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Kopko

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(54) **CHILLER SYSTEM WITH MULTIPLE COMPRESSORS**

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F25B 5/04 (2006.01)
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CPC F28D 2021/0071; F28D 2021/007; F28D 7/163; F28D 7/0075; F25B 2400/23;
(Continued)

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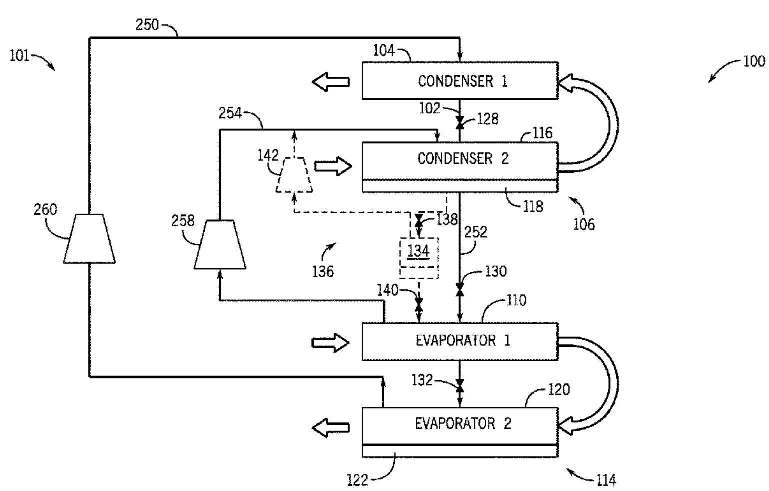
(57) **ABSTRACT**

A heating, ventilation, air conditioning, and/or refrigeration (HVAC&R) system includes a first vapor compression flow path having a first condenser configured to place a working fluid in a heat exchange relationship with a cooling fluid, a second vapor compression flow path having a first evaporator configured to place the working fluid in a heat exchange relationship with a conditioning fluid, and a shared vapor compression flow path having a second condenser configured to place the working fluid in a heat exchange relationship with the cooling fluid and a second evaporator configured to place the working fluid in a heat exchange relationship with the conditioning fluid. The first vapor compression flow path is configured to direct working fluid
(Continued)



vapor from the second evaporator to the first condenser and the second vapor compression flow path is configured to direct working fluid liquid from the second evaporator to the first evaporator.

20 Claims, 10 Drawing Sheets

(51) **Int. Cl.**

F25B 6/04	(2006.01)
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F28D 7/16	(2006.01)
F28D 21/00	(2006.01)

(52) **U.S. Cl.**
CPC ***F28D 7/0075*** (2013.01); ***F28D 7/163*** (2013.01); *F25B 2339/0242* (2013.01); *F25B 2400/0403* (2013.01); *F25B 2400/0409* (2013.01); *F25B 2400/0411* (2013.01); *F25B 2400/075* (2013.01); *F25B 2400/13* (2013.01); *F25B 2400/23* (2013.01); *F28D 2021/007* (2013.01); *F28D 2021/0071* (2013.01)

(58) **Field of Classification Search**
CPC F25B 2400/13; F25B 2400/075; F25B 2400/0411; F25B 2400/0409; F25B 2400/0403; F25B 2339/0242; F25B 6/04; F25B 5/04; F25B 41/39; F25B 39/02
See application file for complete search history.

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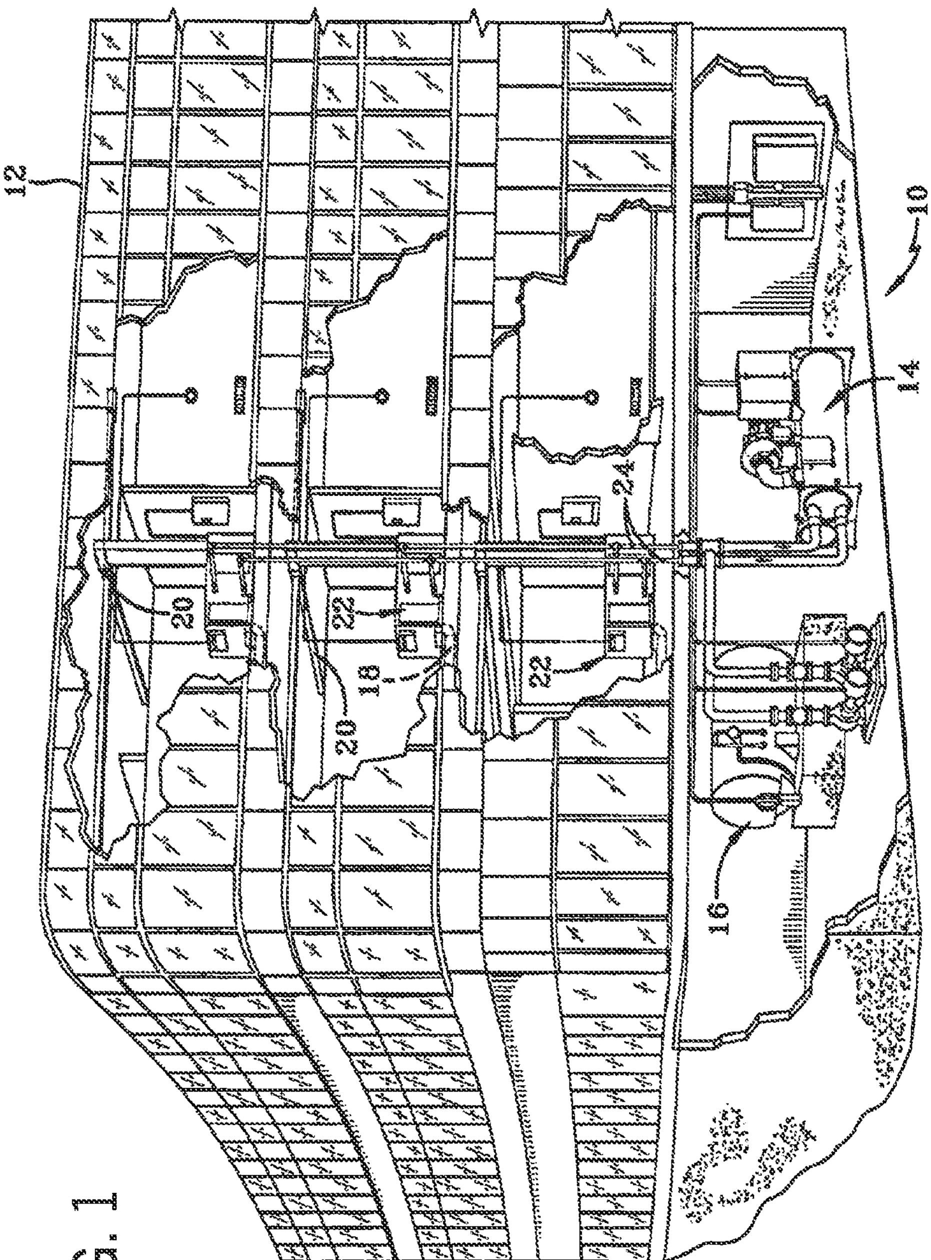


FIG. 1

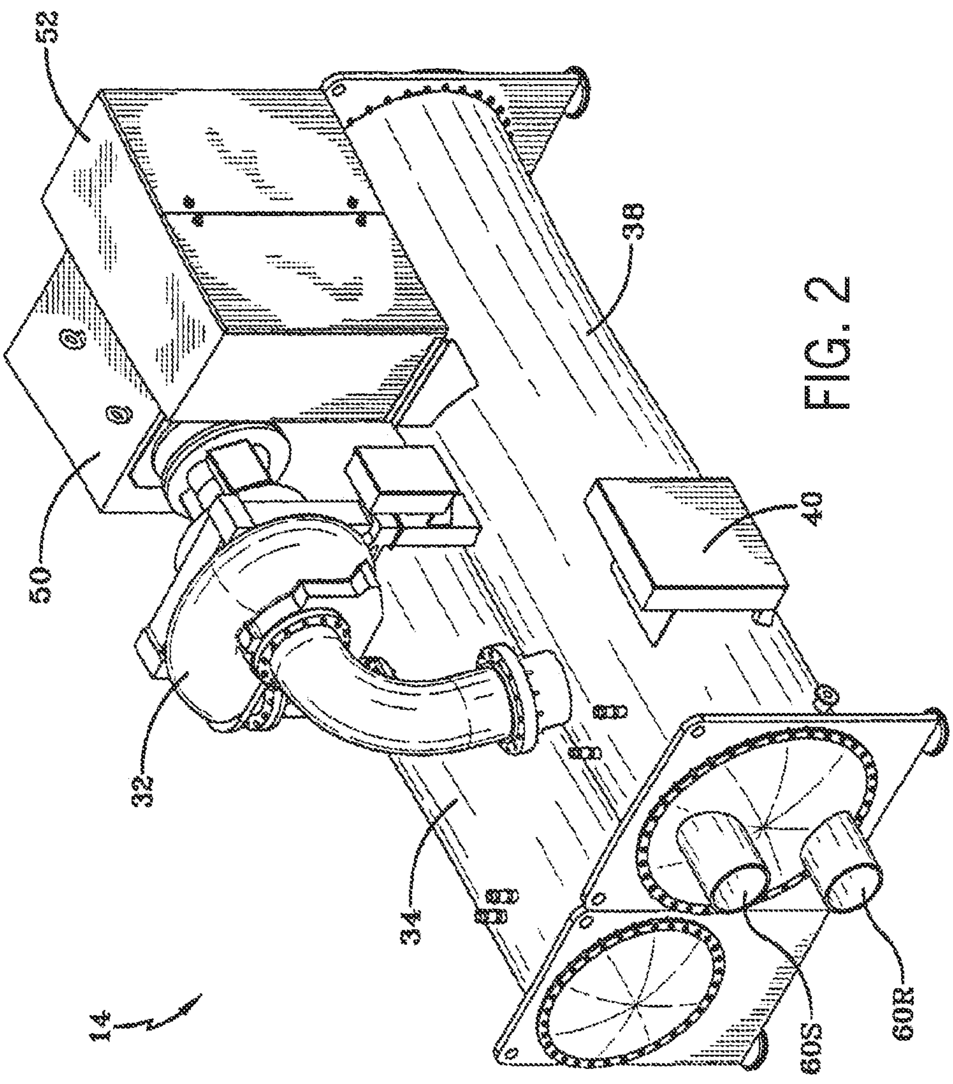
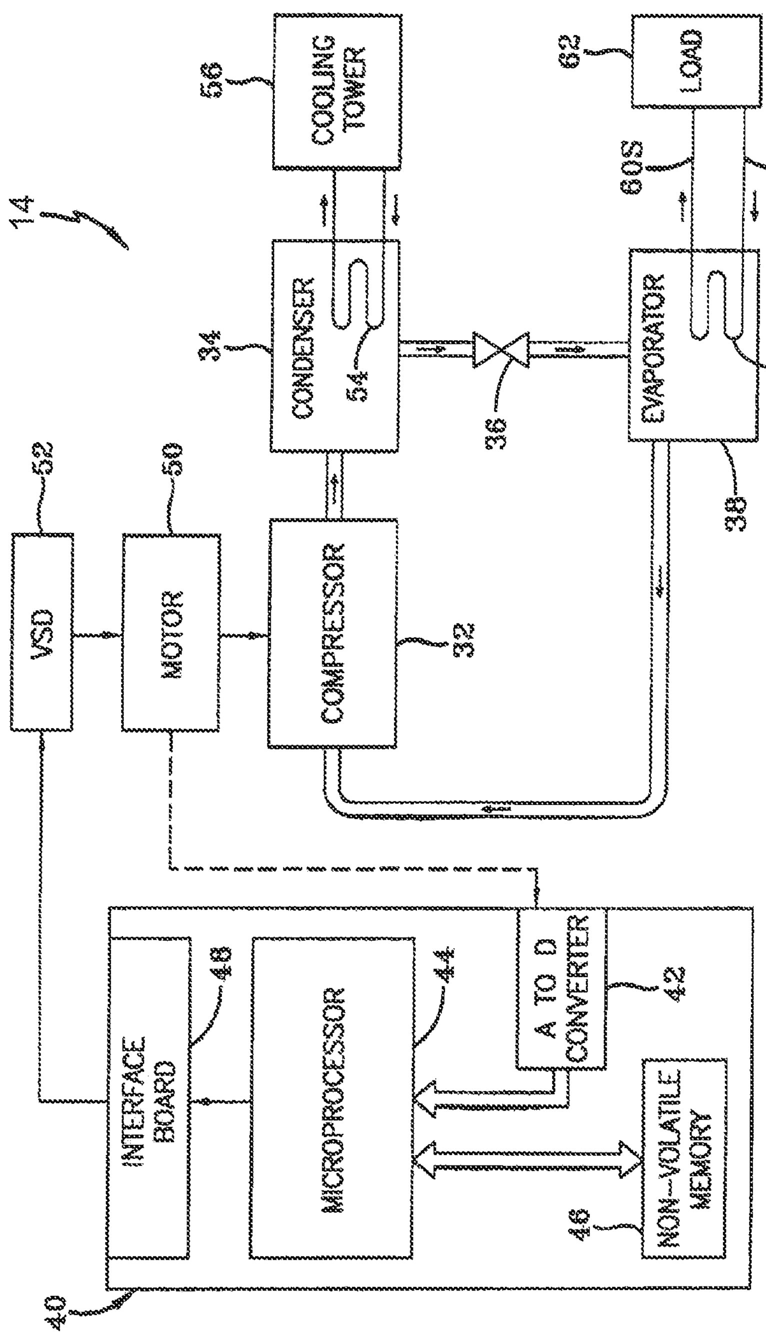


FIG. 2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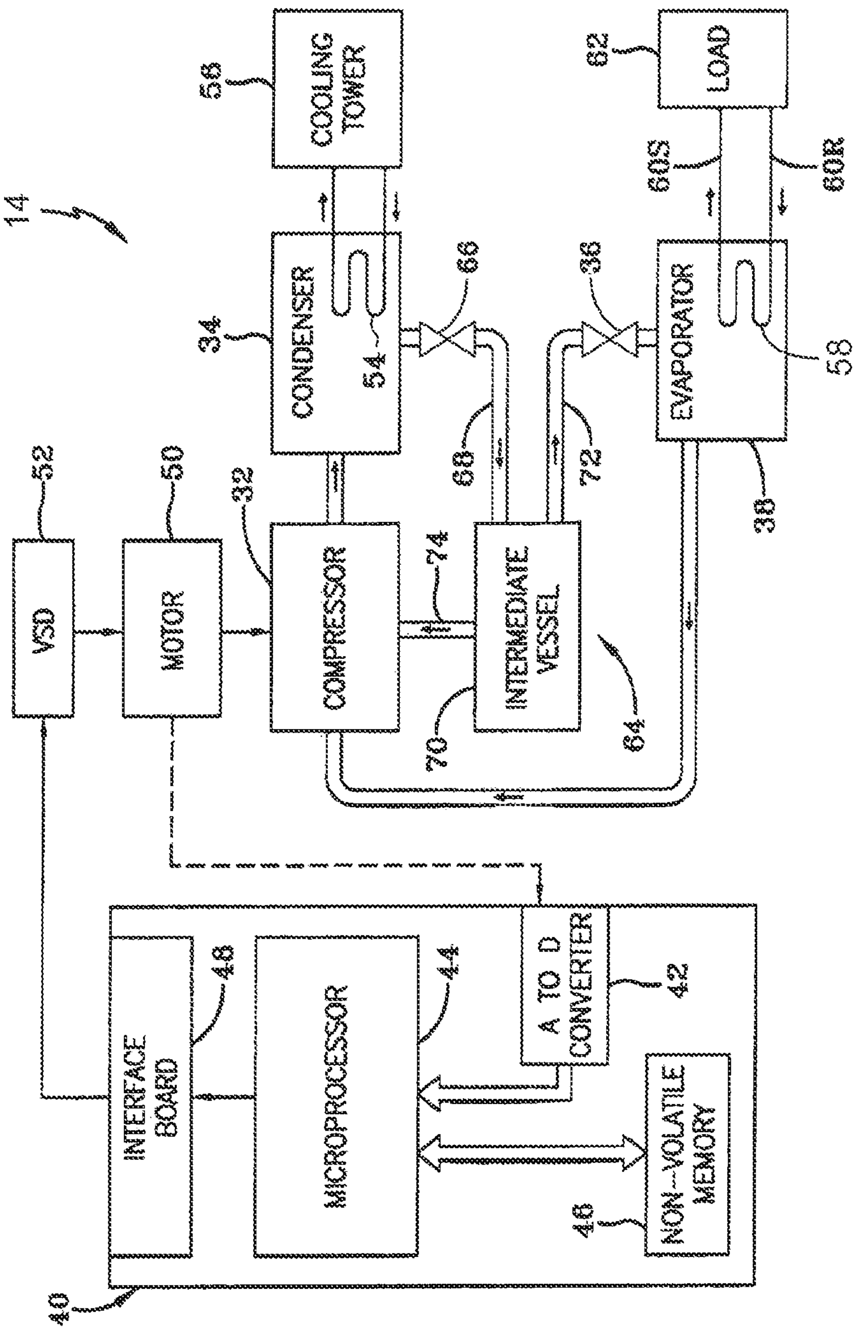
COOLING TOWER
56
LOAD
62
60S
60R
CONDENSER
34
54
EVAPORATOR
58
36
38
VSD
52
MOTOR
50
COMPRESSOR
32
INTERFACE BOARD
48
MICROPROCESSOR
44
A TO D CONVERTER
42
NON-VOLATILE MEMORY
46
40

FIG. 3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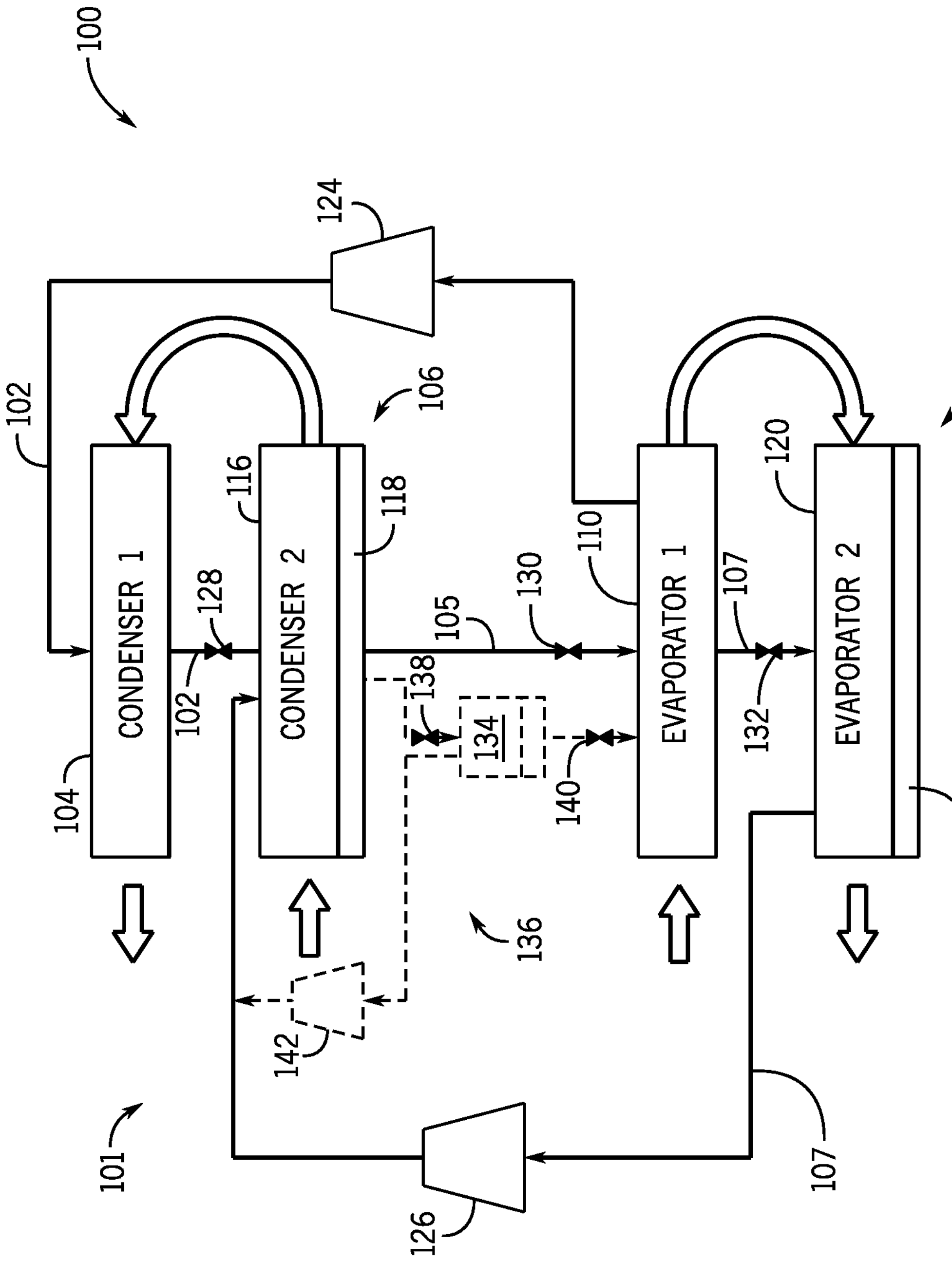
COOLING TOWER
56
LOAD
62
60S
60R
CONDENSER
34
54
66
36
EVAPORATOR
58
38
68
72
VSD
52
MOTOR
50
COMPRESSOR
32
74
INTERMEDIATE VESSEL
70
64
INTERFACE BOARD
48
MICROPROCESSOR
44
A TO D CONVERTER
42
NON-VOLATILE MEMORY
46
40

FIG. 4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106
114
CONDENSER 1
CONDENSER 2
EVAPORATOR 1
EVAPORATOR 2
116
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138
134
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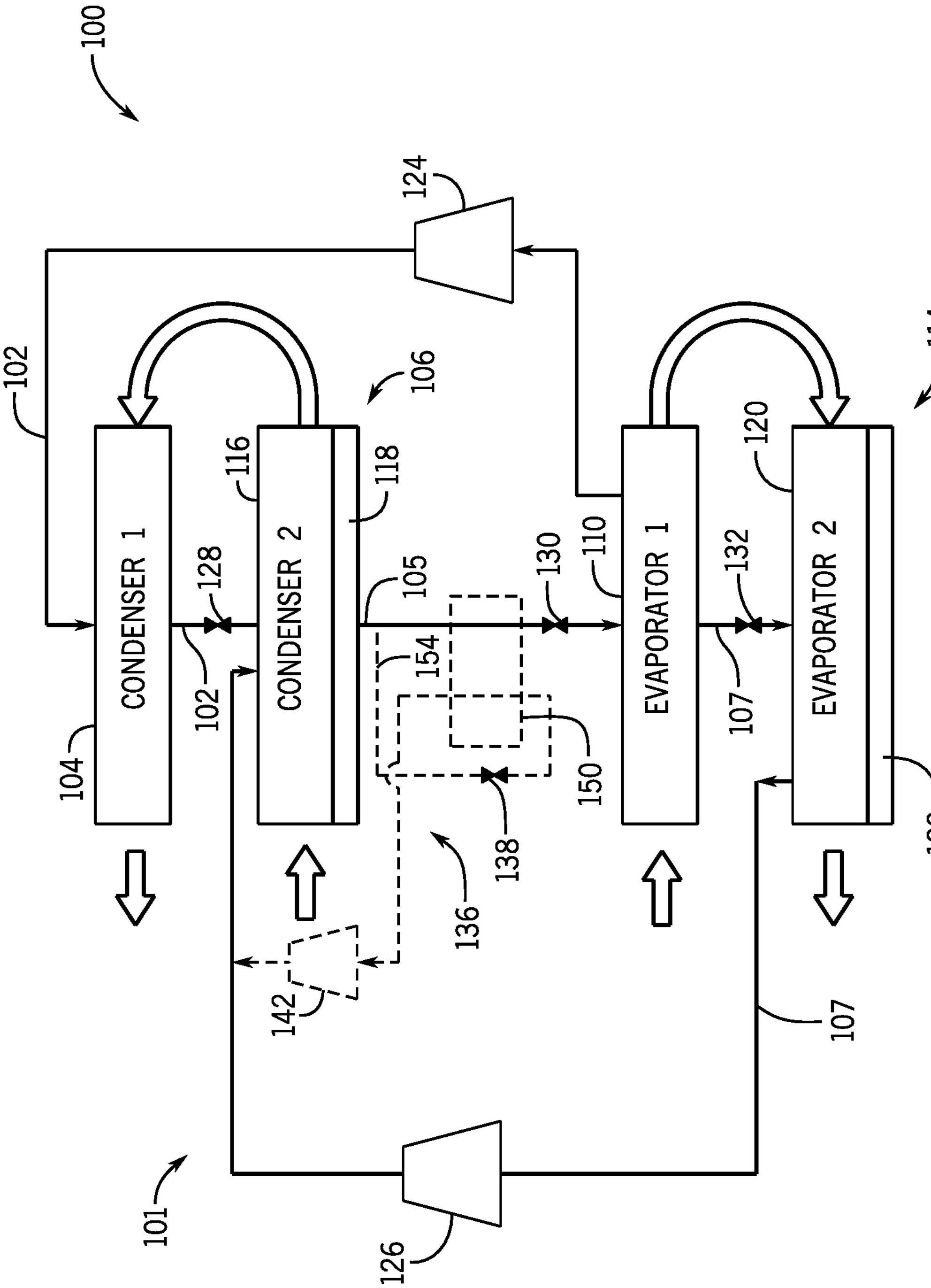
122
136
142
101
107
126

FIG. 5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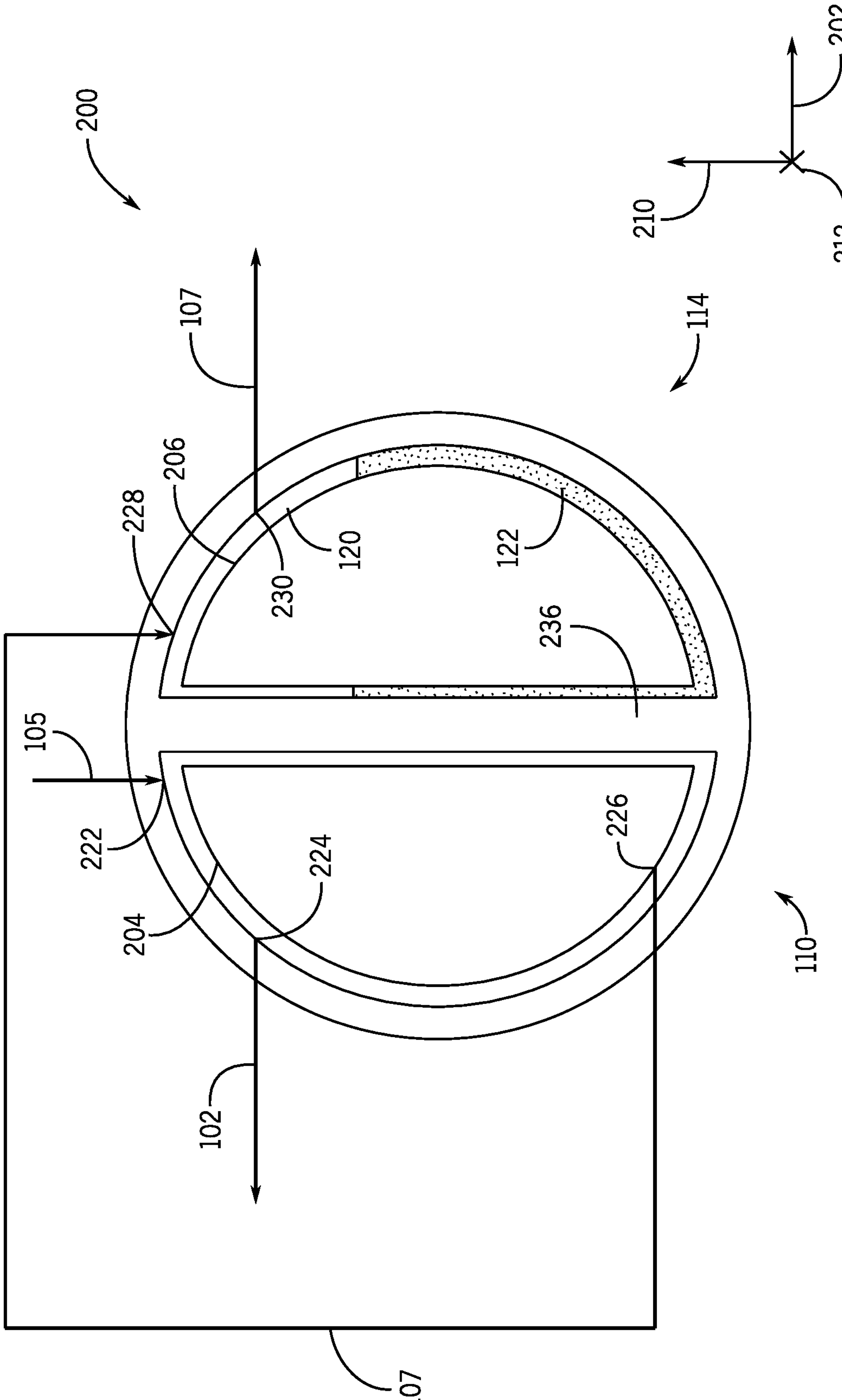
154
CONDENSER 1
CONDENSER 2
EVAPORATOR 1
EVAPORATOR 2

FIG. 6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202
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228
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236
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222
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224
226
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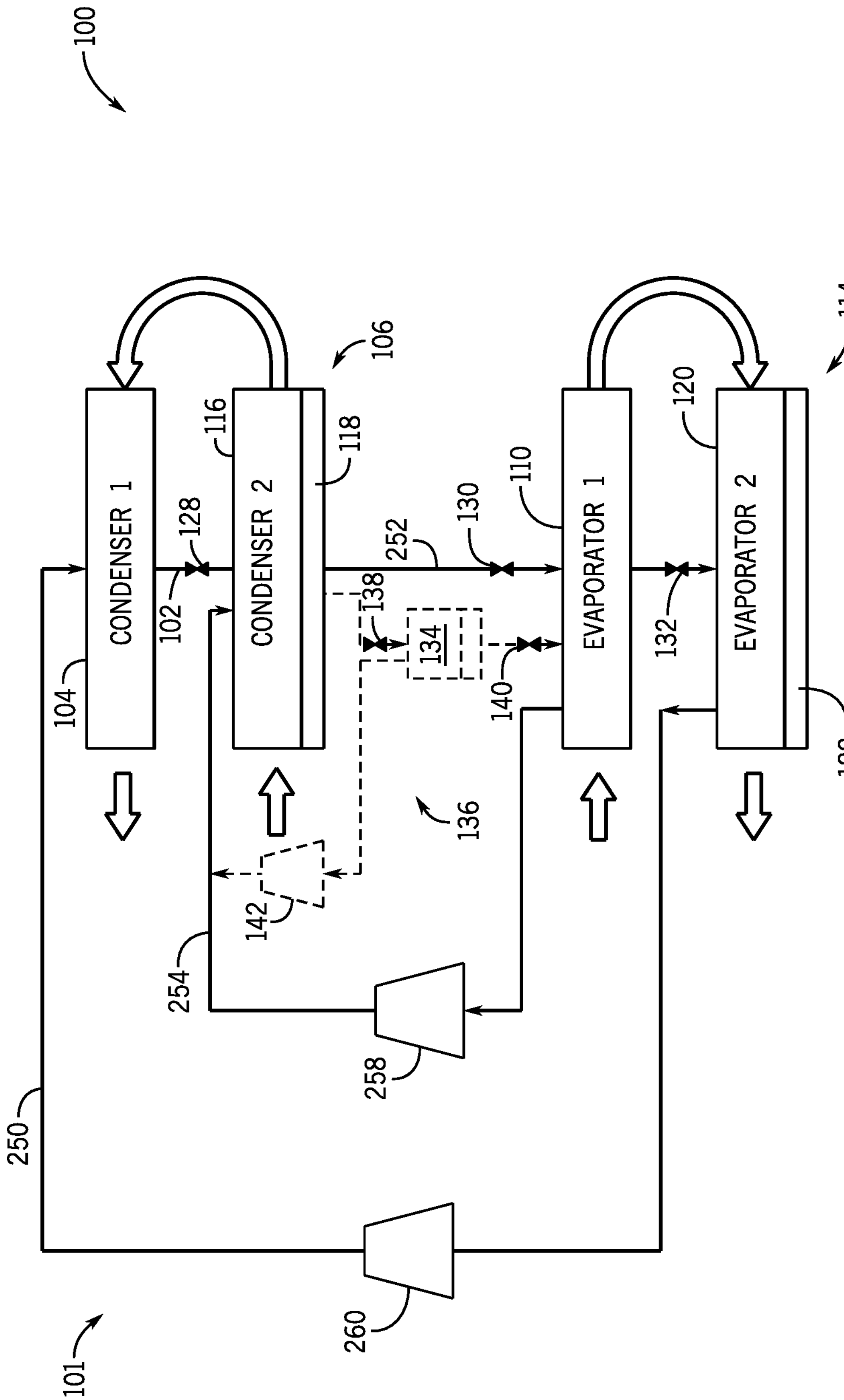
102
107

FIG. 7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CONDENSER 2
EVAPORATOR 1
EVAPORATOR 2
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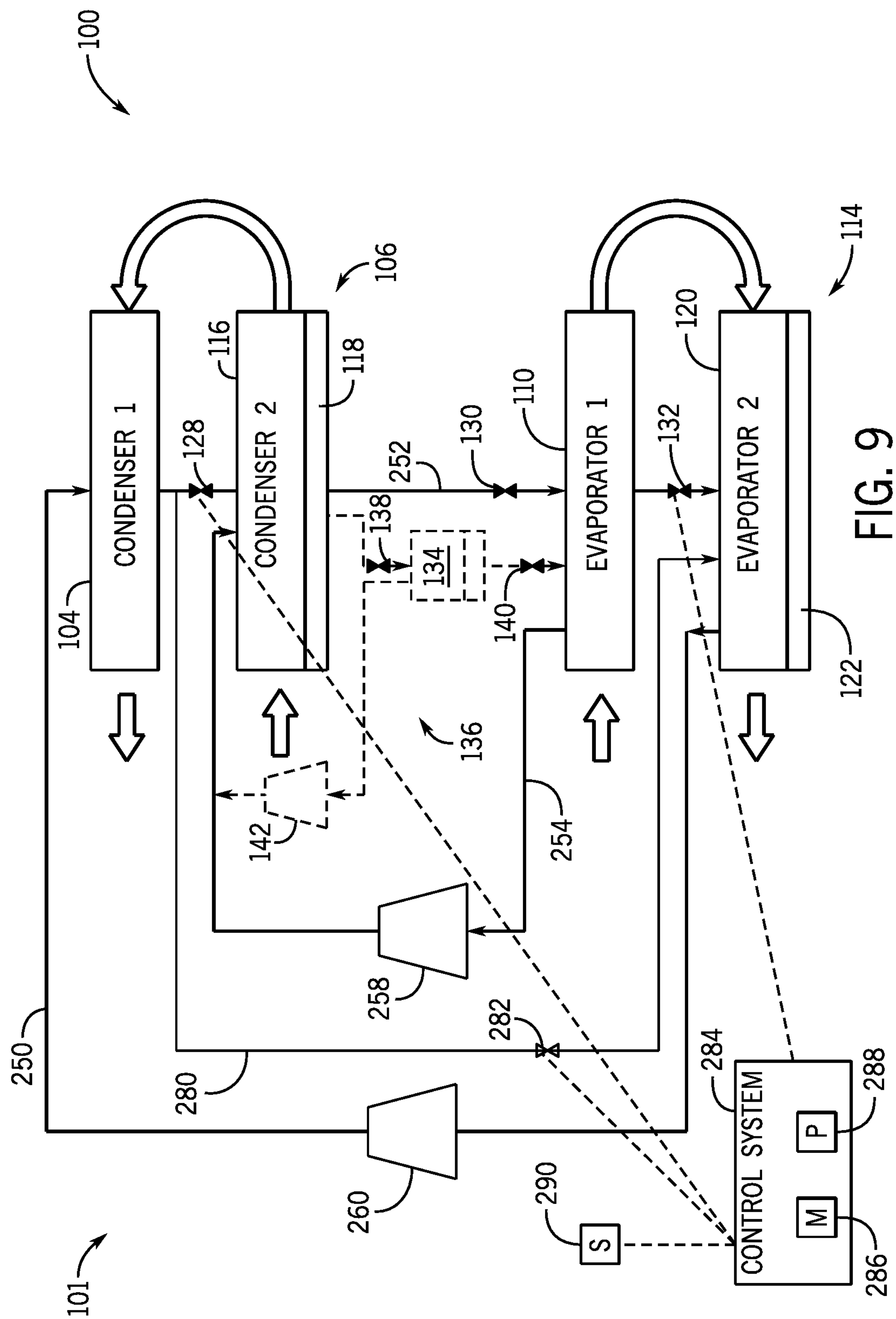
142
254
258
250
260
101

FIG. 8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101
CONDENSER 1
CONDENSER 2
EVAPORATOR 1
EVAPORATOR 2
CONTROL SYSTEM
M
P
S
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116
118
120
122
128
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132
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136
138
140
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286
288
290

FIG. 9

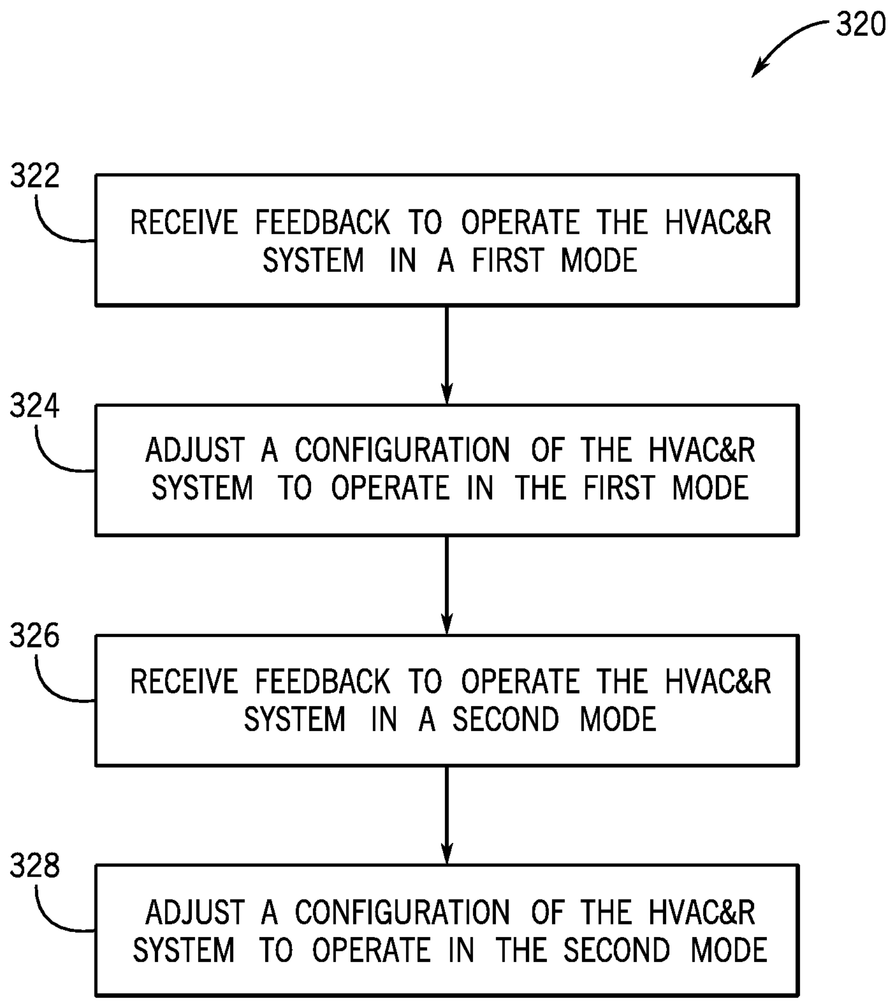
320
322
RECEIVE FEEDBACK TO OPERATE THE HVAC&R SYSTEM IN A FIRST MODE
324
ADJUST A CONFIGURATION OF THE HVAC&R SYSTEM TO OPERATE IN THE FIRST MODE
326
RECEIVE FEEDBACK TO OPERATE THE HVAC&R SYSTEM IN A SECOND MODE
328
ADJUST A CONFIGURATION OF THE HVAC&R SYSTEM TO OPERATE IN THE SECOND MODE

FIG. 10

CHILLER SYSTEM WITH MULTIPLE COMPRESSORS

CROSS REFERENCE TO RELATED APPLICATION

This application is a U.S. National Stage Application of PCT International Application No. PCT/US2020/041972, entitled "CHILLER SYSTEM WITH MULTIPLE COMPRESSORS." filed Jul. 14, 2020, which claims priority from to and the benefit of U.S. Provisional Application Ser. No. 62/874,394, entitled "CHILLER SYSTEM WITH MULTIPLE COMPRESSORS," filed Jul. 15, 2019, each of which is hereby incorporated by reference in its entirety for all purposes.

BACKGROUND

This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present disclosure, and are described below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

Chiller systems, or vapor compression systems, utilize a working fluid (e.g., a refrigerant) that changes phases between vapor, liquid, and combinations thereof, in response to exposure to different temperatures and pressures within components of the vapor compression system. The chiller system may direct the working fluid through a heat exchanger configured to place the working fluid in a heat exchange relationship with a conditioning fluid, such as to remove thermal energy (e.g., heat) from the conditioning fluid. The chiller system may then deliver the conditioning fluid to conditioning equipment and/or an environment conditioned by the chiller system. In some cases, the chiller system may include multiple vapor compression systems that may operate in a series flow arrangement with the conditioning fluid to increase a capacity of the chiller system. In some cases, respective working fluids of each vapor compression system are directed through the respective components of the corresponding vapor compression system to enable each vapor compression system to operate independently from one another. As such, each vapor compression system may be activated or deactivated based on a target capacity of the chiller system. However, in some circumstances, this arrangement of multiple vapor compression systems may limit an effectiveness or an efficiency of the chiller system.

SUMMARY

A summary of certain embodiments disclosed herein is set forth below. It should be understood that these aspects are presented merely to provide the reader with a brief summary of these certain embodiments and that these aspects are not intended to limit the scope of this disclosure. Indeed, this disclosure may encompass a variety of aspects that may not be set forth below.

In one embodiment, a heating, ventilation, air conditioning, and/or refrigeration (HVAC&R) system includes a first vapor compression flow path having a first condenser configured to place a working fluid in a heat exchange relationship with a cooling fluid, a second vapor compression flow path having a first evaporator configured to place the working fluid in a heat exchange relationship with a conditioning fluid, and a shared vapor compression flow path having a second condenser configured to place the working fluid in a heat exchange relationship with the cooling fluid and a second evaporator configured to place the working fluid in a heat exchange relationship with the conditioning fluid. The first vapor compression flow path is configured to direct working fluid vapor from the second evaporator to the first condenser and the second vapor compression flow path is configured to direct working fluid liquid from the second evaporator to the first evaporator.

In another embodiment, a heating, ventilation, air conditioning, and/or refrigeration (HVAC&R) system includes a first vapor compression flow path having a first condenser configured to place a first portion of a working fluid in thermal communication with a cooling fluid, a first evaporator configured to place the first portion of the working fluid in thermal communication with a conditioning fluid, and a first compressor configured to direct the first portion of the working fluid from the first evaporator to the first condenser. The HVAC&R system also includes a second vapor compression flow path having a second compressor configured to direct a second portion of the working fluid from a second evaporator to a second condenser, and the HVAC&R system further includes a shared vapor compression flow path having the second condenser and the second evaporator. The second condenser is configured to receive the first portion of the working fluid from the first condenser of the first vapor compression flow path and receive the second portion of the working fluid from the second evaporator, in which the shared vapor compression flow path is configured to direct the first portion of the working fluid and the second portion of the working fluid from the second condenser to the second evaporator.

In another embodiment, a heating, ventilation, air conditioning, and/or refrigeration (HVAC&R) system includes a first vapor compression flow path having a first condenser configured to place a first portion of a working fluid in thermal communication with a cooling fluid, a first evaporator configured to place the first portion of the working fluid in thermal communication with a conditioning fluid, and a first compressor configured to direct the first portion of the working fluid from the first evaporator to the first condenser. The HVAC&R system also includes a shared vapor compression flow path having a second condenser configured to place a second portion of the working fluid in thermal communication with the cooling fluid and a second evaporator configured to place the second portion of the working fluid in thermal communication with the conditioning fluid. The shared vapor compression flow path is configured to direct the second portion of the working fluid from the second condenser to the second evaporator. The HVAC&R system further includes a second vapor compression flow path having a second compressor configured to direct a third portion of the working fluid from the second evaporator to the second condenser and a bypass conduit system configured to direct the first portion of the working fluid from the first condenser to the first evaporator, such that the first portion of the working fluid bypasses the second condenser and the second evaporator.

DRAWINGS

Various aspects of this disclosure may be better understood upon reading the following detailed description and upon reference to the drawings in which:

FIG. **1** is a perspective view of a building that may utilize an embodiment of a heating, ventilation, air conditioning, and/or refrigeration (HVAC&R) system in a commercial setting, in accordance with an aspect of the present disclosure;

FIG. **2** is a perspective view of an embodiment of a vapor compression system, in accordance with an aspect of the present disclosure;

FIG. **3** is a schematic view of an embodiment of the vapor compression system of FIG. **2**, in accordance with an aspect of the present disclosure;

FIG. **4** is a schematic view of another embodiment of the vapor compression system of FIG. **2**, in accordance with an aspect of the present disclosure;

FIG. **5** is a schematic view of an embodiment of an HVAC&R system having multiple vapor compression circuits, in accordance with an aspect of the present disclosure;

FIG. **6** is a schematic view of another embodiment of the HVAC&R system using an additional heat exchanger in an economizer system, in accordance with an aspect of the present disclosure;

FIG. **7** is a cross-section of an embodiment of a shell of a heat exchanger within a common vapor compression circuit of an HVAC&R system, in accordance with an aspect of the present disclosure;

FIG. **8** is a schematic view of another embodiment of an HVAC&R system having multiple vapor compression circuits, in accordance with an aspect of the present disclosure;

FIG. **9** is a schematic view of another embodiment of an HVAC&R system having multiple vapor compression circuits and a bypass conduit assembly that enables the multiple vapor compression circuits to operate independently of one another, in accordance with an aspect of the present disclosure; and

FIG. **10** is a block diagram illustrating an embodiment of a method for adjusting operation of the HVAC&R system of FIGS. **5**, **7**, and **8**, in accordance with an aspect of the present disclosure.

DETAILED DESCRIPTION

One or more specific embodiments will be described below. In an effort to provide a concise description of these embodiments, not all features of an actual implementation are described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

Embodiments of the present disclosure relate to an HVAC&R system having multiple vapor compression circuits, such as a first vapor compression circuit (e.g., a high pressure vapor compression circuit), a second vapor compression circuit (e.g., a low pressure vapor compression circuit), and a shared or common vapor compression circuit (e.g., a mixed high pressure and low pressure vapor compression circuit). As used herein, a vapor compression circuit (e.g., a vapor compression flow path) includes components, such as conduits, piping, tubing, valves, pumps, and so forth that direct a working fluid through a portion of the HVAC&R system. In some embodiments, the vapor compression circuit may not define a complete loop. The first and second vapor compression circuits may each include a condenser configured to place a working fluid in thermal communication with a cooling fluid and an evaporator configured to place respective the working fluids in thermal communication with a conditioning fluid. Including multiple vapor compression circuits may generally increase a capacity of the HVAC&R system to absorb heat from the conditioning fluid as compared to an HVAC&R system having a single vapor compression circuit. For example, the conditioning fluid may be directed through and cooled by multiple heat exchangers (e.g., evaporators) instead of by a single heat exchanger. In existing HVAC&R systems, vaporous working fluid and liquid working fluid may mix with one another in certain portions of a given vapor compression system, and may limit an efficiency of the HVAC&R system generally.

In accordance with embodiments of the present disclosure, an HVAC&R system may combine working fluid from the first vapor compression circuit and the second vapor compression circuit into the common vapor compression circuit to increase an efficiency of the HVAC&R system. Further, in some embodiments, the HVAC&R system may include components (e.g., valves) that enable each of the vapor compression circuits to operate independently from one another, such that the respective working fluids of the vapor compression systems may be fluidly separate from one another. In other words, the components (e.g., valves) may enable the HVAC&R system to operate without directing a mixture of working fluids from the first vapor compression circuit and the second vapor compression circuit through the common vapor compression circuit.

Under some operating conditions, enabling the respective working fluids of the multiple vapor compression circuits to combine with one another in the common vapor compression circuit may reduce an amount of mixed vapor and liquid working fluid within various locations of the vapor compression circuits, and thereby improve an efficiency of the HVAC&R system. For example, combining the respective working fluids of the multiple vapor compression circuits within a condenser of the second vapor compression circuit (e.g., a low pressure condenser) and/or an evaporator of the first vapor compression circuit (e.g., a high pressure evaporator) may reduce an amount of working fluid vapor within the evaporator of the first vapor compression circuit, thereby increasing an amount of thermal energy that the working fluid within the evaporator of the first vapor compression circuit may absorb from the conditioning fluid. Further, working fluid liquid that evaporates within the evaporator of the first vapor compression circuit may be drawn toward a condenser (e.g., of the first vapor compression circuit) via a first compressor, and any remaining liquid working fluid within the evaporator of the first vapor compression circuit may be directed toward an evaporator (e.g., of the second vapor compression circuit) to further absorb thermal energy from the conditioning fluid. Thus, the cooling capacity of the working fluids in both evaporators of the first vapor compression circuit and the second vapor compression circuit may be improved, and an overall performance of the HVAC&R system to cool the conditioning fluid may be increased.

Turning now to the drawings, FIG. **1** is a perspective view of an embodiment of an environment for a heating, ventilation, and air conditioning (HVAC&R) system **10** in a building **12** for a typical commercial setting. The HVAC&R system **10** may include a vapor compression system **14** that supplies a chilled liquid, which may be used to cool the building **12**. The HVAC&R system **10** may also include a boiler **16** to supply warm liquid to heat the building **12** and an air distribution system that circulates air through the building **12**. The air distribution system can also include an air return duct **18**, an air supply duct **20**, and/or an air handler **22**. In some embodiments, the air handler **22** may include a heat exchanger that is connected to the boiler **16** and the vapor compression system **14** by conduits **24**. The heat exchanger in the air handler **22** may receive either heated liquid from the boiler **16** or chilled liquid from the vapor compression system **14**, depending on the mode of operation of the HVAC&R system **10**. The HVAC&R system **10** is shown with a separate air handler on each floor of building **12**, but in other embodiments, the HVAC&R system **10** may include air handlers **22** and/or other components that may be shared between or among floors.

FIGS. **2** and **3** are embodiments of the vapor compression system **14** that can be used in the HVAC&R system **10**. The vapor compression system **14** may circulate a refrigerant through a circuit starting with a compressor **32**. The circuit may also include a condenser **34**, an expansion valve(s) or device(s) **36**, and a liquid chiller or an evaporator **38**. The vapor compression system **14** may further include a control panel **40** (e.g., controller) that has an analog to digital (A/D) converter **42**, a microprocessor **44**, a non-volatile memory **46**, and/or an interface board **48**.

Some examples of fluids that may be used as refrigerants in the vapor compression system **14** are hydrofluorocarbon (HFC) based refrigerants, for example, R-410A, R-407, R-134a, hydrofluoro-olefin (HFO), “natural” refrigerants like ammonia (NH3), R-717, carbon dioxide (CO2), R-744, or hydrocarbon based refrigerants, water vapor, refrigerants with low global warming potential (GWP), or any other suitable refrigerant. In some embodiments, the vapor compression system **14** may be configured to efficiently utilize refrigerants having a normal boiling point of about 19 degrees Celsius (66 degrees Fahrenheit or less) at one atmosphere of pressure, also referred to as low pressure refrigerants, versus a medium pressure refrigerant, such as R-134a. As used herein, “normal boiling point” may refer to a boiling point temperature measured at one atmosphere of pressure.

In some embodiments, the vapor compression system **14** may use one or more of a variable speed drive (VSDs) **52**, a motor **50**, the compressor **32**, the condenser **34**, the expansion valve or device **36**, and/or the evaporator **38**. The motor **50** may drive the compressor **32** and may be powered by a variable speed drive (VSD) **52**. The VSD **52** receives alternating current (AC) power having a particular fixed line voltage and fixed line frequency from an AC power source, and provides power having a variable voltage and frequency to the motor **50**. In other embodiments, the motor **50** may be powered directly from an AC or direct current (DC) power source. The motor **50** may include any type of electric motor that can be powered by a VSD or directly from an AC or DC power source, such as a switched reluctance motor, an induction motor, an electronically commutated permanent magnet motor, or another suitable motor.

The compressor **32** compresses a refrigerant vapor and delivers the vapor to the condenser **34** through a discharge passage. In some embodiments, the compressor **32** may be a centrifugal compressor. The refrigerant vapor delivered by the compressor **32** to the condenser **34** may transfer heat to a cooling fluid (e.g., water or air) in the condenser **34**. The refrigerant vapor may condense to a refrigerant liquid in the condenser **34** as a result of thermal heat transfer with the cooling fluid. The refrigerant liquid from the condenser **34** may flow through the expansion device **36** to the evaporator **38**. In the illustrated embodiment of FIG. **3**, the condenser **34** is water cooled and includes a tube bundle **54** connected to a cooling tower **56**, which supplies the cooling fluid to the condenser.

The refrigerant liquid delivered to the evaporator **38** may absorb heat from another cooling fluid, which may or may not be the same cooling fluid used in the condenser **34**. The refrigerant liquid in the evaporator **38** may undergo a phase change from the refrigerant liquid to a refrigerant vapor. As shown in the illustrated embodiment of FIG. **3**, the evaporator **38** may include a tube bundle **58** having a supply line **60**S and a return line **60**R connected to a cooling load **62**. The cooling fluid of the evaporator **38** (e.g., water, ethylene glycol, calcium chloride brine, sodium chloride brine, or any other suitable fluid) enters the evaporator **38** via return line **60**R and exits the evaporator **38** via supply line **60**S. In certain embodiments, the supply line **60**S and/or the return line **60**R may include a pump or another suitable device to circulate the cooling fluid. The evaporator **38** may reduce the temperature of the cooling fluid in the tube bundle **58** via thermal heat transfer with the refrigerant. The tube bundle **58** in the evaporator **38** can include a plurality of tubes and/or a plurality of tube bundles. In any case, the refrigerant vapor exits the evaporator **38** and returns to the compressor **32** by a suction line to complete the cycle.

FIG. **4** is a schematic view of the vapor compression system **14** with an intermediate circuit **64** incorporated between condenser **34** and the expansion device **36**. The intermediate circuit **64** may have an inlet line **68** that is directly fluidly connected to the condenser **34**. In other embodiments, the inlet line **68** may be indirectly fluidly coupled to the condenser **34**. As shown in the illustrated embodiment of FIG. **4**, the inlet line **68** includes a first expansion device **66** positioned upstream of an intermediate vessel **70**. In some embodiments, the intermediate vessel **70** may be a flash tank (e.g., a flash intercooler). In other embodiments, the intermediate vessel **70** may be configured as a heat exchanger or a “surface economizer.” In the illustrated embodiment of FIG. **4**, the intermediate vessel **70** is used as a flash tank, and the first expansion device **66** is configured to lower the pressure of (e.g., expand) the refrigerant liquid received from the condenser **34**. During the expansion process, a portion of the liquid may vaporize, and thus, the intermediate vessel **70** may be used to separate the vapor from the liquid received from the first expansion device **66**. Additionally, the intermediate vessel **70** may provide for further expansion of the refrigerant liquid because of a pressure drop experienced by the refrigerant liquid when entering the intermediate vessel **70** (e.g., due to a rapid increase in volume experienced when entering the intermediate vessel **70**). The vapor in the intermediate vessel **70** may be drawn by the compressor **32** through an economizer suction line **74** of the compressor **32**. In other embodiments, the vapor in the intermediate vessel may be drawn to an intermediate stage of the compressor **32** (e.g., not the suction stage). The liquid that collects in the intermediate vessel **70** may be at a lower enthalpy than the refrigerant liquid exiting the condenser **34** because of the expansion in the expansion device **66** and/or the intermediate vessel **70**. The liquid from intermediate vessel **70** may then flow in line **72** through a second expansion device **36** to the evaporator **38**.

In certain embodiments, an HVAC&R system may include multiple vapor compression circuits, such as combinations of a vapor-compression system **14**, to increase a cooling capacity of the HVAC&R system. For example, the HVAC&R system may direct a working fluid through a first vapor compression circuit (e.g., a high pressure vapor compression circuit), a second vapor compression circuit (e.g., a low pressure vapor compression circuit), and/or a shared or common vapor compression circuit. In some embodiments, the first vapor compression circuit includes a first condenser that places a working fluid in thermal communication with a cooling fluid to cool the working fluid. Additionally, the second vapor compression circuit and/or the shared vapor compression circuit may include a second condenser that also places the working fluid in thermal communication with the cooling fluid. The HVAC&R system may also direct the working fluid through a first evaporator of the shared vapor compression circuit and through a second evaporator of the second vapor compression circuit, in which the working fluid is placed in thermal communication with a conditioning fluid in each of the evaporators to cool the conditioning fluid. Generally, the cooling capacity of the working fluid is increased when the working fluid enters the evaporators is in a liquid state as compared to a gaseous or vaporous state. However, working fluid vapor may be produced at certain sections of the HVAC&R system, such as within the evaporators of the HVAC&R system, and may therefore limit the cooling capacity of the working fluid. As such, in accordance with embodiments of the present disclosure, the HVAC&R system may be configured to separate the working fluid vapor from the working fluid liquid to remove the working fluid vapor from certain locations within the HVAC&R system to increase the cooling capacity of the working fluid.

FIG. **5** is a schematic view an embodiment of an HVAC&R system **100** having multiple vapor compression circuits. The HVAC&R system **100** may have a conduit system **101** configured to direct a working fluid through the vapor compression circuits. For instance, the conduit system **101** may direct the working fluid through a first vapor compression circuit **102** configured to direct the working fluid through a first condenser **104**, in which the working fluid is placed in a heat exchange relationship, or in thermal communication with, a cooling fluid. Additionally, the conduit system **101** may direct the working fluid through a shared vapor compression circuit **105**, where working fluid from the first condenser **104** mixes with working fluid from a second vapor compression circuit **107** in a second condenser **106**. The second condenser **106** may place the combined working fluid in thermal communication with the cooling fluid to further cool the working fluid. In some embodiments, the cooling fluid may be directed from the second condenser **106** to the first condenser **104** in a series flow arrangement to remove thermal energy (e.g., heat) from the working fluid in each of the condensers **104**, **106**. Additionally, the shared vapor compression circuit **105** may direct the combined working fluid from the second condenser **106** to a first evaporator **110**. In the first evaporator **110**, vaporous working fluid may be removed and returned to the first condenser **104** via the first vapor compression circuit **102**. Further, the second vapor compression circuit **107** is configured to receive and direct the working fluid from the first evaporator **110** to a second evaporator **114** and from the second evaporator **114** to the second condenser **106**. The working fluid may be placed in a heat exchange relationship, or in thermal communication, with a conditioning fluid in each of the evaporators **110**, **114**. As an example, the conditioning fluid may be directed from the first evaporator **110** to the second evaporator **114** in a series flow arrangement, in which the working fluid may remove thermal energy from the conditioning fluid in each of the evaporators **110**, **114**.

By directing the working fluid through multiple condensers **104**, **106** and multiple evaporators **110**, **114**, the HVAC&R system **100** may cool the conditioning fluid more effectively or efficiently as compared to directing the working fluid through a single condenser and/or evaporator. By way of example, an initial amount of thermal energy may be removed from the conditioning fluid in the first evaporator **110** to cool the conditioning fluid, and an additional amount of thermal energy may be removed from the conditioning fluid in the second evaporator **114** to further cool the conditioning fluid. In addition, directing the working fluid through the first condenser **104** may enable an initial amount of thermal energy to be removed from the working fluid, and directing the working fluid through the second condenser **106** may enable an additional amount of thermal energy to be removed from the working fluid. As such, the working fluid exiting the second condenser **106** may be in a liquid state and/or a subcooled state, such that the cooling capacity of the working fluid is increased.

In certain embodiments, at least one of the condensers **104**, **106** may include a subcooler. For example, the second condenser **106** may include a condensing section **116** and a condenser subcooler **118** that may each receive a portion of the cooling fluid directed into the second condenser **106**. In some embodiments, the condensing section **116** and the condenser subcooler **118** may each receive substantially the same flow rate (e.g., volumetric flow rate) of cooling fluid. In other embodiments, the condensing section **116** may receive a different flow rate (e.g., 25% more or 25% less) of cooling fluid than the condenser subcooler **118**. As such, a first amount of thermal energy may be removed from the working fluid in the condensing section **116**, and a second amount of thermal energy may be removed from the working fluid in the condenser subcooler **118** to further cool the working fluid. Although FIG. **5** illustrates the second condenser **106** having the condenser subcooler **118**, the first condenser **104** may additionally or alternatively include a subcooler.

Furthermore, at least one of the evaporators **110**, **114** may include a flooded section where liquid working fluid may accumulate and absorb thermal energy from the conditioning fluid. For example, the second evaporator **114** may include a vapor section **120** that includes working fluid vapor that has evaporated (e.g., as a result of heat transfer between the working fluid and the conditioning fluid). The second evaporator **114** may further include a flooded section **122** that accumulates working fluid liquid that has not been evaporated, such that the working fluid liquid may further absorb thermal energy from the conditioning fluid flowing through the second evaporator **114**. In some embodiments, the first evaporator **110** may additionally or alternatively have a flooded section, which may contain working fluid liquid that is directed from the first evaporator **110** to the second evaporator **114**.

In some embodiments, the first vapor compression circuit **102** and the second vapor compression circuit **107** may each include compressors configured to increase a pressure of the respective working fluid flowing through the first and second vapor compression circuits **102**, **107**. For example, a first compressor **124** may be fluidly coupled to the first vapor compression circuit **102**, in which the first compressor **124** is configured to compress working fluid vapor received from the first evaporator **110** and direct the compressed working fluid to the first condenser **104** via the first vapor compression circuit **102**. A second compressor **126** may be fluidly coupled to the second vapor compression circuit **107**, in which the second compressor **126** is configured to compress working fluid vapor received from the second evaporator **114** and direct the compressed working fluid to the second condenser **106** via the second vapor compression circuit **107**. Compressing the working fluid with the compressors **124**, **126** may increase a temperature of the respective working fluid flows through the first and second vapor compression circuits **102**, **107**. As such, the working fluid is directed toward the respective condensers **104**, **106** from the compressors **124**, **126**, where the cooling fluid may remove thermal energy from the working fluid.

In certain embodiments, the HVAC&R system **100** may also include a plurality of expansion valves configured to decrease a pressure of the working fluid. For example, the first vapor compression circuit **102** may include a first expansion valve or device **128** positioned between the first condenser **104** and the second condenser **106** and may be configured to expand the working fluid flowing from the first condenser **104** to the second condenser **106**. Thus, the pressure of the combined working fluid in the second condenser **106** may be less than the pressure of the working fluid in the first condenser **104**, such that the first condenser **104** may be considered a high pressure condenser and the second condenser may be considered a low pressure condenser. The shared vapor compression circuit **105** may include a second expansion valve **130** positioned between the second condenser **106** and the first evaporator **110** and may be configured to expand the combined working fluid flowing from the second condenser **106** to the first evaporator **110**. In this manner, the pressure of the working fluid in the first evaporator **110** may be less than the pressure of the working fluid in the second condenser **106**, and may further reduce a temperature of the working fluid to reduce an amount of working fluid vapor entering the first evaporator **110**. The second vapor compression circuit **107** may include a third expansion valve **132** positioned between the first evaporator **110** and the second evaporator **114** and may be configured to expand the working fluid flowing from the first evaporator **110** to the second evaporator **114**. As such, the pressure of the working fluid in the second evaporator **114** may be less than the pressure of the working fluid in the first evaporator **110**, such that the first evaporator **110** may be considered a high pressure evaporator and the second evaporator may be considered a low pressure evaporator.

Furthermore, the first vapor compression circuit **102** may be considered a high pressure vapor compression circuit because the first vapor compression circuit **102** directs working fluid from the first evaporator **110** (e.g., high pressure evaporator) to the first condenser **104** (e.g., high pressure condenser). Thus, the first compressor **124** may be considered a high pressure compressor that discharges compressed working fluid to the first condenser **104** at a relatively high pressure. The second vapor compression circuit **107** may be considered a low pressure vapor compression circuit because the second vapor compression circuit **107** directs working fluid from the second evaporator **114** (e.g., low pressure evaporator) to the second condenser **106** (e.g., low pressure condenser). Thus, the second compressor **126** may be considered a low pressure compressor that discharges compressed working fluid to the second condenser **106** at a pressure less than the working fluid discharged from the first compressor **124**. Additionally, the shared vapor compression circuit **105** may be considered a mixed line because working fluid from both the first vapor compression circuit **102** (e.g., high pressure vapor compression circuit) and the second vapor compression circuit **107** (e.g., low pressure vapor compression circuit) combine to flow through the shared vapor compression circuit **105**.

Generally, decreasing the pressure of the working fluid may decrease a temperature of the working fluid and thus increase the cooling capacity of the working fluid within the evaporators **110**, **114** (e.g., to absorb heat from the conditioning fluid). However, decreasing the pressure of the working fluid may also vaporize a portion of the working fluid and may reduce a performance of the HVAC&R system **100**, as set forth above. Moreover, a portion of the working fluid may vaporize as the working fluid is directed into one of the heat exchangers due to a sudden increase in volume. Further still, some of the working fluid may vaporize when absorbing thermal energy (e.g., from the conditioning fluid). For example, a portion (e.g., 25%, 50%) of the working fluid in the first evaporator **110** may vaporize after absorbing thermal energy from the conditioning fluid, and a portion (e.g., 90% to substantially 100%) of the working fluid in the second evaporator **114** may vaporize in the second evaporator **114**.

The presence of vaporized working fluid entering the first evaporator **110** and/or the second evaporator **114** may decrease an effectiveness or an efficiency of the HVAC&R system **100**. For instance, the working fluid vapor may have a lower cooling capacity when compared to working fluid liquid. Thus, the presence of working fluid vapor in the first evaporator **110** and/or the second evaporator **114** (e.g., received from the first evaporator **110**) may limit an overall cooling capacity of the working fluid to absorb thermal energy from the conditioning fluid. To reduce the presence of working fluid vapor in the first evaporator **110** and increase the cooling capacity of the working fluid generally, working fluid vapor may be removed from first evaporator **110** while the HVAC&R system **100** is in operation. For example, the first evaporator **110** may act as an economizer that separates the working fluid liquid from the working fluid vapor. In some embodiments, the first compressor **124** may force or draw at least a portion of the working fluid vapor from the first evaporator **110** into the first vapor compression circuit **102**, in which the working fluid vapor is compressed and directed toward the first condenser **104**. The working fluid liquid may be directed from the first evaporator **110** to the second evaporator **114** via the second vapor compression circuit **107**. Thus, the first compressor **124** may enable the first and second evaporators **110**, **114** to contain a greater amount of working fluid liquid, thereby increasing an efficiency or effectiveness of the first and second evaporators **110**, **114** to cool the conditioning fluid. Similarly, the second compressor **126** may force or draw at least a portion of the working fluid vapor within the second evaporator **114** (e.g., formed as a result of absorption of thermal energy from the conditioning fluid) to pressurize and direct the working fluid toward the second condenser **106**.

In some embodiments, the HVAC&R system **100** may additionally include an economizer system **136**, which may include a flash tank **134** that is similar to the intermediate vessel **70** described above, disposed between the second condenser **106** and the first evaporator **110**. For example, the economizer **134** may be configured to receive the working fluid from the second condenser **106**. A first valve **138** may be disposed along the shared vapor compression circuit **105** and may be configured to expand the working fluid flowing from the second condenser **106** to the economizer **134**. The flash tank **134** may separate a mixture of working fluid liquid and working fluid vapor received from the second condenser **106**. The working fluid liquid may be directed from the economizer system **136** toward the first evaporator **110**. In some embodiments, a second valve **140** may be configured to expand the working fluid liquid flowing from the flash tank **134** to the first evaporator **110**. In this manner, the working fluid flowing from the economizer system **136** to the first evaporator **110** may be at a lower temperature than the working fluid flowing from the second condenser **106** to the first evaporator **110** via the second expansion valve **130**. Thus, the economizer system **136** may decrease an overall temperature of the working fluid entering the first evaporator **110**, which may enable the working fluid to absorb a greater amount of thermal energy from the conditioning fluid, thereby increasing an efficiency of the first evaporator **110**. Moreover, the economizer **136** may include a third compressor **142** configured to force or draw the working fluid vapor from the flash tank **134**. The compressor **142** may pressurize the working fluid vapor and direct the pressurized working fluid vapor to the second vapor compression circuit **107** and toward the second condenser **106**.

In some embodiments, the second expansion valve **130** may be closed, or the shared vapor compression circuit **105** may not be included, such that substantially all of the working fluid in the second condenser **106** flows to the flash tank **134**. In other words, the working fluid is discharged from the second condenser **106** and directed toward the flash tank **134**. The working fluid in the flash tank **134** may separate into a liquid portion and a vapor portion, where the vapor portion may be drawn from the flash tank **134** via the third compressor **142** and the liquid portion flows toward the first evaporator **110**. In an additional or an alternative embodiment, the third compressor **142** may be removed, and the second compressor **126** may be configured to draw the vapor portion of the working fluid directly from the flash tank **134**. For example, the second compressor **126** may be a multistage (e.g., two-stage) compressor having an economizer port. The economizer port may draw the vapor portion of the working fluid from the flash tank **134** into the second compressor **126**, where the vapor portion of the working fluid is combined with the working fluid received from the second evaporator **114**. The compressor **126** may then pressurize the combined working fluid and direct the combined working fluid to the second condenser **106**.

FIG. **6** is a schematic view of an embodiment of the HVAC&R system **100** using an additional heat exchanger **150** (e.g., a shell and tube heat exchanger, a brazed plate heat exchanger) in the economizer system **136** in addition to or in lieu of the flash tank **134**. The additional heat exchanger **150** may receive working fluid liquid from the second condenser **106** and may further cool the working fluid liquid directed to the first evaporator **110**. For example, the shared vapor compression circuit **105** may direct the working fluid liquid through the additional heat exchanger **150**. A portion **154** (e.g., a first portion) of the working fluid liquid may be directed from the shared vapor compression circuit **105** through the first valve **138**, which expands and cools the portion **154** of the working fluid liquid. The first valve **138** then directs the cooled portion **154** of the working fluid liquid through the additional heat exchanger **150**, which then may then place the cooled portion **154** of the working fluid liquid in a heat exchange relationship with a remaining portion (e.g., a second portion) of the working fluid liquid directed through the additional heat exchanger **150** to further cool the remaining portion of the working fluid liquid. In the illustrated embodiment, the portion **154** of the working fluid liquid and the remaining portion of the working fluid liquid are directed through the additional heat exchanger **150** in a parallel counterflow arrangement. In additional or alternative embodiments, the portion **154** of the working fluid liquid and the remaining portion of the working fluid liquid may be directed through the additional heat exchanger **150** in a parallel series flow arrangement or another suitable flow arrangement. After exchanging heat with the remaining portion of the working fluid, the portion **154** of the working fluid liquid may be drawn into the third compressor **142**, and the remaining portion of the working fluid liquid flows toward the first evaporator **110**. In further embodiments, the additional heat exchanger **150** may not be utilized to cool the working fluid liquid, such that the first valve **138** may close and/or the working fluid liquid may bypass the additional heat exchanger **150**.

FIG. **7** is a cross-section of an embodiment of a shell **200** of a heat exchanger (e.g., the first evaporator **110** and/or the second evaporator **114**) that may be included in the HVAC&R system **100**. As illustrated in FIG. **7**, the shell **200** may have a substantially circular cross-section, though in other embodiments, the shell **200** may have any suitable cross-sectional shape. In the illustrated embodiment, the shell **200** may include the first evaporator **110** and the second evaporator **114** positioned adjacent to one another relative to a lateral axis **202**, though the shell **200** may alternatively include the first evaporator **110** and the second evaporator **114** positioned in another configuration. Additionally, another shell may include a different set of heat exchangers, such as the first condenser **104** and the second condenser **106**. The first evaporator **110** may include a first tube bundle **204** configured to receive the conditioning fluid directed through the first evaporator **110**. The second evaporator **114** may include a second tube bundle **206** configured to receive the conditioning fluid directed through the second evaporator **114**. For example, the conditioning fluid may be directed through the first evaporator **110** (e.g., in a first flow direction along a longitudinal axis **212**) via the first tube bundle **204** and then the conditioning fluid may flow through the second evaporator **114** (e.g., in a second flow direction along the longitudinal axis **212** opposite the first flow direction).

Furthermore, the shared vapor compression circuit **105** may direct working fluid into the first evaporator **110** via a first inlet **222** to place the working fluid in thermal communication with the conditioning fluid directed through the first tube bundle **204** so as to absorb thermal energy from the conditioning fluid. As a result of absorbing thermal energy, a portion of the working fluid in the first evaporator **110** may vaporize, while a remainder of the working fluid remains in a liquid state. In some cases, the working fluid vapor and the working fluid liquid may separate in the first evaporator **110**, such that the working fluid vapor is directed out of the first evaporator **110** via a first outlet **224** and toward the first condenser **104** (e.g., via the first compressor **124**). The working fluid liquid may be directed out of the first evaporator **110** via a second outlet **226** that is fluidly coupled to the first evaporator **110** (e.g., via the second vapor compression circuit **107**). The second vapor compression circuit **107** may then direct the working fluid liquid into the second evaporator **114** via a second inlet **228**. In the second evaporator **114**, the working fluid liquid may further be placed in thermal communication with the conditioning fluid, and a portion of the working fluid liquid may evaporate as a result of absorbing heat from the conditioning fluid. The working fluid may separate in the second evaporator **114** into the vapor section **120** containing the working fluid vapor and the flooded section **122** containing the working fluid liquid. As an example, the working fluid liquid may be denser than the working fluid vapor such that the flooded section **122** is located below the vapor section **120** relative to the vertical axis **210**. The working fluid vapor may be directed out of the second evaporator **114** via a third outlet **230** and toward the second condenser **106**. Further, the working fluid liquid may remain in the second evaporator **114** to absorb heat from conditioning fluid entering the second evaporator **114**.

In some embodiments, the shell **200** may include a wall **236** that fluidly separates the first evaporator **110** from the second evaporator **114**. That is, the wall **236** separates the working fluid flowing through the first evaporator **110** and the working fluid flowing through the second evaporator **114**. In alternate embodiments, the first evaporator **110** and the second evaporator **114** may be separated by a gap or space instead of the wall **236**.

FIG. **8** is a schematic view of another embodiment of the HVAC&R system **100** having multiple vapor compression circuits. As illustrated in FIG. **8**, the HVAC&R system **100** includes the first condenser **104** (e.g., high pressure condenser), the second condenser **106** (e.g., low pressure condenser), the first evaporator **110** (e.g., high pressure evaporator), and the second evaporator **114** (e.g., low pressure evaporator). The conduit system **101** of the HVAC&R system **100** may include a first vapor compression circuit **250** (e.g., a high pressure vapor compression circuit) configured to direct working fluid from the second evaporator **114** to the first condenser **104** and then to the second condenser **106**. The conduit system **101** may also include a shared vapor compression circuit **252** configured to direct combined working fluid within the second condenser **106** toward the first evaporator **110**. Further a second vapor compression circuit **254** (e.g., a low pressure vapor compression circuit) is configured to direct working fluid from the first evaporator **110** to the second condenser **106**. The first vapor compression circuit **250** may include a first compressor **260**, and the second vapor compression circuit **254** may include a second compressor **258**. Additionally, in some embodiments, the first vapor compression circuit **250** may be configured to direct working fluid from the first evaporator **110** to the second evaporator **114**. In some embodiments, the HVAC&R system **100** may include the economizer system **136**, as described above with respect to the embodiment of FIG. **5**.

The first evaporator **110** of the embodiment of the HVAC&R system **100** of FIG. **8** may also act as an economizer, in which working fluid liquid may be separated from working fluid vapor in the first evaporator **110**. For example, working fluid liquid may be directed from the first evaporator **110** to the second evaporator **114**. Moreover, in the HVAC&R system **100** of FIG. **8**, working fluid vapor formed within, or otherwise present in, the first evaporator **110** may be directed toward the second condenser **106**, rather than the first condenser **104** as described above with reference to FIG. **5**. By way of example, the second compressor **258** may be fluidly coupled to the first evaporator **110** via the second vapor compression circuit **254**, where the first second compressor **258** is configured to force or draw the working fluid vapor from the first evaporator **110** toward the second condenser **106**. In the second condenser **106**, the working fluid is placed in thermal communication with the cooling fluid to reduce a temperature of the working fluid.

In the illustrated embodiment of FIG. **8**, working fluid from the second evaporator **114** may be directed toward the first condenser **104**. For example, the first compressor **260** may be fluidly coupled to the second evaporator **114** via the first vapor compression circuit **250**, where the second first compressor **260** is configured to force or draw working fluid from the second evaporator **114** into the first vapor compression circuit **250**. The working fluid is then placed in thermal communication with cooling fluid directed through the first condenser **104**. The first vapor compression circuit **250** may be considered a high pressure vapor compression circuit that includes a pressure of the working fluid that is greater than a pressure of the working fluid within the second vapor compression circuit **254**. As such, the second vapor compression circuit **254** may be considered a low pressure vapor compression circuit. Furthermore, the shared vapor compression circuit **252** may be considered a mixed vapor compression circuit that combines working fluid from the high pressure vapor compression circuit and the lower pressure vapor compression circuit.

FIG. **9** is a schematic view of another embodiment of the HVAC&R system **100** having multiple vapor compression circuits and having a bypass conduit assembly **280** that enables the multiple vapor compression circuit to operate independently of one another and/or without mixing working fluid from each of the multiple vapor compression circuits. For example, the bypass conduit assembly **280** may include a bypass valve **282** to enable working fluid to flow from the first condenser **104** to the second evaporator **114** (e.g., without flowing through the second condenser **106** and/or the first evaporator **110**). Therefore, the working fluid flowing through the bypass conduit assembly **280** bypasses the second condenser **106** and the first evaporator **110**, such that working fluid from the first vapor compression circuit **250** is not mixed with working fluid from the second vapor compression circuit **254** in the second condenser **106**.

In some embodiments, the HVAC&R system **100** may be configured to operate in two modes based on feedback indicative of operating conditions of the HVAC&R system **100**. For instance, a position of the bypass valve **282** may be adjusted based on the feedback to transition between a first operating mode and a second operating mode. In the first operating mode, the bypass valve **282** may be adjusted to a closed position, and the first expansion valve **128**, the second expansion valve **130**, and the third expansion valve **132** may be adjusted to an open position to enable working fluid to flow from the first condenser **104** and through the second condenser **106** and the first evaporator **110**, as previously described in FIG. **8**. In the second operating mode, the bypass valve **282** may be adjusted to an open position to enable working fluid to flow from the first condenser **104** toward the second evaporator **114**, and the first expansion valve **128**, the second expansion valve **130**, and/or the third expansion valve **132** may be adjusted to a closed position to block working fluid from flowing from the first condenser **104** to the second condenser **106** and/or the first evaporator **110**. In some embodiments, operation of the second condenser **106** and the first evaporator **110** may be suspended in the second operating mode to reduce energy consumption of the HVAC&R system **100**. In other embodiments, operation of the second condenser **106** and the first evaporator **110** may be active, such that the first vapor compression circuit **250** and the second vapor compression circuit **254** operate independent of one another (e.g., working fluid from the first vapor compression circuit **250** does not mix with working fluid from the vapor compression circuit **254**).

The HVAC&R system **100** may further include a control system **284** configured to control operation of the HVAC&R system **100** by adjusting the bypass valve **282**, the first expansion valve **128**, the second expansion valve **130**, and/or the third expansion valve **132**. For example, the control system **284** may include a memory **286** and a processor **288**. The memory **286** may be a mass storage device, a flash memory device, a removable memory, or any other non-transitory computer-readable medium that includes instructions for controlling the HVAC&R system **100**. The memory **286** may also include volatile memory, such as randomly accessible memory (RAM) and/or non-volatile memory, such as hard disc memory, flash memory, and/or other suitable memory formats. The processor **288** may execute the instructions stored in the memory **286**, such as instructions to adjust the position of the bypass valve **282**, the first expansion valve **128**, the second expansion valve **130**, and/or the third expansion valve **132** to control a flow of the working fluid between components of the HVAC&R system **100**.

For example, the control system **284** may be configured to operate the HVAC&R system **100** in the first operating mode by opening the first expansion valve **128**, opening the second expansion valve **130**, opening the third expansion valve **132**, and closing the bypass valve **282**. The control system **284** may also be configured to operate the HVAC&R system **100** in the second operating mode by closing the first expansion valve **128**, closing the second expansion valve **130**, closing the third expansion valve **132**, and/or opening the bypass valve **282**. In some embodiments, the control system **284** may be configured to operate the HVAC&R system **100** based on user input received from a user interface that is communicatively coupled to the control system **284**. In other embodiments, the control system **284** may be configured to transition between the first operating mode and the second operating mode based on feedback received by the control system **284** that is indicative of one or more operating parameters of the HVAC&R system **100**.

By way of example, the control system **284** may be communicatively coupled to a sensor **290** configured to determine an operating parameter of the HVAC&R system **100**. The operating parameter may be a target temperature of the conditioning fluid, a current temperature of the conditioning fluid, a temperature of the working fluid, a pressure of the working fluid, a temperature of the cooling fluid, a target load demand of the HVAC&R system **100**, another suitable operating parameter, or any combination thereof. In certain embodiments, the control system **284** may compare the feedback indicative of the operating parameter with a threshold value, and the control system **284** may adjust operation of the HVAC&R system **100** based on the comparison. For instance, the control system **284** may operate the HVAC&R system **100** in the first operating mode upon receiving feedback indicative of a load demand of the HVAC&R system falling below a threshold value. In other words, the control system **284** operates the HVAC&R system **100** in the first operating mode when a target temperature of the conditioning fluid may be achieved using a single vapor compression circuit (e.g., a single evaporator may reduce a temperature of the conditioning fluid to the target temperature). In another example, the input may be a user input indicating that the HVAC&R system **100** should operate in the first operating mode or the second operating mode. In some cases, the user input may override a current operating mode of the HVAC&R system **100** that is determined based on the feedback indicative of the operating parameter of the HVAC&R system **100**. For example, the user input may suspend operation of a component of the HVAC&R system **100** (e.g., the second condenser **106**), such that maintenance may be performed on the component. Thus, operating the HVAC&R system **100** in the first operating mode enables the HVAC&R system **100** to continue to condition the conditioning fluid (e.g., using the first vapor compression circuit **250**) while maintenance is performed on inactive components (e.g., components of the second vapor compression circuit **254**).

FIG. **10** is a block diagram illustrating an embodiment of a method **320** for adjusting operation of the HVAC&R system **100** (e.g., between the first operating mode and the second operating mode). In certain embodiments, the method **320** may be performed by one or more controllers, such as the control system **284**. This disclosure primarily discusses the method **320** as applied to the HVAC&R system **100** of FIG. **9**, but a similar method or process may be performed in embodiments of the HVAC&R system **100** having a different arrangement or configuration. Furthermore, steps may be performed in addition to the steps described in the method **320**, or certain steps of the depicted method **320** may be modified, removed, and/or performed in a different order than shown in FIG. **10**.

At block **322**, the control system **284** may receive feedback indicating that the HVAC&R system **100** should operate in the first operating mode, which may enable the first vapor compression circuit **250** to operate independently of the second vapor compression circuit **254** (e.g., working fluid from the first vapor compression circuit **250** does not mix with working fluid from the second vapor compression circuit **254**). The feedback may include feedback indicative of an operating parameter transmitted by the sensor **290** (e.g., a relatively low operating load) that indicates that operation of a single vapor compression circuit is sufficient for achieving a target temperature of the conditioning fluid. In some embodiments, the feedback may include a user input indicating that the HVAC&R system **100** should operate in the first operating mode.

At block **324**, the control system **284** adjusts operation of components of the HVAC&R system **100** to operate in the first operating mode. As an example, the control system **284** may close the first expansion valve **128**, close the second expansion valve **130**, close the third expansion valve **132**, and open the bypass valve **282**. In some embodiments, the control system **284** may also suspend or disable operation of certain components (e.g., the second condenser **106**, the first evaporator **110**) that may not be used while the HVAC&R system **100** is operating in the first operating mode.

At block **326**, the control system **284** may receive feedback indicating that the HVAC&R system **100** should operate in the second operating mode (e.g., directing working fluid through the first vapor compression circuit **250**, the shared vapor compression circuit **252**, and the second vapor compression circuit **254**). As described herein, the feedback may include an operating parameter transmitted by the sensor **290** indicative of a condition (e.g., a relatively high operating load) in which operation of the both the first vapor compression circuit **250** and the second vapor compression circuit **254** is utilized to achieve a target operating load. Additionally or alternatively, the feedback may be a user input, such as transmitted from a user interface, indicating that the HVAC&R system **100** should operate in the second operating mode.

At block **328**, the control system **284** adjusts one or more components of the HVAC&R system **100** to operate in the second operating mode. For example, the control system **284** may open the first expansion valve **128**, open the second expansion valve **130**, open the third expansion valve **132**, and close the bypass valve **282**. Additionally, the control system **284** may enable operation of the second condenser **106**, the first evaporator **110**, the second compressor **258**, and other suitable components to operate the HVAC&R system **100** in the second operating mode.

Embodiments of the present disclosure are directed to an HVAC&R system having multiple vapor compression circuits. For example, the HVAC&R system may circulate a working fluid through a first vapor compression circuit having a first condenser, a shared vapor compression circuit having a second condenser and/or a first evaporator, and/or a second vapor compression circuit having a second evaporator. In each of the condensers, the working fluid may be placed in thermal communication with a cooling fluid configured to absorb thermal energy from the working fluid. In each of the evaporators, the working fluid may be placed in thermal communication with a conditioning fluid, where the working fluid is configured to absorb heat from the conditioning fluid. In the first evaporator, the working fluid may absorb a certain amount of heat that transforms at least a portion of the working fluid from a liquid state to a vaporous state, and the working fluid liquid and the working fluid vapor may be separated in the first evaporator. The working fluid vapor may be directed from the first evaporator to the first condenser of the first vapor compression circuit. The working fluid liquid may be directed from the first evaporator to the second evaporator, in which the working fluid may absorb an additional amount of heat that transforms an additional portion of the working fluid from the liquid state to the vaporous state. The working fluid vapor of the additional portion of the working fluid may be directed from the second evaporator to the second condenser of the second vapor compression circuit. By directing working fluid vapor out of the first evaporator, the second evaporator may receive primarily working fluid liquid, thereby increasing a cooling capacity of the working fluid. Thus, a performance of the HVAC&R system to remove heat from the conditioning fluid may be improved. The technical effects and technical problems in the specification are examples and are not limiting. It should be noted that the embodiments described in the specification may have other technical effects and can solve other technical problems.

While only certain features and embodiments of the disclosure have been illustrated and described, many modifications and changes may occur to those skilled in the art (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters (e.g., temperatures, pressures, etc.), mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited in the claims. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the disclosure. Furthermore, in an effort to provide a concise description of the exemplary embodiments, all features of an actual implementation may not have been described (i.e., those unrelated to the presently contemplated best mode of carrying out the disclosure, or those unrelated to enabling the claimed disclosure). It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation specific decisions may be made. Such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure, without undue experimentation.

The invention claimed is:

1. A heating, ventilation, air conditioning, and/or refrigeration (HVAC&R) system, comprising:

a first vapor compression flow path comprising a first condenser configured to place a working fluid in a heat exchange relationship with a cooling fluid;

a second vapor compression flow path comprising a first evaporator configured to place the working fluid in a heat exchange relationship with a conditioning fluid;

a shared vapor compression flow path comprising:

the first evaporator; and

a second condenser of the second vapor compression flow path, wherein the second condenser is configured to place the working fluid in a heat exchange relationship with the cooling fluid,

wherein the first vapor compression flow path comprises a second evaporator configured to place the working fluid in a heat exchange relationship with the conditioning fluid, the first vapor compression flow path is configured to direct working fluid vapor from the second evaporator to the first condenser, the first vapor compression flow path is configured to direct working fluid liquid from the first evaporator to the second evaporator, the first vapor compression flow path comprises a valve disposed between the first evaporator and the second evaporator, the valve is configured to open and close to control a flow of working fluid liquid from the first evaporator to the second evaporator, the first vapor compression flow path is a high pressure vapor compression flow path, and the second vapor compression flow path is a low pressure vapor compression flow path, such that the first vapor compression flow path is configured to operate at a first working fluid pressure greater than a second working fluid pressure of the second vapor compression flow path; and

a bypass conduit system configured to selectively direct a flow of working fluid from the first condenser to the second evaporator of the first vapor compression flow path, such that the flow of working fluid bypasses the second condenser and the first evaporator of the second vapor compression flow path.

2. The HVAC&R system of claim 1, wherein the first vapor compression flow path comprises a compressor configured to direct working fluid vapor from the second evaporator to the first condenser of the first vapor compression flow path.

3. The HVAC&R system of claim 1, wherein the second vapor compression flow path comprises a compressor configured to direct working fluid vapor from the first evaporator to the second condenser of the shared vapor compression flow path.

4. The HVAC&R system of claim 1, wherein the first evaporator and the second evaporator are disposed in a single shell, and wherein the single shell comprises a wall configured to fluidly separate the first evaporator and the second evaporator.

5. The HVAC&R system of claim 1, wherein the shared vapor compression flow path is configured to direct working fluid from the second condenser to the first evaporator.

6. The HVAC&R system of claim 5, comprising an economizer disposed along the shared vapor compression flow path, wherein the economizer is configured to receive at least a portion of the working fluid from the second condenser.

7. The HVAC&R system of claim 6, wherein the first evaporator is configured to receive at least the portion of the working fluid from the economizer.

8. A heating, ventilation, air conditioning, and/or refrigeration (HVAC&R) system, comprising:

a first vapor compression flow path comprising a first condenser configured to place a first portion of a working fluid in thermal communication with a cooling fluid, and a first compressor configured to direct the first portion of the working fluid to the first condenser;

a second vapor compression flow path comprising a second compressor configured to direct a second portion of the working fluid from a first evaporator to a second condenser;

a shared vapor compression flow path comprising the second condenser and the first evaporator, wherein the second condenser is configured to receive the first portion of the working fluid from the first condenser of the first vapor compression flow path and receive the second portion of the working fluid from the first evaporator, wherein the shared vapor compression flow path is configured to direct the first portion of the working fluid and the second portion of the working fluid from the second condenser to the first evaporator, the shared vapor compression flow path comprises a first valve disposed between the second condenser and the first evaporator, and the first valve is configured to open and close to control a combined flow of the first portion of the working fluid and the second portion of the working fluid from the second condenser to the first evaporator,

wherein the first vapor compression flow path comprises a second evaporator configured to place the first portion of the working fluid in thermal communication with a conditioning fluid, the first vapor compression flow path comprises a second valve disposed between the first evaporator and the second evaporator, the second valve is configured to open and close to control a flow of the first portion of the working fluid from the first evaporator to the second evaporator, the first vapor compression flow path comprises a third valve disposed between the first condenser and the second condenser, and the third valve is configured to open and close to control a flow of the first portion of the working fluid from the first condenser to the second condenser;

a bypass conduit system configured to selectively direct the first portion of the working fluid from the first condenser to the second evaporator, such that the first portion of the working fluid bypasses the second condenser and the first evaporator; and

a controller configured to control operation of the bypass conduit system and to adjust respective positions of the second valve and the third valve to independently operate the first vapor compression flow path and the second vapor compression flow path.

9. The HVAC&R system of claim **8**, wherein the first vapor compression flow path is a high pressure vapor compression flow path and the second vapor compression flow path is a low pressure vapor compression flow path.

10. The HVAC&R system of claim **8**, wherein the shared vapor compression flow path comprises an economizer, and wherein the economizer is configured to receive the first portion of the working fluid and the second portion of the working fluid from the second condenser.

11. The HVAC&R system of claim **10**, wherein the shared vapor compression flow path comprises a compressor configured to direct a third portion of the working fluid from the economizer to the second condenser, and wherein the first evaporator is configured to receive a fourth portion of the working fluid from the economizer.

12. The HVAC&R system of claim **8**, wherein the second evaporator is configured to receive the first portion of the working fluid from the first evaporator.

13. The HVAC&R system of claim **8**, wherein the bypass conduit system comprises a bypass valve configured to open and close to control flow of the first portion of the working fluid from the first condenser to the second evaporator, and the controller is configured to adjust the second valve and the third valve to respective closed positions and adjust the bypass valve to an open position to operate the first vapor compression flow path during suspended operation of the second vapor compression flow path.

14. A heating, ventilation, air conditioning, and/or refrigeration (HVAC&R) system, comprising:

a first vapor compression flow path comprising a first condenser configured to place a first portion of a working fluid in thermal communication with a cooling fluid and a first compressor configured to direct the first portion of the working fluid to the first condenser;

a second vapor compression flow path comprising a second compressor configured to direct a second portion of the working fluid from a first evaporator to a second condenser;

a shared vapor compression flow path comprising:

the second condenser, wherein the second condenser is configured to place the first portion of the working fluid and the second portion of the working fluid in thermal communication with the cooling fluid; and

the first evaporator, wherein the first evaporator is configured to place the first portion of the working fluid and the second portion of the working fluid in thermal communication with a conditioning fluid, wherein the shared vapor compression flow path is configured to direct the first portion of the working fluid and the second portion of the working fluid from the second condenser to the first evaporator; and

a bypass conduit system configured to selectively direct the first portion of the working fluid from the first condenser to a second evaporator of the first vapor compression flow path, such that the first portion of the working fluid bypasses the second condenser and the first evaporator.

15. The HVAC&R system of claim **14**, wherein the bypass conduit system comprises a valve having a first position and a second position, wherein the valve is configured to enable the first portion of the working fluid to flow through the bypass conduit system in the first position, and the valve is configured to block the first portion of the working fluid from flowing through the bypass conduit system in the second position.

16. The HVAC&R system of claim **15**, wherein the valve is a first valve, and the HVAC&R system comprises a second valve having a third position and a fourth position, wherein the second valve is configured to enable the first portion of the working fluid to flow from the first condenser to the second condenser in the third position, and the second valve is configured to block the first portion of the working fluid from flowing from the first condenser to the second condenser in the fourth position.

17. The HVAC&R system of claim **16**, comprising a controller communicatively coupled to the first valve and the second valve, wherein the controller is configured to adjust the first valve between the first position and the second position and to adjust the second valve between the third position and the fourth position based on feedback indicative of an operating parameter of the HVAC&R system.

18. The HVAC&R system of claim **17**, wherein the controller is configured to adjust the first valve and the second valve to operate the HVAC&R system in a first operating mode and a second operating mode, wherein the first valve is in the first position and the second valve is in the fourth position in the first operating mode of the HVAC&R system, and the first valve is in the second position and the second valve is in the third position in the second operating mode of the HVAC&R system.

19. The HVAC&R system of claim **18**, wherein the controller is configured to suspend operation of the second compressor in the first operating mode.

20. The HVAC&R system of claim **18**, wherein the controller is configured to operate the HVAC&R system in the first operating mode and the second operating mode based on the operating parameter, wherein the operating parameter comprises a target temperature of the conditioning fluid, a current temperature of the conditioning fluid, a temperature of the working fluid, a pressure of the working fluid, a temperature of the cooling fluid, a target load demand, or any combination thereof.

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