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(72) Inventors:
• **ELSHERBINI, Abdelrahman**
East Hartford, CT Connecticut 06108 (US)
• **ALAHYARI, Abbas A.**
East Hartford, CT Connecticut 06108 (US)

(74) Representative: **Dehns**
St. Bride's House
10 Salisbury Square
London EC4Y 8JD (GB)

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(71) Applicant: **Carrier Corporation**
Palm Beach Gardens, FL 33418 (US)

(54) **THERMALLY ENHANCED HEATING**

(57) A thermally enhanced heating system (100) and a method for thermally enhancing a HVAC system are provided. The thermally enhanced heating system (100) preferably includes an outdoor HVAC unit (200) and an indoor HVAC unit (300). The indoor HVAC unit (300) includes a first heat exchanger (310) for transferring heat from a refrigerant, a second heat exchanger (320) for transferring heat from a fuel source, and a third heat exchanger (330) for transferring heat to the refrigerant. The outdoor HVAC unit (200) includes an outdoor heat ex-

changer (210) for transferring heat from an outdoor air to the refrigerant, a pump (220) configured to circulate the refrigerant, and an ejector (230) configured to combine the refrigerant from the outdoor heat exchanger (210) and the third heat exchanger (330). Preferably the outdoor HVAC unit (200) is operated to circulate the refrigerant through a first refrigerant circuit (500) and a second refrigerant circuit (400), and combine refrigerant in the first refrigerant circuit (500) and the second refrigerant circuit (400).

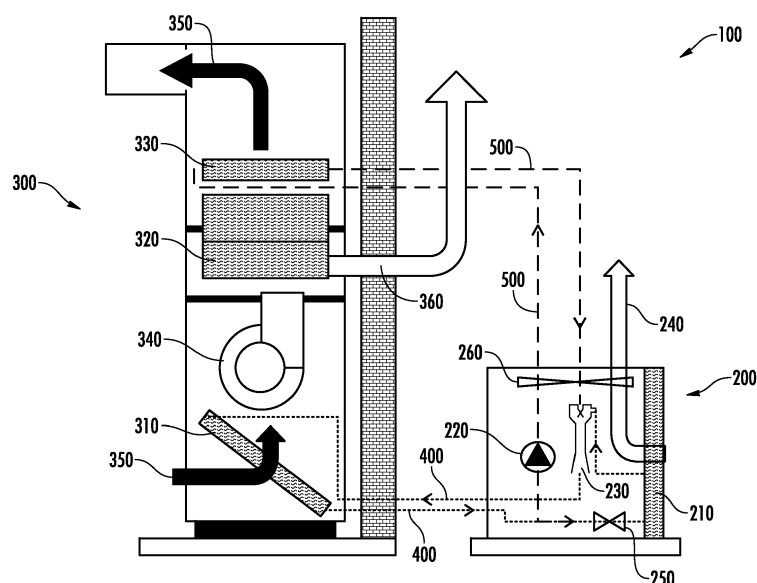


FIG. 1

Description

[0001] The subject matter disclosed herein relates to heating systems. More particularly, the subject matter disclosed herein relates to a thermally enhanced heating system and method for thermally enhancing a HVAC system.

[0002] Many houses in areas with colder winters use furnaces to supply heat to the interior space of the home. Furnaces typically contain four different components: a burner that produces heat by burning a fuel source, a heat exchanger to transfer heat to the air, a fan to direct air through the furnace, and a conduit for exhausting flue gas produced by the burning of the fuel source. The fuel sources most commonly used by furnaces are natural gas, propane gas, or heating oil.

[0003] As an alternative to a furnace, houses in more moderate climates can use heat pumps and/or electric heaters to supply heat to the interior space of the home. In addition to being able to supply heat to the interior space of the home, heat pumps can also provide cooling in the summer months due to their ability to switch the flow of the refrigerant. Heat pumps typically contain four different components: a compressor to both move and increase the pressure of the refrigerant, a heat exchanger for transferring heat either to or from the refrigerant, a reversing valve for changing the direction the refrigerant flows, and an expansion valve for regulating the flow of the refrigerant. To drive the compressor, heat pumps ordinarily use electricity as an energy source. Due to the fact that heat pumps pull heat from outdoor air, as temperatures drop, less heat is available in the outdoor air, and thus the heat pump becomes less capable of supplying the necessary heat for the home.

[0004] To combine the ability of a furnace to provide heating with lower temperatures and the efficiency of using a heat pump when temperatures are only moderately low, duel fuel systems have been developed. Duel fuel systems utilize both a furnace and a heat pump. A duel fuel system automatically switches the heating source between the furnace and the heat pump. When temperatures are more moderately cold the duel fuel system uses the heat pump to supply heat. When temperatures drop below the level at which the heat pump is capable of supplying the necessary heat for the home, the duel fuel system switches to the furnace to supply heat. Although the duel fuel system provides increased efficiency when compared to a standalone furnace and increased capability with colder temperatures when compared to a standalone heat pump, the duel fuel system generally is more expensive due to the need for both systems.

[0005] Accordingly, there remains a need for a thermally enhanced heating system and method with increased efficiency, while also considering the overall cost of the system.

[0006] According to a first aspect of the invention, a thermally enhanced heating system is provided, which includes an indoor HVAC unit and an outdoor HVAC unit,

the indoor HVAC unit including a first heat exchanger for transferring heat from a refrigerant, a second heat exchanger for transferring heat from a fuel source, and a third heat exchanger for transferring heat to the refrigerant, the outdoor HVAC unit including an outdoor heat exchanger for transferring heat from an outdoor air to the refrigerant, a pump operably coupled to the first heat exchanger and the third heat exchanger, the pump configured to circulate the refrigerant, and an ejector including a first inlet, a second inlet, and an outlet, wherein the first inlet is operably coupled to the outdoor heat exchanger, the second inlet is operably coupled to the third heat exchanger, and the outlet is operably coupled to the first heat exchanger.

[0007] The indoor HVAC unit may further include a fan.

[0008] The first heat exchanger may be upstream of the fan, and the second heat exchanger and third heat exchanger may be downstream of the fan.

[0009] The third heat exchanger may be downstream of the second heat exchanger.

[0010] The first heat exchanger, second heat exchanger, and third heat exchanger may be downstream of the fan.

[0011] The third heat exchanger may be downstream of the second heat exchanger, and the first heat exchanger may be adjacent to the second heat exchanger and the third heat exchanger.

[0012] The second heat exchanger may be operably coupled to a conduit, and the third heat exchanger may be disposed within the conduit.

[0013] The outdoor HVAC unit may further include a valve operably coupled to the outdoor heat exchanger and the first heat exchanger.

[0014] The outdoor HVAC unit may further include a fan.

[0015] The fuel source may include at least one of: a natural gas, propane, and a heating oil.

[0016] The ejector may be a single phase ejector.

[0017] According to another aspect of the invention, a method for thermally enhancing a HVAC system is provided. The method including, operating an outdoor HVAC unit to circulate a refrigerant through a first refrigerant circuit and a second refrigerant circuit, operating a heat exchanger to transfer heat to the first refrigerant circuit, and operating the outdoor HVAC unit to combine the refrigerant in the first refrigerant circuit and the second refrigerant circuit.

[0018] The outdoor HVAC unit may include a pump to circulate the refrigerant through the first refrigerant circuit and the second refrigerant circuit.

[0019] The outdoor HVAC unit may include an ejector to combine the refrigerant in the first refrigerant circuit and the second refrigerant circuit.

[0020] The method may further include operating a fan to circulate an indoor air through an indoor HVAC unit, wherein the heat exchanger may transfer heat from the indoor air to the first refrigerant circuit.

[0021] The method may further include operating a

second heat exchanger to transfer heat from a fuel source, the second heat exchanger operatively coupled to a conduit, wherein the heat exchanger may be disposed in the conduit.

[0022] The subject matter, which is regarded as the invention, is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The following descriptions of the drawings are by way of example only and should not be considered limiting in any way. With reference to the accompanying drawings, like elements are numbered alike:

FIG. 1 is a schematic illustration of a thermally enhanced heating system.

FIG. 2 is a schematic illustration of a thermally enhanced heating system.

FIG. 3 is a schematic illustration of a thermally enhanced heating system.

FIG. 4 is a perspective view of an ejector.

[0023] As will be described below, a thermally enhanced heating system and a method for thermally enhancing a HVAC system are provided. The thermally enhanced heating system includes an indoor HVAC unit and an outdoor HVAC unit. The outdoor HVAC unit enables the combination of heat generated by the indoor HVAC unit with heat generated by the outdoor HVAC unit. The outdoor HVAC unit includes a pump to circulate a refrigerant through a first refrigerant circuit and a second refrigerant circuit.

[0024] The pump in the outdoor HVAC unit is different than the compressor typically used in a heat pump. Instead of increasing the pressure of a vapor refrigerant, as a compressor does within a heat pump, the pump in the outdoor HVAC unit increases the pressure of a liquid refrigerant. By utilizing a pump instead of a compressor, the thermally enhanced heating system and method for thermally enhancing a HVAC system are able to reduce the overall cost of the system and reduce electricity consumption, as the pump uses much less electricity than a typical compressor.

[0025] With reference now to the Figures, a thermally enhanced heating system 100, in accordance with various aspect of the disclosure, is shown in FIG. 1, FIG. 2, and FIG. 3. The thermally enhanced heating system 100 may be described as a HVAC system. The thermally enhanced heating system 100 includes an indoor HVAC unit 300 and an outdoor HVAC unit 200. The indoor HVAC unit 300 includes a first heat exchanger 310 for transferring heat from a refrigerant, a second heat exchanger 320 for transferring heat from a fuel source, and a third heat exchanger 330 for transferring heat to the refrigerant. The outdoor HVAC unit 200 includes an outdoor heat exchanger 210 for transferring heat from an outdoor air 240 to the refrigerant, a pump 220 operatively

coupled to the first heat exchanger 310 and the third heat exchanger 330, the pump 220 configured to circulate the refrigerant, and an ejector 230 including a first inlet 231, a second inlet 232, and an outlet 233 (shown in FIG. 4), wherein the first inlet 231 is operatively coupled to the outdoor heat exchanger 210, the second inlet 232 is operatively coupled to third heat exchanger 330, and the outlet 233 is operatively coupled to the first heat exchanger 310. In various instances, the outdoor HVAC unit 200 includes a fan to move the outdoor air 240 through the outdoor heat exchanger 210.

[0026] To circulate an indoor air 350 through the indoor HVAC unit 300, in certain instances, the indoor HVAC unit 300 includes a fan 340. In certain instances, the thermally enhanced heating system 100 includes the first heat exchanger 310 upstream of the fan 340, and the second heat exchanger 320 and the third heat exchanger 330 downstream of the fan 340. Potential examples of thermally enhanced heating systems 100 depicting such configuration are shown in FIG. 1 and FIG. 3.

[0027] To transfer heat to the refrigerant, in certain instances, the third heat exchanger 330 is downstream of the second heat exchanger 320. In instances where the third heat exchanger 330 is downstream of the second heat exchanger 320, at least a portion of the heat being transferred to the refrigerant occurring in the third heat exchanger 330 may be generated by the second heat exchanger 320. Potential examples of thermally enhanced heating systems 100 depicting such configuration are shown in FIG. 1 and FIG. 2.

[0028] In various instances, the first heat exchanger 310, second heat exchanger 320, and third heat exchanger 330 are downstream of the fan 340. A thermally enhanced heating system 100 depicting such a configuration is shown in FIGs. 2 and 3. In one embodiment, the first heat exchanger 310, second heat exchanger 320, and third heat exchanger 330 are configured to effectuate the transfer of heat either to or from the refrigerant. In certain instances, the third heat exchanger 330 is downstream of the second heat exchanger 320, and the first heat exchanger 310 is adjacent to the second heat exchanger 320 and the third heat exchanger 330. An example of a thermally enhanced heating system 100 depicting such configuration is shown in FIG. 2.

[0029] The third heat exchanger 330 is configured to transfer heat to the refrigerant. In certain instances, the second heat exchanger 320 is operably coupled to a conduit 360, the third heat exchanger 330 being disposed within the conduit 360. In instances where the third heat exchanger 330 is disposed within the conduit 360, at least a portion of the heat being transferred to the refrigerant occurring in the third heat exchanger 330 may be received from within the conduit. In various instances, the conduit 360 provides for the exhausting of a flue gas generated in the second heat exchanger 320. An example of a thermally enhanced heating system 100 depicting a third heat exchanger 330 disposed within the conduit is shown in FIG. 3.

[0030] To control the flow of refrigerant through the thermally enhanced heating system 100, in certain instances, the outdoor HVAC unit 200 of the thermally enhanced heating system 100 includes a valve 250. When incorporating a valve 250, in certain instances, the valve 250 is operably coupled to the outdoor heat exchanger 210 and the first heat exchanger 310.

[0031] In certain instances the second heat exchanger 320 in the indoor HVAC unit 300 is capable of transferring heat from a fuel source. In certain instances, the fuel source used by the second heat exchanger 320 includes at least one of: a natural gas, propane gas, and a heating oil.

[0032] To combine the refrigerant from the first heat exchanger 310 and the third heat exchanger 330, the outdoor HVAC unit 200 includes an ejector 230. In certain instances, the ejector 230 is a single phase ejector (ex. a vapor to vapor ejector). In certain instances, the ejector 230 is used in the outdoor HVAC unit 200 to combine the refrigerant in a first refrigerant circuit 500 and a second refrigerant circuit 400. An example of an ejector 230 is shown in FIG. 4.

[0033] These refrigerant circuits 400, 500 may be configured such that heat is transferred either to or from the refrigerant within the thermally enhanced heating system 100. Preferably the refrigerant is circulated between a first refrigerant circuit 500 and a second refrigerant circuit 400 to thermally enhance the HVAC system. The method for thermally enhancing the HVAC system preferably includes operating an outdoor HVAC unit 200 to circulate the refrigerant through the first refrigerant circuit 500 and the second refrigerant circuit 400, operating a heat exchanger 330 to transfer heat to the first refrigerant circuit 500, and operating the outdoor HVAC unit 200 to combine the refrigerant in the first refrigerant circuit 500 and the second refrigerant circuit 400. In certain instances, the outdoor HVAC unit 200 includes a pump to circulate the refrigerant through the first refrigerant circuit 500 and the second refrigerant circuit 400. In certain instances, the outdoor HVAC unit includes an ejector 230 to combine the refrigerant in the first refrigerant circuit 500 and the second refrigerant circuit 400. The method may, in certain instances, further include operating a fan to circulate air 350 through an indoor HVAC unit 300, where the heat exchanger 330 transfers heat from the indoor air 350 to the first refrigerant circuit 500. The method may, in certain instances, further include operating a second heat exchanger 320 to transfer heat from a fuel source, the second heat exchanger 320 operatively coupled to a conduit, where the heat exchanger 330 is disposed in the conduit.

[0034] The method may, in various instances, provide for the circulating of the refrigerant through the first refrigerant circuit 500 and the second refrigerant circuit 400 between an indoor HVAC unit 300 and an outdoor HVAC unit 200. In certain instances, heat is transferred to the first refrigerant circuit 500 in the indoor HVAC unit 300, either from the indoor air 350 circulating through the in-

door HVAC unit 300 or from flue gas exhausting through the conduit 360. In certain instances, heat is transferred from the second refrigerant circuit 400 in the indoor HVAC unit 300 to the indoor air 350. By transferring heat to the first refrigerant circuit 500 in the heat exchanger 330, the outdoor HVAC unit 200 is capable of taking advantage of heat generated in the indoor HVAC unit 300 to further drive the thermally enhanced heating system 100. In various instances, the heat being transferred to the first refrigerant circuit 500 in the heat exchanger 330 is a waste heat. The thermally enhanced heating system 100 and method for thermally enhancing an HVAC system, in certain instances, captures this waste heat to generate additional heat. The capturing of waste heat to generate additional heat may, in certain instances, increase the efficiency of the thermally enhanced heating system 100.

[0035] At least a portion of the increased efficiency of the thermally enhanced heating system 100 may be due to reduced electrical consumption by outdoor HVAC unit 200. By generating additional heat from the heat generated in the indoor HVAC unit 300, less heat is needed to be generated in the outdoor HVAC unit 200. With the reduced need for heat production by outdoor HVAC unit 200, the outdoor HVAC unit 200 consumes less electricity.

[0036] In certain instances, the refrigerant in the first refrigerant circuit 500 and the second refrigerant circuit 400 includes at least one of: R410A, R32, R452B, R454B, R134a, R515, R513, R1234ze, R1234yf, and R1233zd.

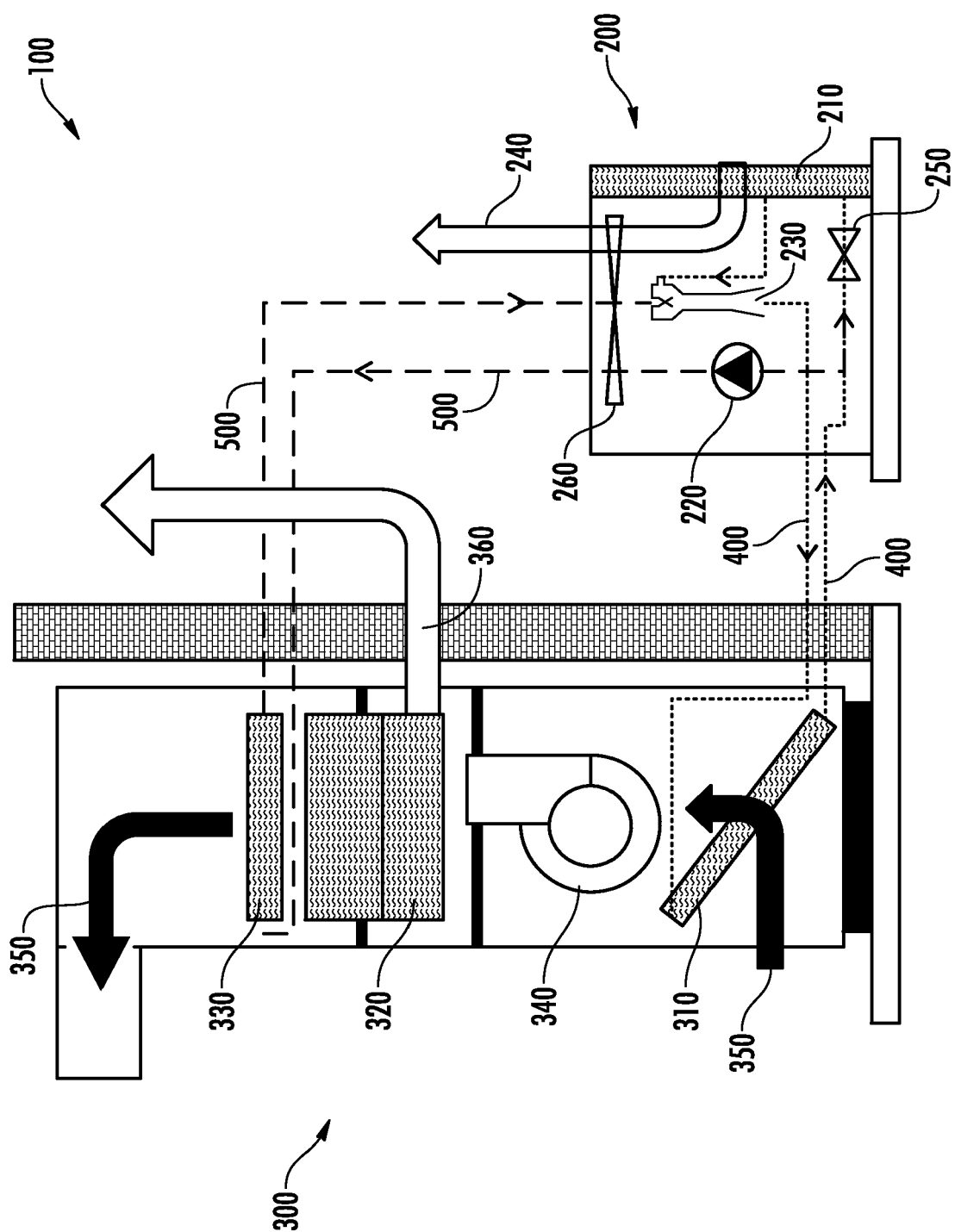
[0037] While the present invention has been described with reference to an exemplary embodiment or embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present invention without departing from the essential scope thereof. Therefore, it is intended that the present invention not be limited to the particular embodiment disclosed for carrying out this present disclosure, but that the present disclosure will include all embodiments falling within the scope of the claims.

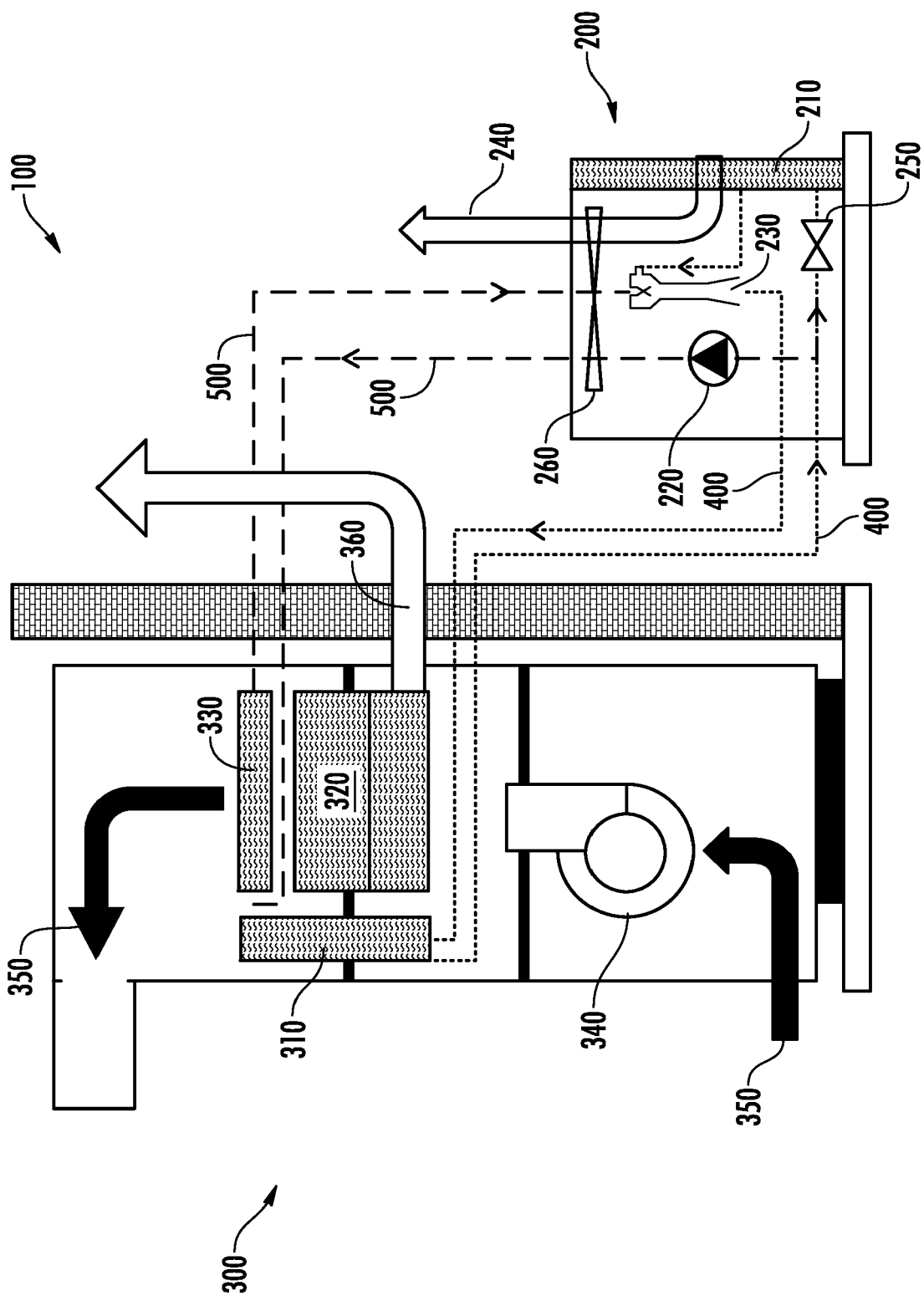
Claims

1. A thermally enhanced heating system (100) comprising:
an indoor HVAC unit (300) comprising:

a first heat exchanger (310) for transferring heat from a refrigerant;
a second heat exchanger (320) for transferring heat from a fuel source; and
a third heat exchanger (330) for transferring heat to the refrigerant; and an outdoor HVAC unit (200) comprising:

- an outdoor heat exchanger (210) for transferring heat from an outdoor air to the refrigerant;
 a pump (220) operably coupled to the first heat exchanger (310) and the third heat exchanger (330), the pump configured to circulate the refrigerant; and
 an ejector (230) including a first inlet (231), a second inlet (232), and an outlet (233); wherein the first inlet is operably coupled to the outdoor heat exchanger (210), the second inlet is operably coupled to the third heat exchanger (330), and the outlet is operably coupled to the first heat exchanger (310).
2. The thermally enhanced system (100) of claim 1, wherein the indoor HVAC unit (300) further comprises a fan (340).
 3. The thermally enhanced system (100) of claim 2, wherein the first heat exchanger (310) is upstream of the fan (340), and the second heat exchanger (320) and third heat exchanger (330) are downstream of the fan.
 4. The thermally enhanced system (100) of claim 1, 2, or 3, wherein the third heat exchanger (330) is downstream of the second heat exchanger (320).
 5. The thermally enhanced system (100) of claim 2, wherein the first heat exchanger (310), second heat exchanger (320), and third heat exchanger (330) are downstream of the fan (340), optionally wherein the third heat exchanger (330) is downstream of the second heat exchanger (320), and the first heat exchanger (310) is adjacent to the second heat exchanger and the third heat exchanger.
 6. The thermally enhanced system (100) of claim 3, wherein the second heat exchanger (320) is operably coupled to a conduit, and the third heat exchanger (330) is disposed within the conduit.
 7. The thermally enhanced heating system (100) of any preceding claim, wherein the outdoor HVAC unit (200) further comprises a valve (250) operably coupled to the outdoor heat exchanger (210) and the first heat exchanger (310).
 8. The thermally enhanced heating system (100) of any preceding claim, wherein the outdoor HVAC unit (200) further comprises a fan.
 9. The thermally enhanced heating system (100) of any preceding claim, wherein the fuel source comprises at least one of: a natural gas, a propane gas, and a heating oil.
 10. The thermally enhanced heating system (100) of any preceding claim, wherein the ejector (230) is a single phase ejector.
 11. A method for thermally enhancing a HVAC system, the method comprising:
 - operating an outdoor HVAC unit (200) to circulate a refrigerant through a first refrigerant circuit (500) and a second refrigerant circuit (400);
 - operating a heat exchanger (330) to transfer heat to the first refrigerant circuit (500); and
 - operating the outdoor HVAC unit (200) to combine the refrigerant in the first refrigerant circuit (500) and the second refrigerant circuit (400).
 12. The method of claim 11, wherein the outdoor HVAC unit (200) comprises a pump (220) to circulate the refrigerant through the first refrigerant circuit (500) and the second refrigerant circuit (400).
 13. The method of claim 11 or 12, wherein the outdoor HVAC unit (200) comprises an ejector (230) to combine the refrigerant in the first refrigerant circuit (500) and the second refrigerant circuit (400).
 14. The method of claim 11, 12, or 13, further comprising operating a fan (340) to circulate an indoor air through an indoor HVAC unit (300), wherein the heat exchanger (330) transfers heat from the indoor air to the first refrigerant circuit (500).
 15. The method of any of claims 11 to 14, further comprising operating a second heat exchanger (320) to transfer heat from a fuel source, the second heat exchanger operatively coupled to a conduit, wherein the heat exchanger (330) is disposed in the conduit.





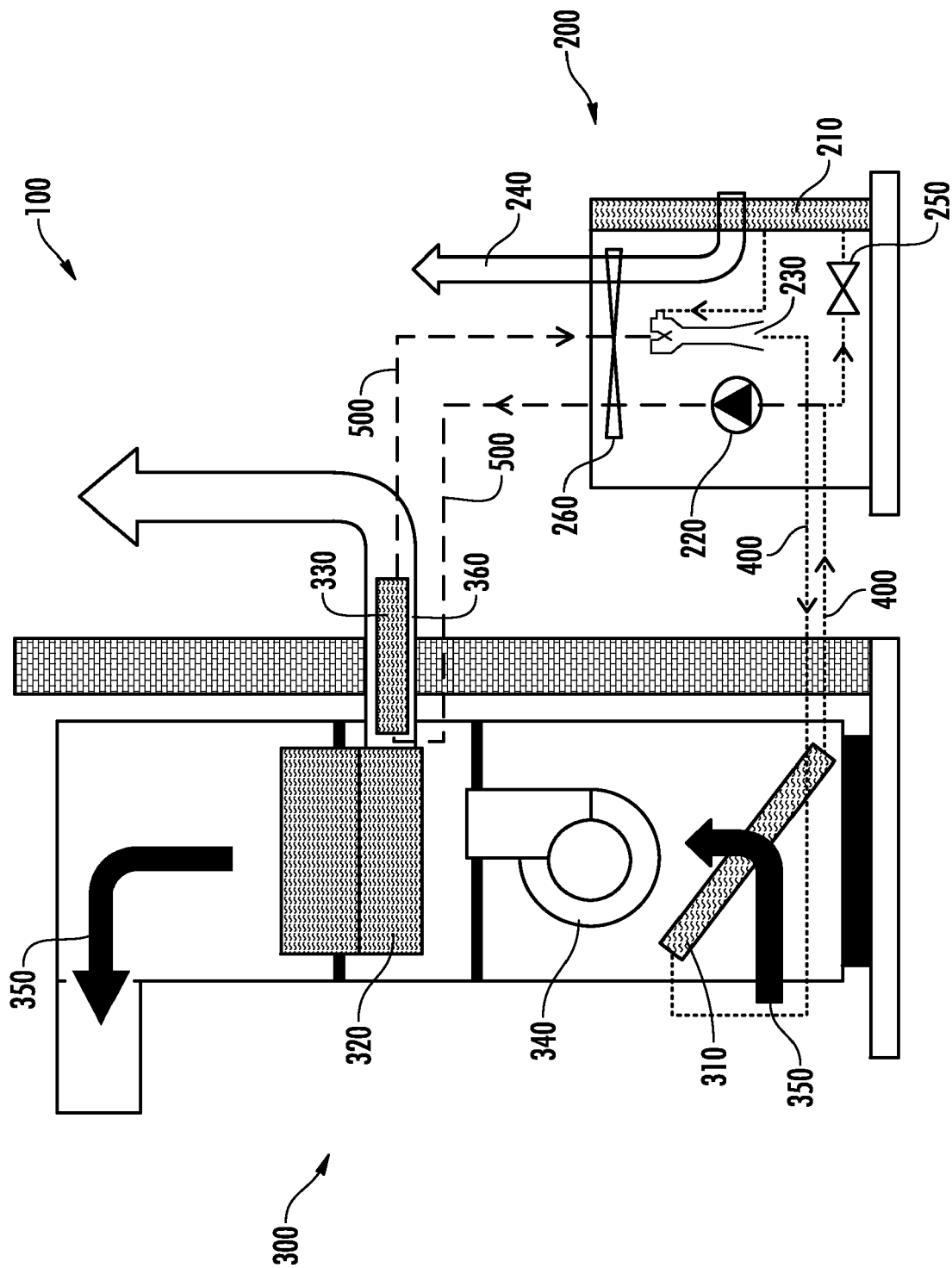


FIG. 3

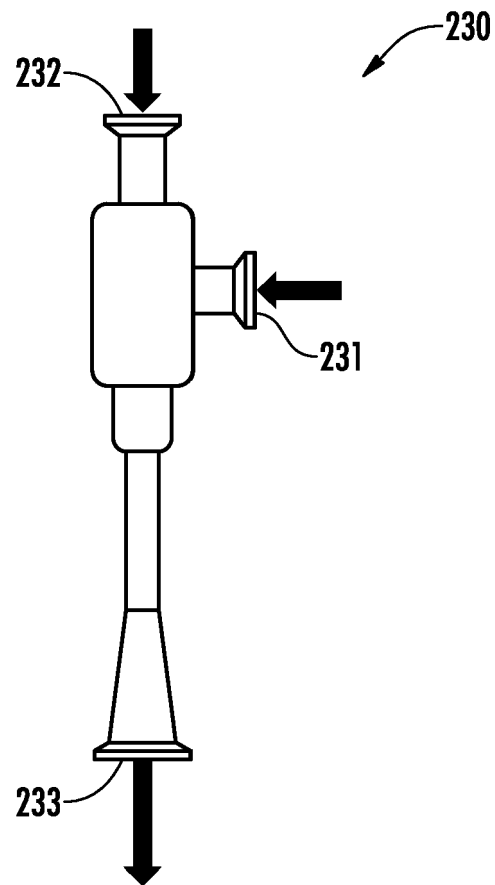


FIG. 4