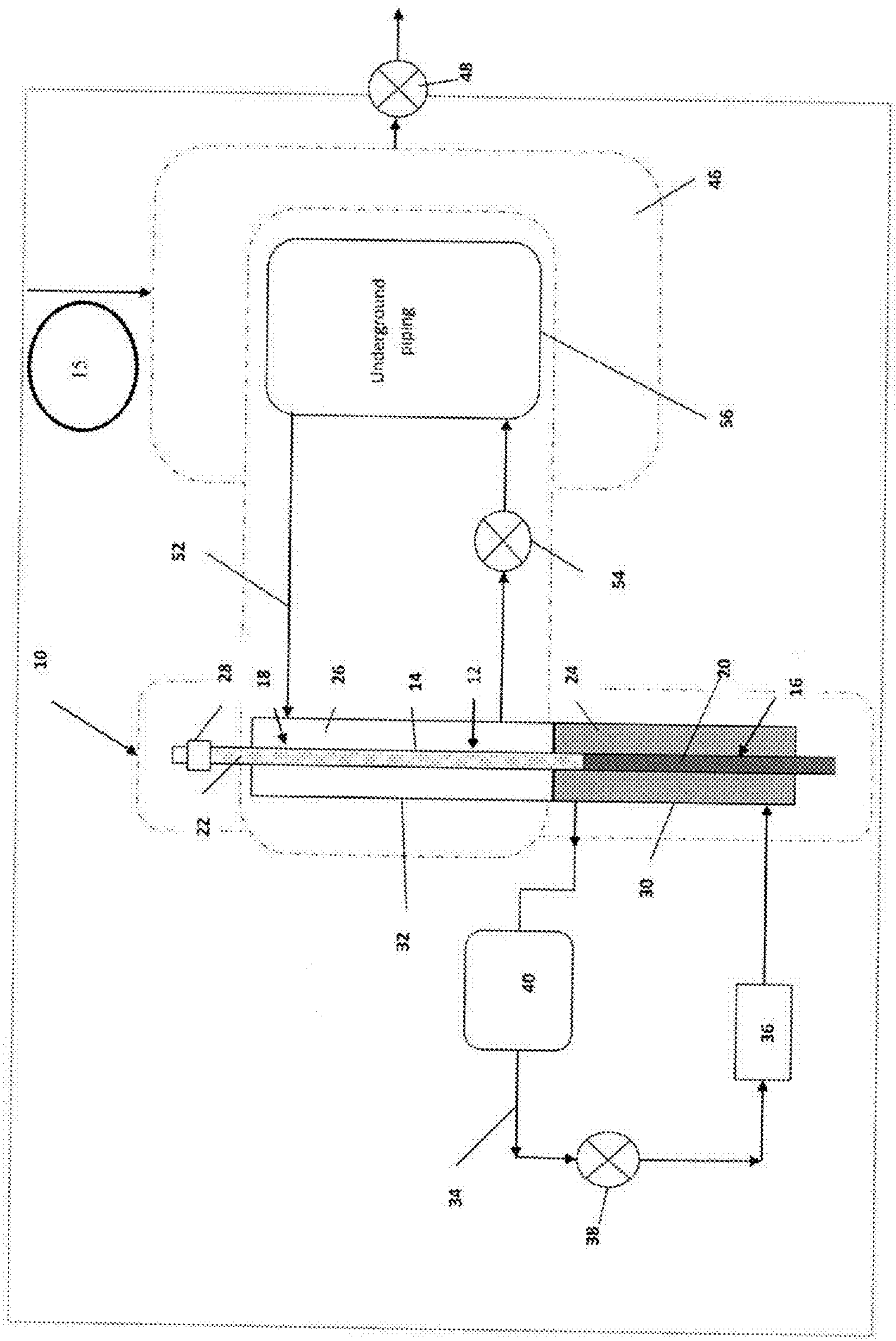
FIG. 2



Underground piping
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FIG. 3

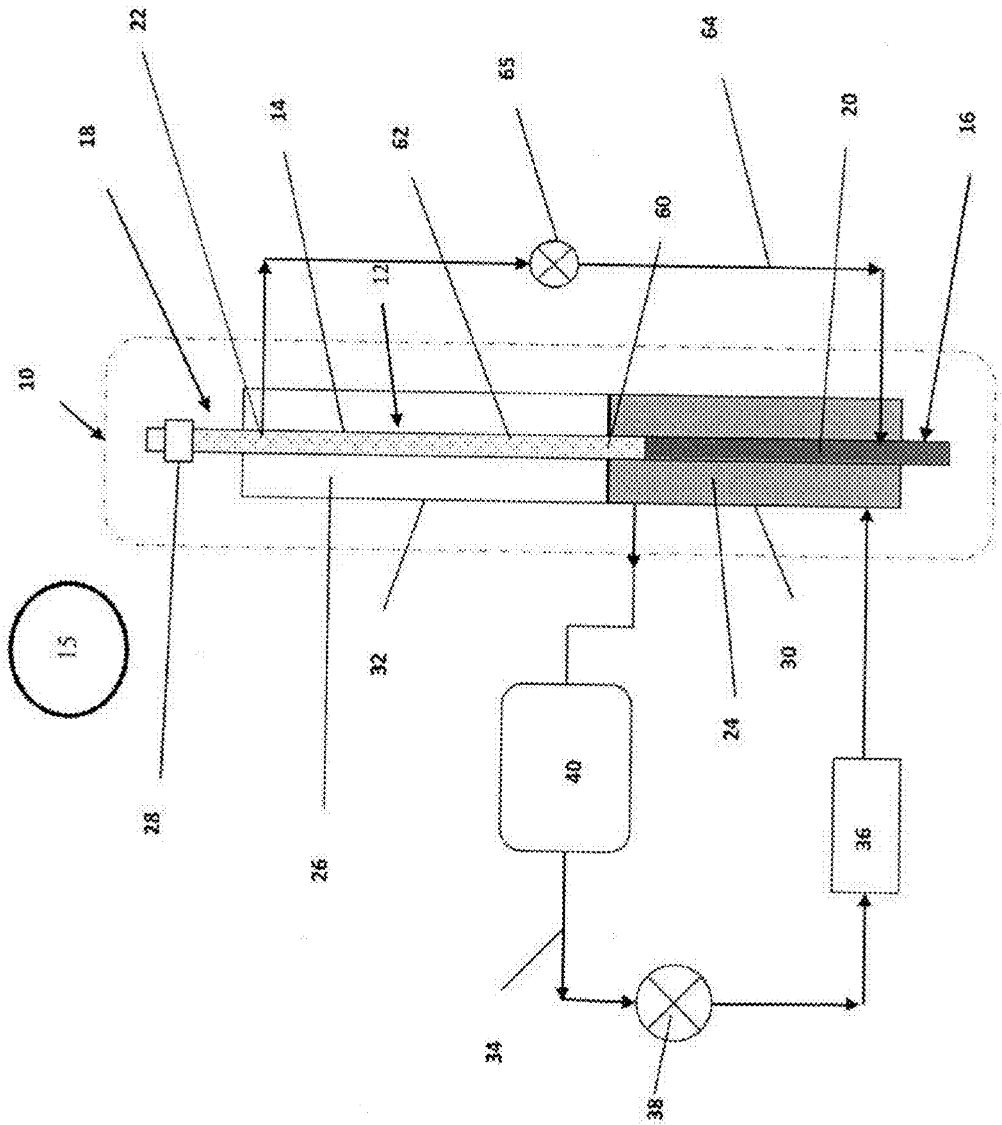

FIG. 4

EQUIPMENT AND METHOD

BACKGROUND

[0001] The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

[0002] Providing heat to various enclosures used in commercial and domestic applications which include living organisms or temperature sensitive items requires providing a heated fluid at a temperature below that directly generated by electrical heaters or by combustion of a fuel. In such systems, the heat must be transferred through one or more heat transfer mediums to the intended end use point. Heat losses due to thermal conductivity, thermal convection and radiation result in lost efficiency.

[0003] There is a need to improve the efficiency of heat transfer in heating systems.

SUMMARY

[0004] This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

[0005] In embodiments, a heating system comprises a heat transfer system comprising an outer vessel comprising an inner vessel, also referred to herein as an inner chamber, comprising a first end separated from, and in fluid communication with a second end, the inner chamber partially filled with a heat transfer medium having a normal boiling point below 60° C., which is present in the first end at a pressure and in an amount sufficient to allow boiling of the heat transfer medium at a first temperature and condensation of a vapor of the heat transfer medium at the second end at a second temperature below the first temperature. In embodiments, the outer vessel is divided into two separate portions or chambers; the first is around the first end of the inner vessel and includes a liquid heated to a temperature slightly above the boiling temperature of the heat transfer medium inside the inner vessel or inner chamber, thus causing boiling, evaporation, and transformation of the heat transfer medium into a gaseous state. This vapor flows to the second end of the inner vessel. The second chamber or portion of the outer vessel is located proximate to, or around the second end of the inner vessel. This chamber includes a fluid to be heated by absorbing the heat present in the gaseous heat transfer medium at the second end which heats this fluid to be heated while simultaneously causing the gaseous heat transfer medium to condense back to a liquid state, which flows or is directed back to the first end of the inner vessel.

[0006] In embodiments, a method comprises providing a heat transfer system comprising a vessel comprising an inner chamber comprising a first end separated from, and in fluid communication with a second end, the inner chamber partially filled with a heat transfer medium having a normal boiling point below 60° C., which is present at a pressure and in an amount sufficient to allow boiling of the heat transfer medium at a first temperature and condensation of a vapor of the heat transfer medium at a second temperature;

[0007] contacting the first end of the vessel with a first fluid having a temperature greater than or equal to the first temperature; and

[0008] contacting the second end of the vessel with a second fluid having a temperature less than or equal to the second temperature for a period of time sufficient to increase the temperature of the second fluid.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0009] Embodiments of heat transfer systems are described with reference to the following figures. The same numbers are used throughout the figures to reference like features and components.

[0010] FIG. **1** is a block diagram of a heat transfer system according to an embodiment of the instant disclosure;

[0011] FIG. **2** is a block diagram of a heat transfer system according to an alternative embodiment of the instant disclosure;

[0012] FIG. **3** is a block diagram of a heat transfer system according to an alternative embodiment of the instant disclosure; and

[0013] FIG. **4** is a block diagram of a heat transfer system according to an alternative embodiment of the instant disclosure.

DETAILED DESCRIPTION

[0014] At the outset, it should be noted that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the developer's specific goals, such as compliance with system related and business related constraints, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time consuming but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of this disclosure. In addition, the composition used/disclosed herein can also comprise some components other than those cited. In the summary and this detailed description, each numerical value should be read once as modified by the term "about" (unless already expressly so modified), and then read again as not so modified unless otherwise indicated in context. Also, in the summary and this detailed description, it should be understood that a physical range listed or described as being useful, suitable, or the like, is intended that any and every value within the range, including the end points, is to be considered as having been stated. For example, "a range of from 1 to 10" is to be read as indicating each and every possible number along the continuum between about 1 and about 10. Thus, even if specific data points within the range, or even no data points within the range, are explicitly identified or refer to only a few specific, it is to be understood that inventors appreciate and understand that any and all data points within the range are to be considered to have been specified, and that inventors possessed knowledge of the entire range and all points within the range.

[0015] The following definitions are provided in order to aid those skilled in the art in understanding the detailed description.

[0016] As used in the specification and claims, "near" is inclusive of "at." A hydrocarbon refers to a compound comprising carbon and hydrogen, whether saturated or unsaturated. A halogenated hydrocarbon refers to a hydrocarbon wherein at least one hydrogen is substituted with a halogen, F, Cl, Br, and/or I. An aqueous liquid refers to a liquid comprising from about 5 wt % up to 100 wt % water.

[0017] A vessel refers to a sealed container, which may comprise one or more pieces or components contacted and arranged to form an inner chamber or space in fluid isolation from an external atmosphere, except for the presence of one or more vents, pressure relief valves, pressure regulator assemblies, and the like required for the safe utilization of the vessel according and embodiments disclosed herein. A conduit refers to a pipe, tube, or any such channel through with a fluid will flow. A "normal boiling point" refers to the boiling point of a material at 1 atm of pressure.

[0018] In embodiments, a heat transfer system comprises a vessel comprising an inner chamber comprising a first end separated from, and in fluid communication with a second end, the inner chamber partially filled with a heat transfer medium having a normal boiling point below 60° C., which is present in an amount sufficient to produce an operational pressure within the inner chamber sufficient to allow boiling of the heat transfer medium at a first temperature and condensation of a vapor of the heat transfer medium at a second temperature below the first temperature. Accordingly, the composition of the heat transfer medium, the amount of the heat transfer medium and the pressure of the heat transfer medium may be selected based on the intended first and second temperatures, the size of the system, and the physical properties of the vessel being used.

[0019] In embodiments, the heat transfer medium comprises a hydrocarbon, a halogenated hydrocarbon, or a combination thereof. In embodiments, the heat transfer medium comprises difluoromethane, difluroethane, chlorodifluromethane, chlorotrifluromethane, tetrafluoroethane, pentafluoroethane, 1-chloro-1,2,2,2-tetrafluoroethane, isobutane, or a combination thereof.

[0020] In embodiments, the vessel comprises copper, aluminum, a ferrous alloy, a copper alloy, an aluminum alloy, or a combination thereof. In embodiments, the first end of the vessel comprises a liquid-liquid heat exchanger. In embodiments, the second end of the vessel comprises a vapor-vapor heat exchanger or a liquid-vapor heat exchanger.

[0021] In embodiments, the first end of the vessel is arranged in physical contact with a first fluid having a temperature greater than or equal to the first temperature, and the second end of the vessel is arranged in physical contact with a second fluid having a temperature less than or equal to the second temperature.

[0022] In embodiments, the first fluid is an aqueous liquid and/or the second fluid is a gas at 25° C. and 1 atm of pressure and/or the second fluid is an aqueous liquid.

[0023] In embodiments, the system further comprises a closed pump-around loop comprising an external heater in thermal contact with the first fluid.

[0024] In embodiments, the first end of the vessel is connected to the second end of the vessel via one or more conduits. In embodiments, the one or more conduits may comprise a vapor supply conduit and/or a liquid return conduit. In embodiments, the condensed vapor of the heat transfer medium, after being condensed in the second end, is returned from the second end to the first end by gravity. In other embodiments, the heat transfer system may further comprise one or more pumps arranged to pump the condensed vapor of the heat transfer medium from the second end back to the first end.

[0025] In embodiments, the transfer system may further comprise a pressure regulator assembly to regulate the pressure of the heat transfer medium within the inner chamber.

[0026] In embodiments, a method comprises providing a heat transfer system according to any one or combination of embodiments disclosed herein, contacting the first end of the vessel with a first fluid having a temperature greater than or equal to the first temperature; and contacting the second end of the vessel with a second fluid having a temperature less than or equal to the second temperature for a period of time sufficient to increase the temperature of the second fluid.

[0027] In embodiments, heat is supplied to the first fluid intermittently based on the temperature of the second fluid.

[0028] As shown in FIG. **1**, in embodiments, a heat transfer system, generally referred to as **10** comprises a vessel **12** comprising an inner chamber **14** in fluid isolation from an external atmosphere **15**, comprising a first end **16** separated from, and in fluid communication with a second end **18**, the inner chamber **14** partially filled with a liquid heat transfer medium **20** having a normal boiling point below 60° C., which is present at a pressure and in an amount sufficient to produce an operational pressure within the inner chamber **14** sufficient to allow boiling of the heat transfer medium **20** at a first temperature and condensation of a vapor of the heat transfer medium **22** at a second temperature below the first temperature. Accordingly, heat present in a first fluid **24** supplied to the first end **16** of the vessel **12** is transferred into the heat transfer medium **20** causing the heat transfer medium **20** to boil. The heat present in the vapor **22** present in the second end **18** is then transferred to a second fluid **26** resulting in an increase in the second fluid **26** temperature with a corresponding decrease in the temperature of the heat transfer medium **20** causing the vapor **22** to condense into a liquid which is then returned from the second end **18** back to the first end **16**, wherein the process is repeated. Heat is thus transferred from the first fluid **24** to the second fluid **26**.

[0029] In embodiments, the heat transfer fluid has a relatively low specific heat. The specific heat is the amount of heat per unit mass required to raise the temperature by one degree Celsius, according to the formula:

$$Q=CM(T_2-T_1) \text{ at temperature } ^\circ \text{ C.;}$$

which may be expressed at a particular temperature X, often temperature T_1, wherein Q represents the heat supplied, m is the mass or amount of the material, and T_2-T_1 refers to the change in temperature. The constant "C" is the specific heat of the material, which may be expressed in Joules per gram ° C. For purposes herein water is considered to have a relatively high specific heat of 4.186 joules/gram ° C. (J/g ° C.). In embodiments, the heat transfer medium has a specific heat less than 2 J/g ° C. at 0° C., or less than 1.5, or less than 1 J/g ° C. at 0° C. In embodiments, the heat transfer medium comprises a refrigerant. Suitable refrigerants for use herein include hydrocarbons, C_1-C_5 hydrocarbons, halogenated hydrocarbons, halogenated C_1-C_5 hydrocarbons, fluorinated hydrocarbons, brominated hydrocarbons, chlorinated hydrocarbons, fluoro-chloro hydrocarbons, fluoro-bromo-chloro hydrocarbons, bromo-chloro hydrocarbons, bromo-fluoro hydrocarbons, and the like, (commonly referred to as Freon's® and/or Halon's®, registered trade names of DuPont) or combinations thereof.

[0030] In embodiments, the heat transfer medium comprises trichlorofluoromethane, dichlorodifluoromethane, difluoromethane, pentafluoroethane, chlorotrifluoromethane, chlorodifluoromethane, dichlorofluoromethane, chlorofluoromethane, bromochlorodifluoromethane, 1,1,2-Trichloro-1, 2,2-trifluoroethane, 1,1,2-trichlorotrifluoroethane, 1,1,1-

trichloro-2,2,2-trifluoroethane, 1,2-dichloro-1,1,2,2-tetrafluoroethane, dichlorotetrafluoroethane, 1-chloro-1,1,2,2,2-pentafluoroethane, chloropentafluoroethane, 2-chloro-1,1,1,2-tetrafluoroethane, 1,1-dichloro-1-fluoroethane, 1-chloro-1,1- difluoroethane, tetrachloro-1,2-difluoroethane, tetrachloro-1,1-difluoroethane, 1,1,2-trichlorotrifluoroethane, 1-bromo-2-chloro-1,1,2-trifluoroethane, 2-bromo-2-chloro-1,1,1-trifluoroethane, 1,1-dichloro-2,2,3,3,3-pentafluoropropane, 1,3-dichloro-1,2,2,3,3-pentafluoropropane, methane, ethane, ethylene, propane, butane, isobutane, pentane, isopentane, and combinations thereof.

[0031] In embodiments, the heat transfer medium comprises difluoromethane, difluroethane, chlorodifluromethane, chlorotrifluromethane, tetrafluoroethane, pentafluoroethane, 1-chloro-1,2,2,2-tetrafluoroethane, butane, isobutane, or a combination thereof.

[0032] In embodiments, the normal boiling point of the heat transfer medium, which may consist essentially of a single component or may comprise a plurality of components in a mixture, when determined at 1 atm of pressure, is less than about 60° C., or less than about 50° C., or less than about 40° C., or less than about 30° C., or less than about 20° C., or less than about 10° C., or less than about 0° C., or less than about −5° C.; depending on the constituents and the percentage of each in the combination. The heat transfer medium may thus be selected according to the intended first temperature and second temperature. In embodiments, the normal boiling point of the heat transfer medium at 1 atm of pressure is less than or equal to about 60° C.

[0033] Likewise, the amount of the heat transfer medium and/or the pressure of the heat transfer medium may be selected and/or controlled to depending on the intended first temperature and second temperature of the heat transferred system. In embodiments, as shown in FIG. **1**, the heat transfer system may further comprise a pressure regulator assembly **28**, effective to regulate the pressure within the inner chamber **14** depending on the desired first and second temperatures of the system **10**.

[0034] In embodiments, the inner vessel or chamber **12** may be formed at least partially from metal. In embodiments, the vessel may comprise copper, aluminum, a ferrous alloy, a copper alloy, an aluminum alloy, or a combination thereof. In embodiments, the first end of the vessel, the second end of the vessel, or both may comprise a liquid-liquid heat exchanger **30**. Examples of heat exchangers include shell-in-tube heat exchangers, double pipe heat exchangers, plate heat exchangers, plate and shell heat exchangers, and the like.

[0035] In embodiments, the first end of the vessel and/or the second end of the vessel may comprises a vapor-vapor heat exchanger **32**. Suitable examples include radiators, wheel heat exchangers, plate fin heat exchanger, pillow plate heat exchangers, and the like. In embodiments, the first end **16** comprises a liquid-liquid heat exchanger and the second end **18** comprises a vapor-vapor heat exchanger.

[0036] In embodiments, the first end of the vessel **16** is arranged in physical contact with the first fluid **24** having a temperature greater than or equal to the first temperature, and the second end of the vessel **18** is arranged in physical contact with the second fluid **26** having a temperature less than or equal to the second temperature. In embodiments, the first fluid and/or the second fluid is an aqueous liquid. Suitable examples include water, brine, ethylene glycol and/or propylene glycol solutions, and the like. In embodiments, the first fluid and/or the second fluid is a gas at 25° C. and 1 atm of pressure, for example, air.

[0037] As shown in FIG. **1**, in embodiments, the heat transfer system may further comprise a closed pump-around loop **34** comprising a recirculation pump **38**, a liquid storage vessel **40** and/or an external heater **36** in thermal contact with the first fluid **24**, in thermal contact with the first end **16**.

[0038] As shown in FIG. **2**, in embodiments, the heat transfer system may further comprise a closed pump-around loop **34** comprising a recirculation pump **38**, a liquid storage vessel **40** and/or an external heater **36** in thermal contact with the first fluid **24**, in thermal contact with the first end **16**, and a vapor-vapor heat exchanger system **42** comprising a vapor (e.g., air) suction fan **44** which pulls ambient air into contact with the second end **18** thereby heating the air which is exhausted into the space to be heated **46** and which then may be exhausted by an exhaust fan **48**, and/or a portion may be recycled back **50** into contact with the second end **18**.

[0039] As shown in FIG. **3**, in embodiments, the heat transfer system may further comprise a closed pump-around loop **34** comprising a recirculation pump **38**, a liquid storage vessel **40** and/or an external heater **36** in thermal contact with the first fluid **24**, in thermal contact with the first end **16**, and a vapor-liquid heat exchanger system comprising a closed pump around loop **52** comprising a recirculation pump **54**, an external liquid-gas (e.g., liquid-air) heat exchanger **56** to transfer heat into the space to be heated **46**, in thermal contact with the second fluid **26**, which is in thermal contact with the vapor of the heat transfer medium **22** within the second end **18**. The system may further include an exhaust fan **48**.

[0040] As shown in FIG. **4**, in embodiments, the first end **16** is connected to the second end **18** via one or more conduits **60**. In embodiments, the one or more conduits **60** comprise a vapor supply conduit **62** and a liquid return conduit **64**, either of which may by arranged internal or external to the inner chamber **14**. Accordingly, in embodiments, the first end may be located remote from the second end. As shown in FIG. **1**, in embodiments, the condensed vapor **20** of the heat transfer medium is returned from the second end **18** to the first end **16** by gravity. As shown in FIG. **4**, in embodiments, the heat transfer system may further comprise one or more heat transfer medium pumps **65** and the associated collectors and piping arranged to pump the condensed vapor **20** of the heat transfer medium from the second end **18** to the first end **16**.

[0041] In embodiments, the heat transfer system according to one or more embodiments may be employed to transfer heat generated by a solar, gas or electric furnace to produce output air at having temperatures from about 40° C. to about 60° C. suitable for heating enclosures containing living things and/or temperature sensitive components. For example, warm air having a temperature from about 40 to 50° C. was provided to heat an animal enclosure with a butane gas consumption of 300 gm/h. The heating source may also comprise waste heat from power generation, and/or combustion of diesel, propane or/or the like. In embodiments, the heating of the first fluid may be cycled on and off depending on the heat demand of the second fluid i.e., the second fluid temperature, allowing for a reduction of energy as would be required to produce the same amount of heat using less efficient systems.

[0042] In an example, hot water at 75° C. was used as the first fluid, with Freon R22 as the heat transfer medium. The pressure within the inner chamber was adjusted to have a first temperature of 70° C. to change the liquid R22 into a gas. A vapor-vapor heat exchanger was used on the second end with a suction fan to deliver hot air at 50° C. with electricity consumption 500 w/h and air flow capacity 3900 m^3/h. Accordingly, heat transfer systems according to one or more embodiments disclosed herein produce hot air for heating an enclosure with a low cost and minimum consumption of energy.

EMBODIMENTS LISTING

[0043] Accordingly, the instant disclosure provides the following embodiments:

[0044] E1. A heat transfer system comprising:

- **[0045]** a vessel comprising an inner chamber comprising a first end separated from, and in fluid communication with a second end,
- **[0046]** the inner chamber partially filled with a heat transfer medium having a normal boiling point below 60° C., [or below 50° C., or below 40° C., or below 30° C., or below 20° C., or below 10° C., or below 0° C., or below −5° C], which is present at a pressure and in an amount sufficient to allow boiling of the heat transfer medium at a first temperature and condensation of a vapor of the heat transfer medium at a second temperature below the first temperature.

[0047] E2. The heat transfer system according to embodiment E1, wherein the heat transfer medium comprises a hydrocarbon, a halogenated hydrocarbon, or a combination thereof.

[0048] E3. The heat transfer system according to embodiment E1 or E2, wherein the heat transfer medium comprises difluoromethane, difluroethane, chlorodifluromethane, chlorotriflurometbane, tetrafluoroethane, pentafluoroethane, 1-chloro-1,2,2,2-tetrafluoroethane, isobutane, or a combination thereof.

[0049] E4. The heat transfer system according to any one of embodiments E1 through E3, wherein the vessel comprises copper, aluminum, a ferrous alloy, a copper alloy, an aluminum alloy, or a combination thereof.

[0050] E5. The heat transfer system according to any one of embodiments E1 through E4, wherein the first end of the vessel comprises a liquid-liquid heat exchanger.

[0051] E6. The heat transfer system according to any one of embodiments E1 through E5, wherein the second end of the vessel comprises a vapor-vapor heat exchanger.

[0052] E7. The heat transfer system according to any one of embodiments E1 through E6, wherein the second end of the vessel comprises a liquid-vapor heat exchanger.

[0053] E8. The heat transfer system according to any one of embodiments E1 through E7, wherein the first end of the vessel is arranged in physical contact with a first fluid having a temperature greater than or equal to the first temperature, and the second end of the vessel is arranged in physical contact with a second fluid having a temperature less than or equal to the second temperature.

[0054] E9. The heat transfer system according to embodiment E8, wherein the first fluid is an aqueous liquid.

[0055] E10. The heat transfer system according to embodiment E9, wherein the second fluid is a gas at 25° C. and 1 atm of pressure.

[0056] E11. The heat transfer system according to any one of embodiments E8 through E10, wherein the second fluid is an aqueous liquid.

[0057] E12. The heat transfer system according to any one of embodiments E8 through E11, further comprising a closed pump-around loop comprising an external heater in thermal contact with the first fluid.

[0058] E13. The heat transfer system according to any one of embodiments E1 through E12, wherein the first end is connected to the second end via one or more conduits.

[0059] E14. The heat transfer system according to any one of embodiments E1 through E13, wherein the one or more conduits comprise a vapor supply conduit and a liquid return conduit.

[0060] E15. The heat transfer system according to any one of embodiments E1 through E14, wherein the condensed vapor of the heat transfer medium is returned from the second end to the first end by gravity.

[0061] E16. The heat transfer system according to any one of embodiments E1 through E15, further comprising one or more pumps arranged to pump the condensed vapor of the heat transfer medium from the second end to the first end.

[0062] E17. The heat transfer system according to any one of embodiments E1 through E16, further comprising a pressure regulator assembly to regulate the pressure of the heat transfer medium within the inner chamber.

[0063] E18. A method comprising:

- **[0064]** providing a heat transfer system according to any one of embodiments E1 through E17, contacting the first end of the vessel with a first fluid having a temperature greater than or equal to the first temperature; and
- **[0065]** contacting the second end of the vessel with a second fluid having a temperature less than or equal to the second temperature for a period of time sufficient to increase the temperature of the second fluid.

[0066] E19. A method comprising:

- **[0067]** providing a heat transfer system comprising:
- **[0068]** a vessel comprising an inner chamber comprising a first end separated from, and in fluid communication with a second end,
- **[0069]** the inner chamber partially filled with a heat transfer medium having a normal boiling point below 60° C., [or below 50° C., or below 40° C., or below 30° C., or below 20° C., or below 10° C., or below 0° C., or below −5° C], which is present in an amount sufficient to produce an operational pressure within the inner chamber sufficient to allow boiling of the heat transfer medium at a first temperature and condensation of a vapor of the heat transfer medium at a second temperature;
- **[0070]** contacting the first end of the vessel with a first fluid having a temperature greater than or equal to the first temperature; and
- **[0071]** contacting the second end of the vessel with a second fluid having a temperature less than or equal to the second temperature for a period of time sufficient to increase the temperature of the second fluid.

[0072] The foregoing disclosure and description of the invention is illustrative and explanatory thereof and it can be readily appreciated by those skilled in the art that various changes in the size, shape and materials, as well as in the details of the illustrated construction or combinations of the elements described herein can be made without departing from the spirit of the invention.

[0073] Although only a few example embodiments have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from this invention. Accordingly, all such modifications are intended to be included within the scope of this disclosure as defined in the following claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures. Thus, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface, in the environment of fastening wooden parts, a nail and a screw may be equivalent structures. It is the express intention of the applicant not to invoke 35 U.S.C. §112, paragraph 6 for any limitations of any of the claims herein, except for those in which the claim expressly uses the words 'means for' together with an associated function.

I claim:

1. A heat transfer system comprising:

a vessel comprising an inner chamber comprising a first end separated from, and in fluid communication with a second end,

the inner chamber partially filled with a heat transfer medium having a normal boiling point below 60° C., which is present at a pressure and in an amount sufficient to allow boiling of the heat transfer medium at a first temperature and condensation of a vapor of the heat transfer medium at a second temperature below the first temperature.

2. The heat transfer system of claim **1**, wherein the heat transfer medium comprises a hydrocarbon, a halogenated hydrocarbon, or a combination thereof.

3. The heat transfer system of claim **1**, wherein the heat transfer medium comprises difluoromethane, difluroethane, chlorodifluromethane, chlorotrifluromethane, tetrafluoroethane, pentafluoroethane, 1-chloro-1,2,2,2-tetrafluoroethane, isobutane, or a combination thereof.

4. The heat transfer system of claim **1**, wherein the vessel comprises copper, aluminum, a ferrous alloy, a copper alloy, an aluminum alloy, or a combination thereof.

5. The heat transfer system of claim **1**, wherein the first end of the vessel comprises a liquid-liquid heat exchanger.

6. The heat transfer system of claim **1**, wherein the second end of the vessel comprises a vapor-vapor heat exchanger.

7. The heat transfer system of claim **1**, wherein the second end of the vessel comprises a liquid-vapor heat exchanger.

8. The heat transfer system of claim **1**, wherein the first end of the vessel is arranged in physical contact with a first fluid having a temperature greater than or equal to the first temperature, and the second end of the vessel is arranged in physical contact with a second fluid having a temperature less than or equal to the second temperature.

9. The heat transfer system of claim **8**, wherein the first fluid is an aqueous liquid.

10. The heat transfer system of claim **8**, wherein the second fluid is a gas at 25° C. and 1 atm of pressure.

11. The heat transfer system of claim **8**, wherein the second fluid is an aqueous liquid.

12. The heat transfer system of claim **8**, further comprising a closed pump-around loop comprising an external heater in thermal contact with the first fluid.

13. The heat transfer system of claim **1**, wherein the first end is connected to the second end via one or more conduits.

14. The heat transfer system of claim **13**, wherein the one or more conduits comprise a vapor supply conduit and a liquid return conduit.

15. The heat transfer system of claim **1**, wherein the condensed vapor of the heat transfer medium is returned from the second end to the first end by gravity.

16. The heat transfer system of claim **1**, further comprising one or more pumps arranged to pump the condensed vapor of the heat transfer medium from the second end to the first end.

17. The heat transfer system of claim **1**, further comprising a pressure regulator assembly to regulate the pressure of the heat transfer medium within the inner chamber.

18. A method comprising:

providing a heat transfer system comprising:

a vessel comprising an inner chamber comprising a first end separated from, and in fluid communication with a second end,

the inner chamber partially filled with a heat transfer medium having a normal boiling point below 60° C., which is present at a pressure and in an amount sufficient to allow boiling of the heat transfer medium at a first temperature and condensation of a vapor of the heat transfer medium at a second temperature;

contacting the first end of the vessel with a first fluid having a temperature greater than or equal to the first temperature; and

contacting the second end of the vessel with a second fluid having a temperature less than or equal to the second temperature for a period of time sufficient to increase the temperature of the second fluid.

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