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(54) METHOD AND SYSTEM FOR DEHUMIDIFICATION AND REFRIGERANT PRESSURE CONTROL

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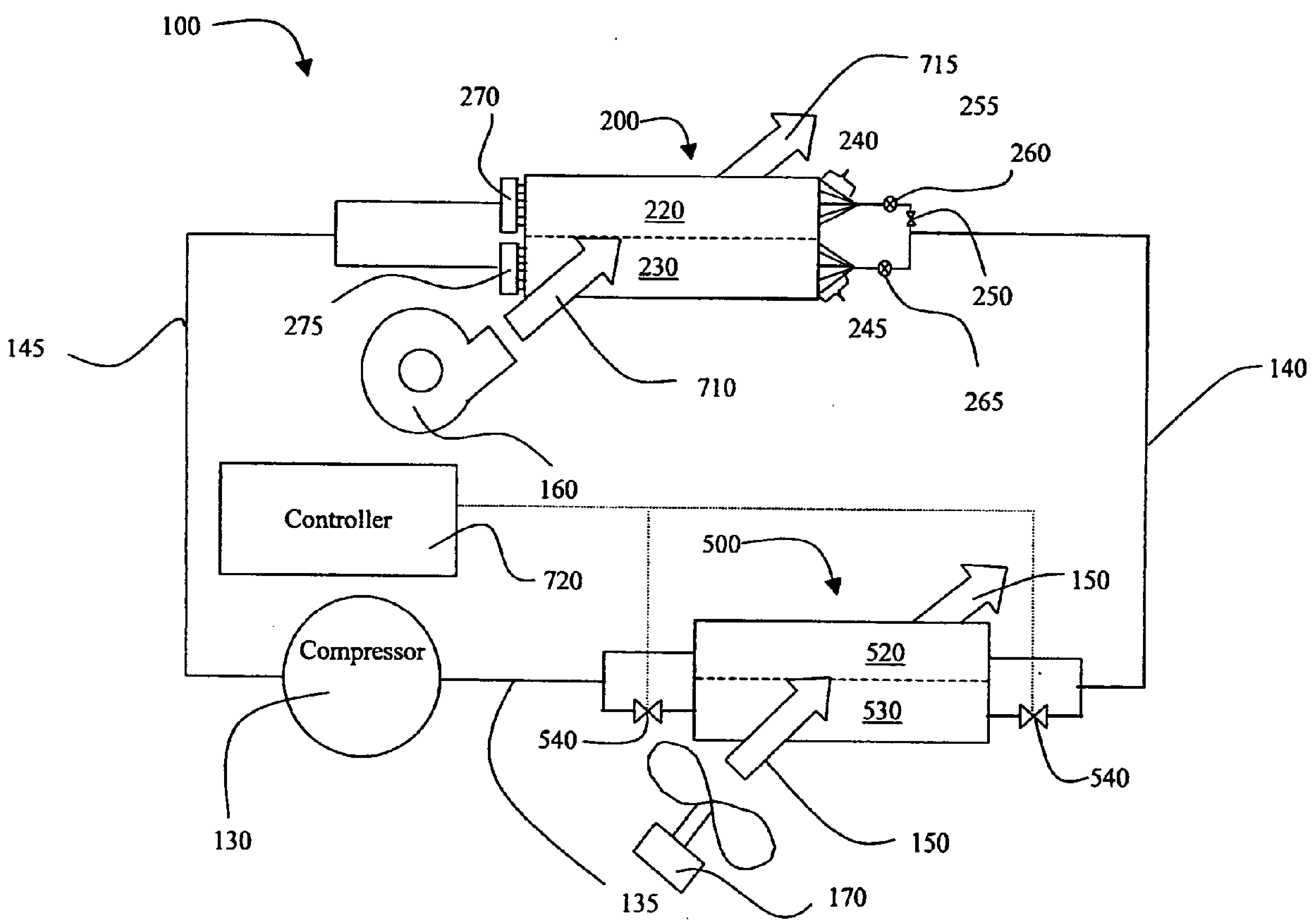
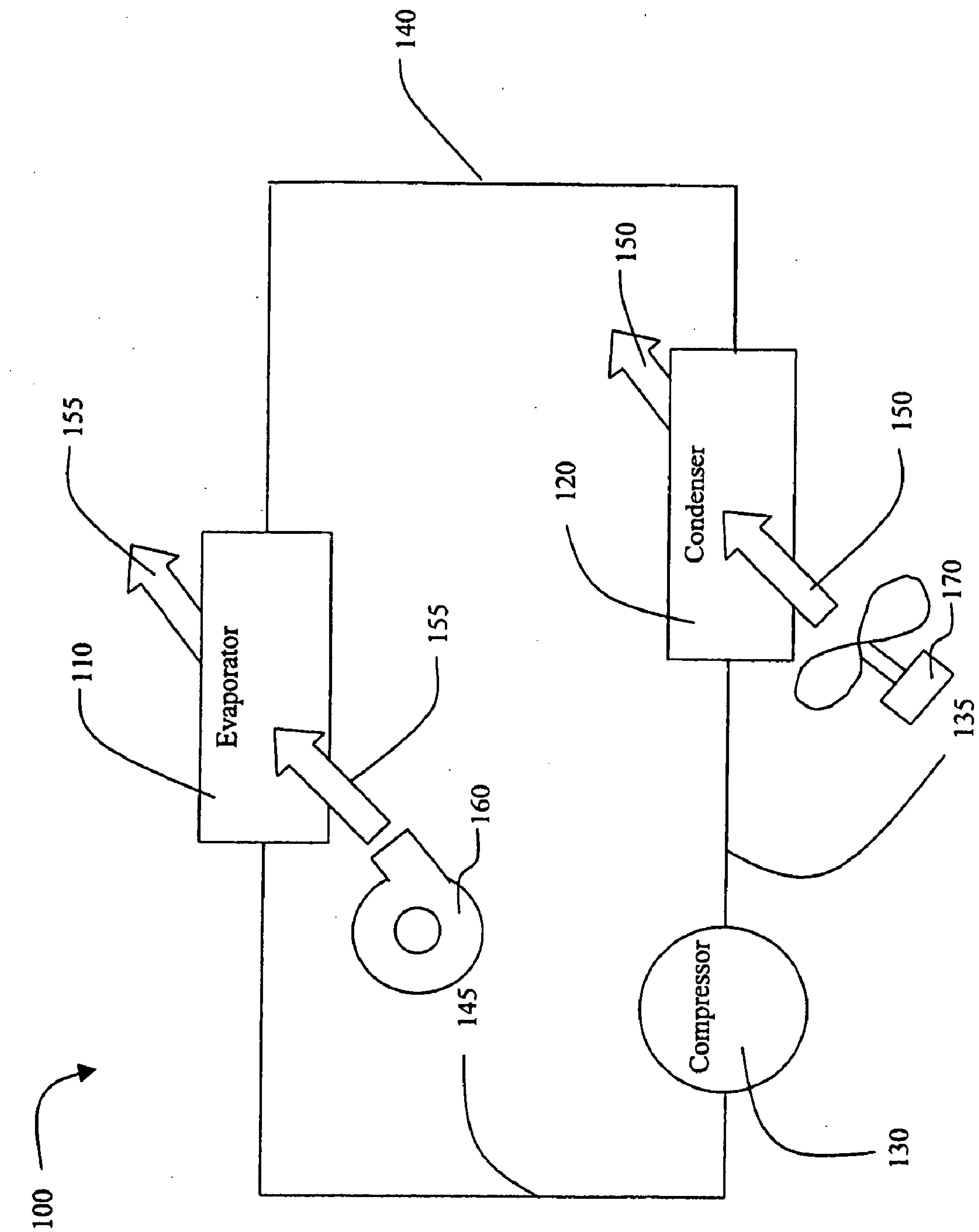
(57) ABSTRACT

A method for dehumidification and controlling system pressure in a refrigeration system includes providing a refrigeration system having a compressor, a condenser and an evaporator connected in a closed refrigerant loop. Each of the condenser and evaporator have a plurality of refrigerant circuits. A first heat transfer fluid is flowed over the condenser and a second heat transfer fluid is flowed over the evaporator. At least one of the refrigerant circuits of the condenser is isolated to provide a decreased amount of heat transfer area within the condenser and to increase the refrigerant pressure within the refrigeration system when the refrigerant pressure within the refrigeration system is at or below a predetermined pressure. At least one of the refrigerant circuits of the evaporator is isolated to dehumidify and maintain the temperature of the second heat transfer fluid at or above a predetermined temperature when dehumidification is required.





100
110
Evaporator
120
Condenser
130
Compressor
135
140
145
150
150
155
155
160
170

Figure 1

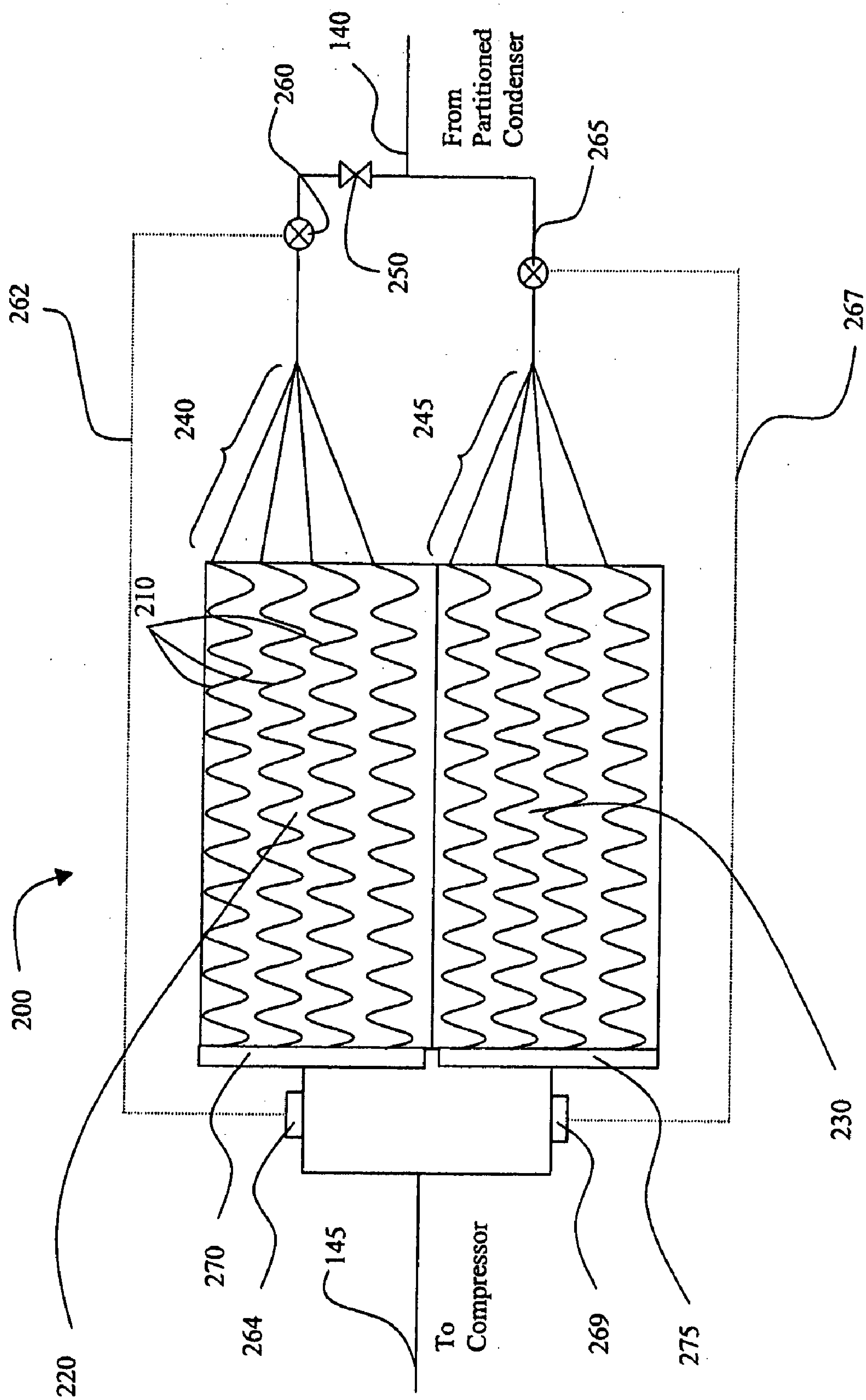

140
From Partitioned Condenser
260
250
265
262
267
240
245
210
200
220
230
270
264
145
To Compressor
269
275

Figure 2

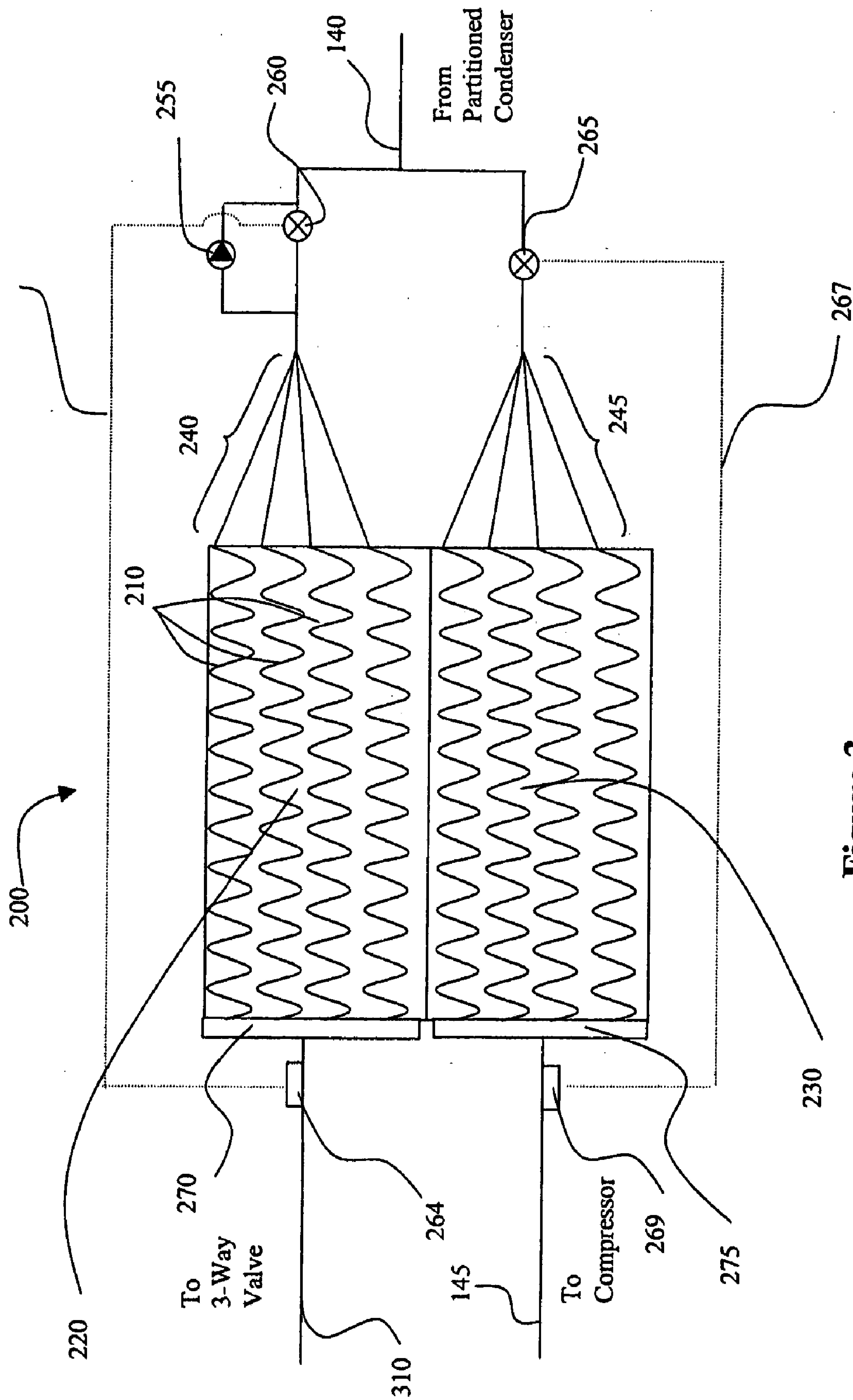

140
From
Partitioned
Condenser
255
260
265
262
267
240
245
210
200
220
230
270
264
269
275
To
3-Way
Valve
145
To
Compressor
310

Figure 3

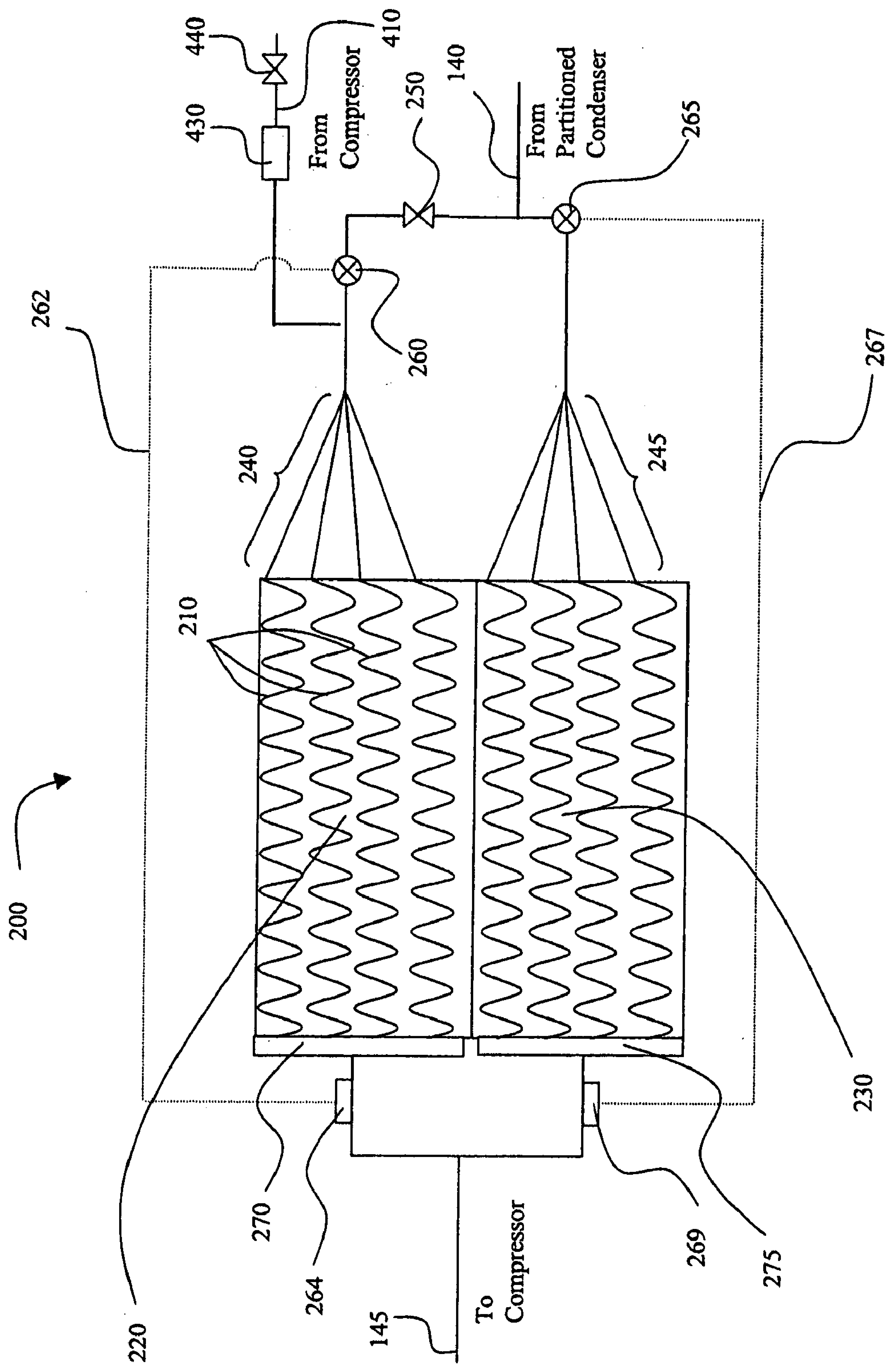

200
262
440
430
410
From Compressor
250
140
From Partitioned Condenser
265
260
267
240
245
210
220
230
270
264
269
275
145
To Compressor

Figure 4

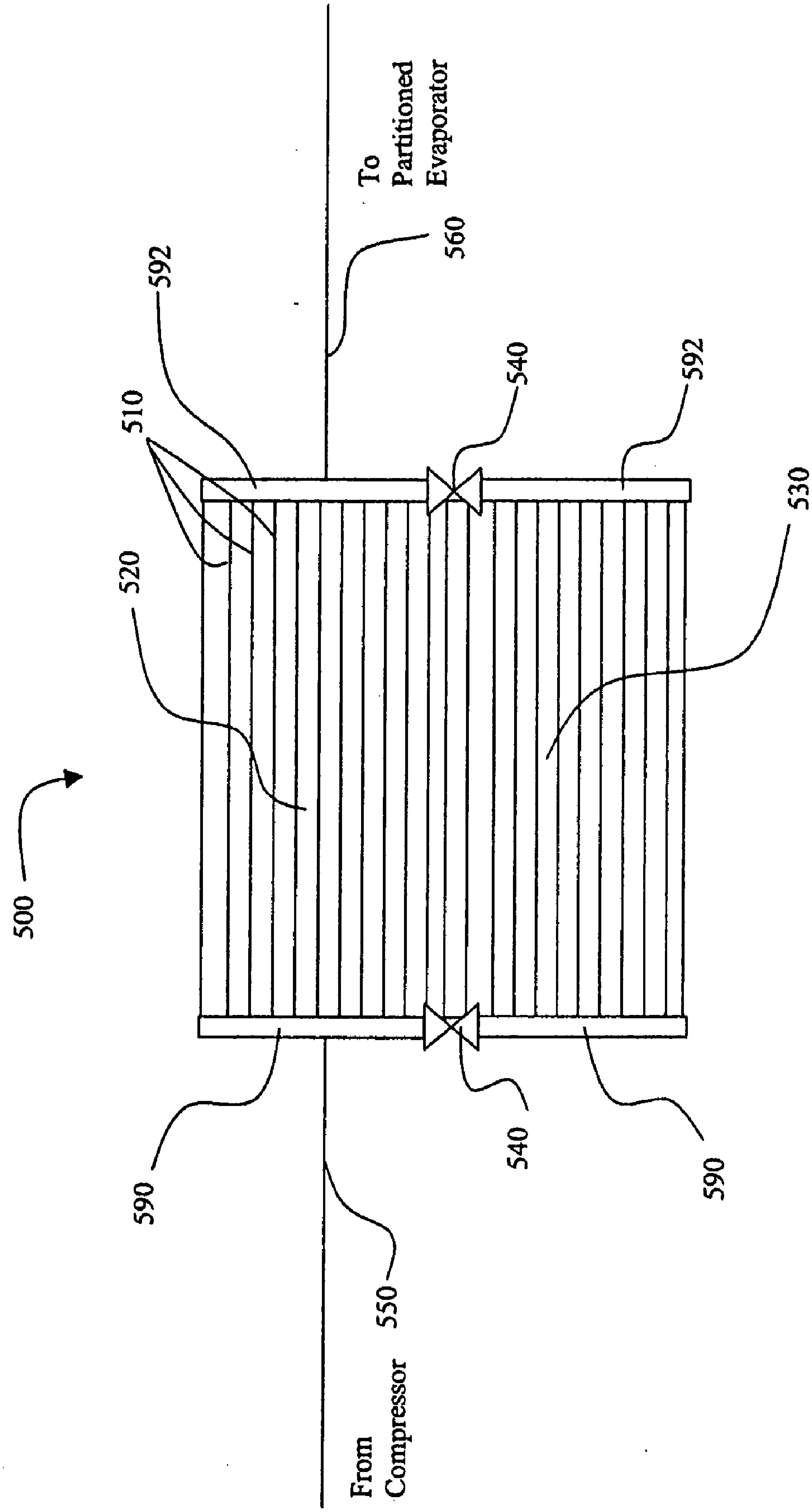

To
Partitioned
Evaporator
560
592
510
540
592
520
530
500
590
540
590
550
From
Compressor

Figure 5

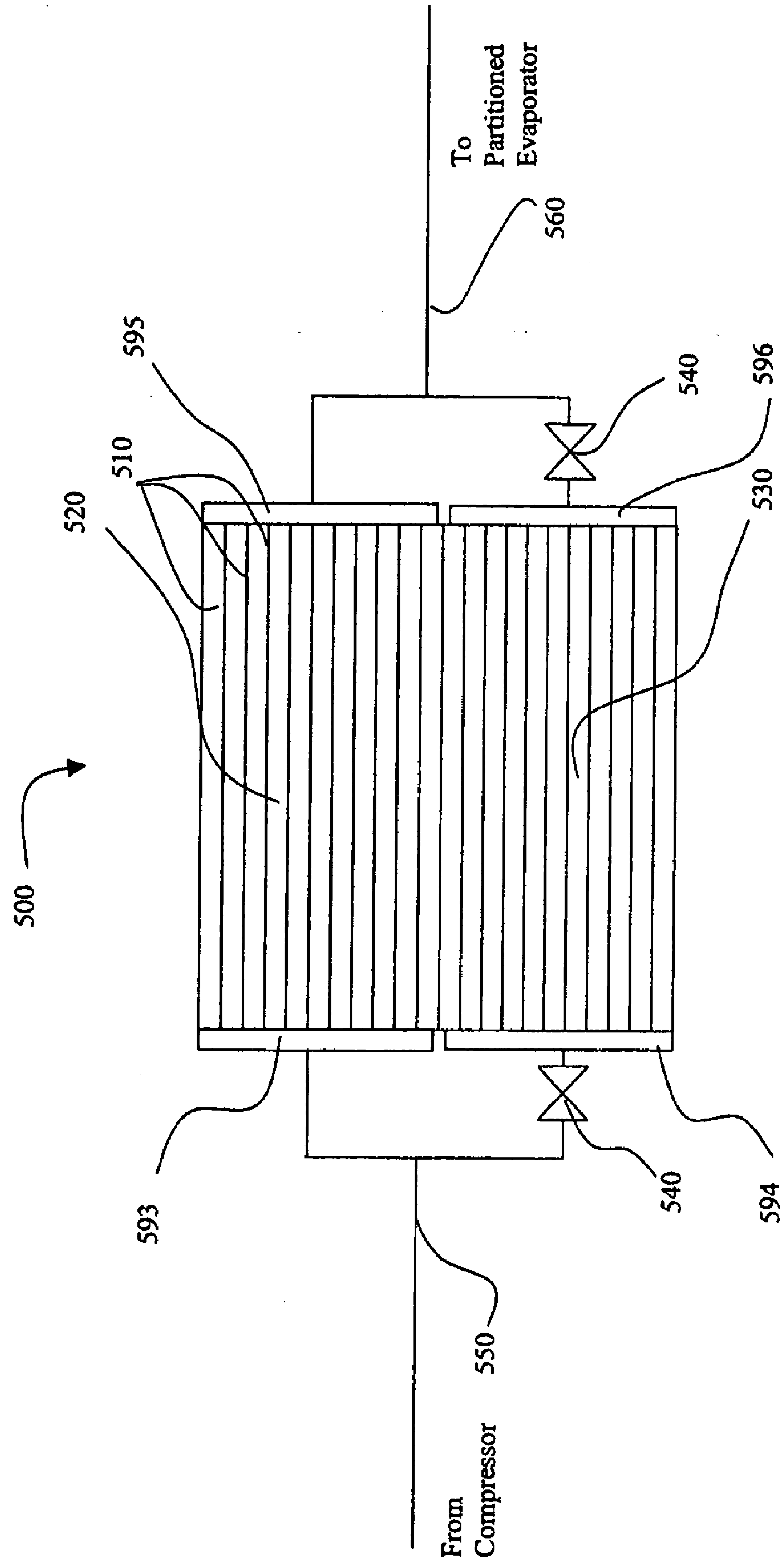

To
Partitioned
Evaporator
560
595
540
596
510
520
530
500
593
540
594
550
From
Compressor

Figure 6

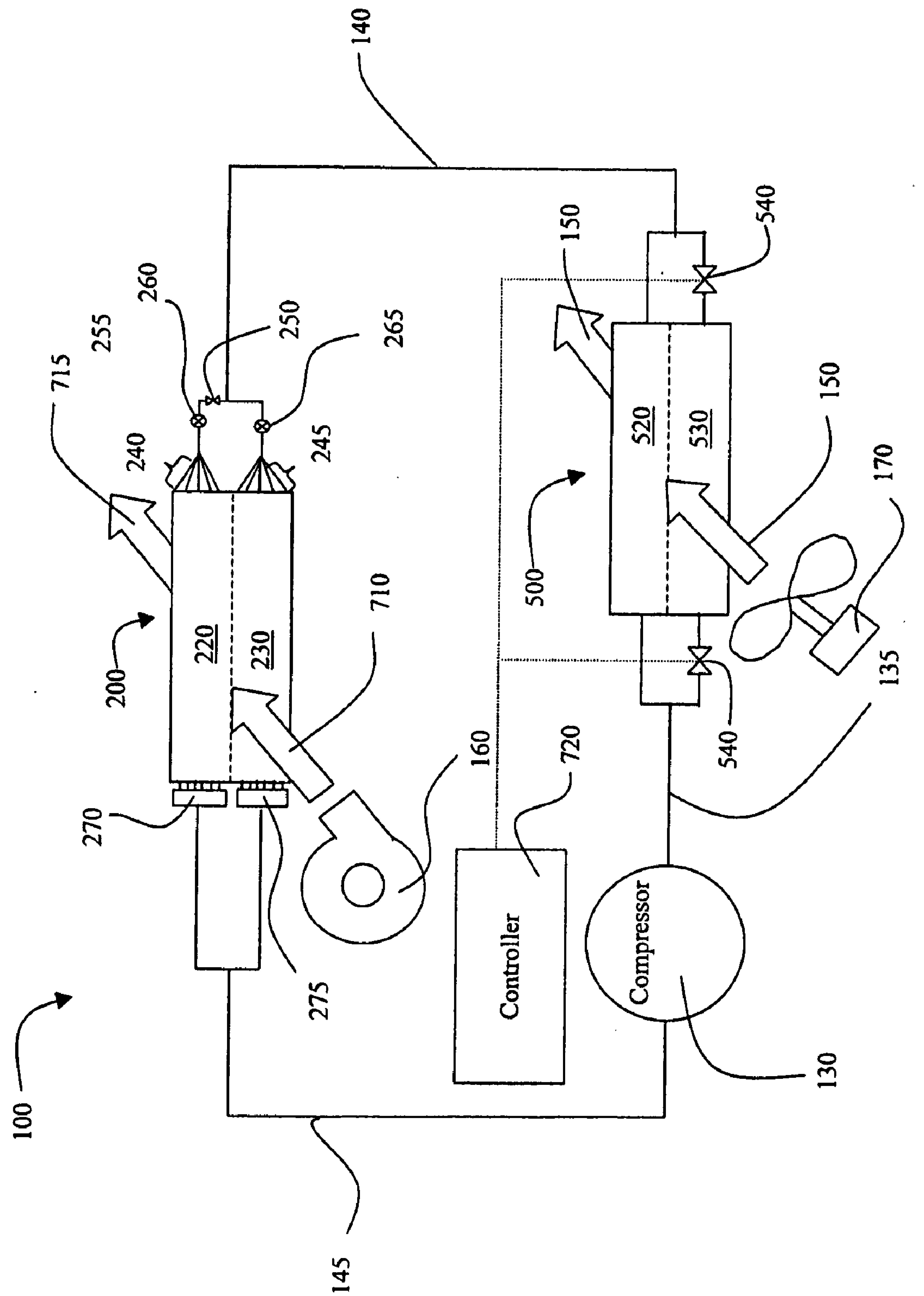

140
540
150
260
250
265
255
715
240
245
520
530
150
170
500
220
230
710
200
135
540
160
720
270
275
Controller
Compressor
100
130
145

Figure 7

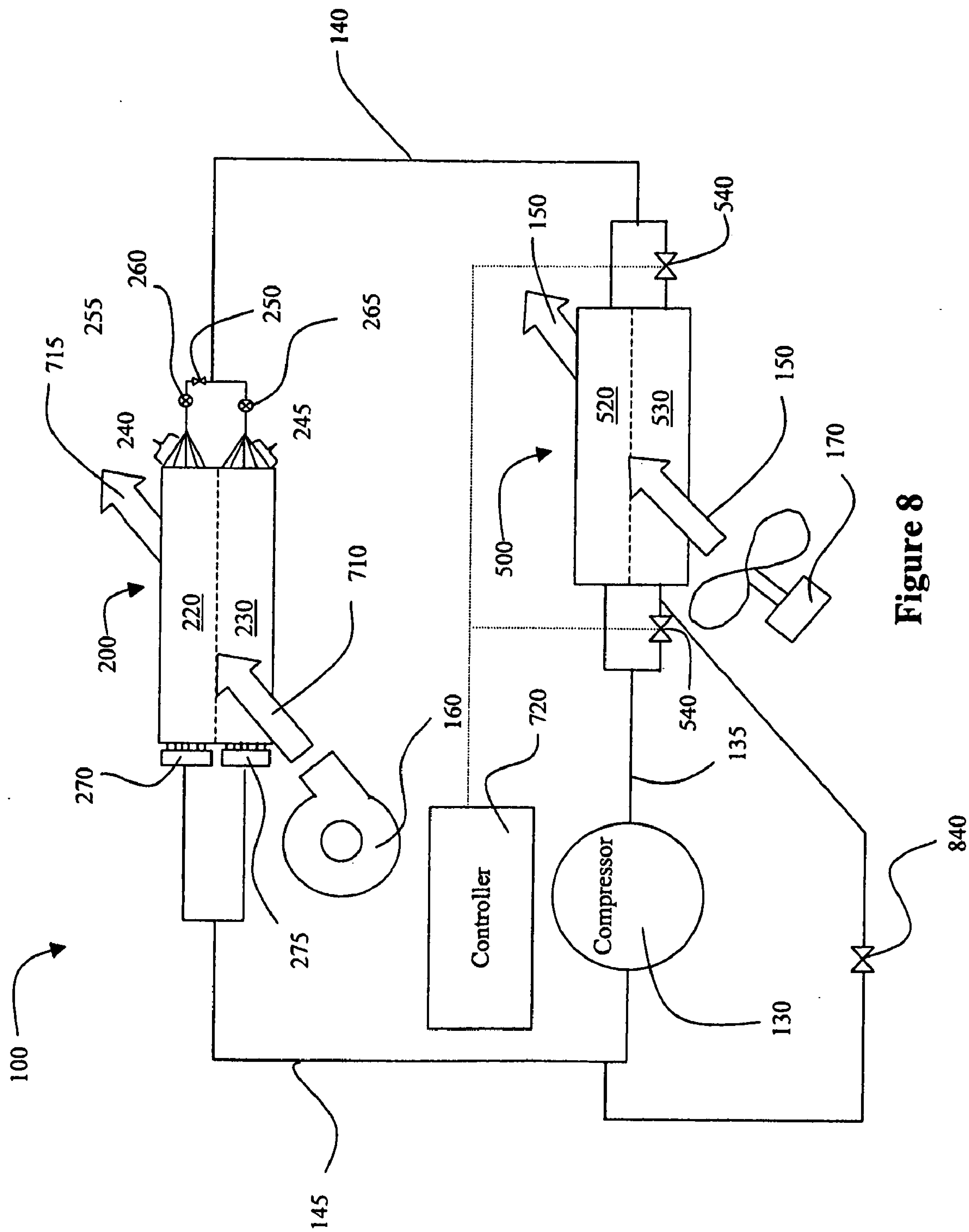
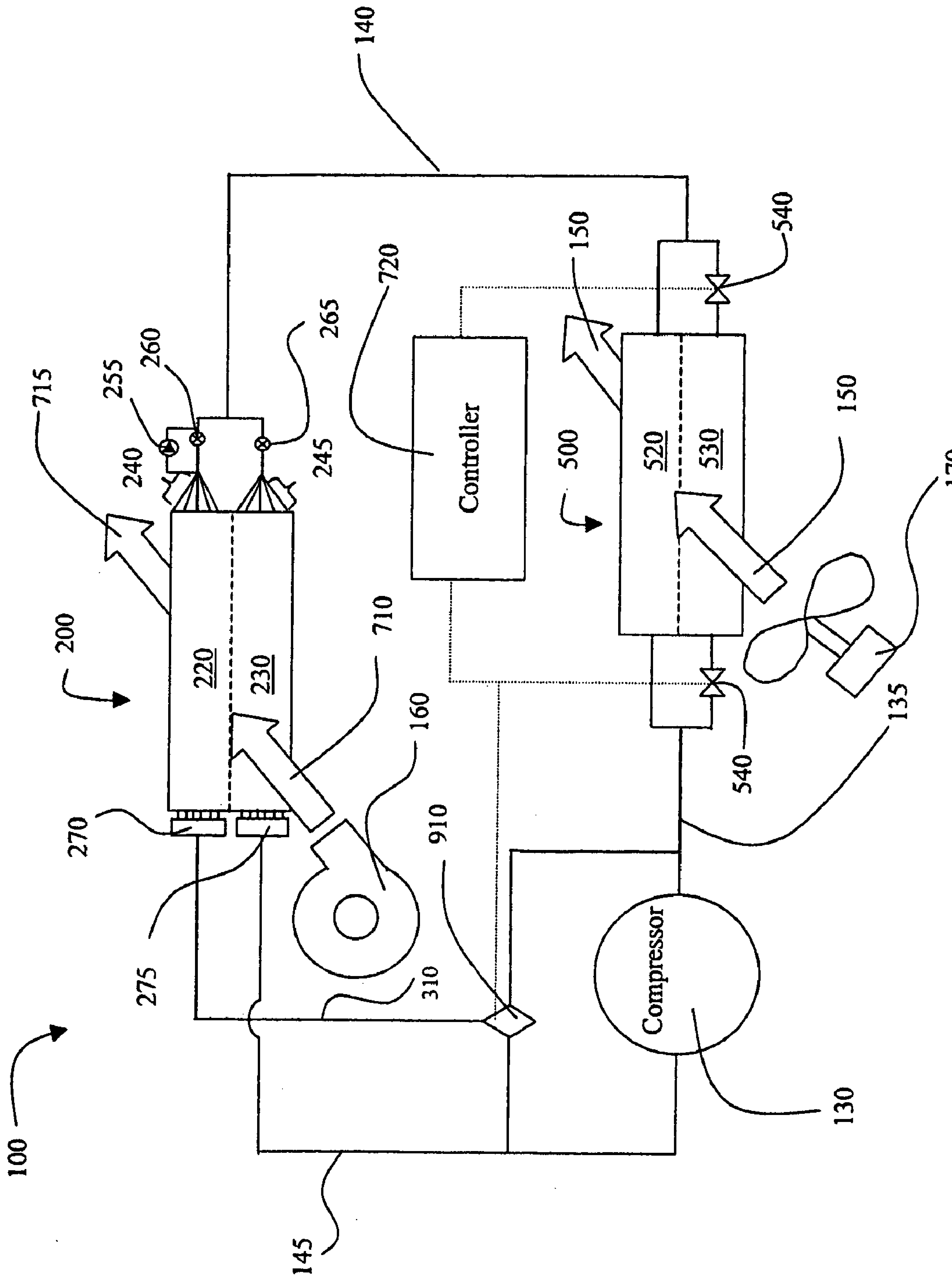

100
140
145
150
160
170
200
220
230
240
245
250
255
260
265
270
275
500
520
530
540
710
715
720
840
130
135
Controller
Compressor

Figure 8



Controller
Compressor
100
200
220
230
240
245
255
260
265
270
275
310
710
715
720
910
140
145
130
135
150
160
170
500
520
530
540

Figure 9

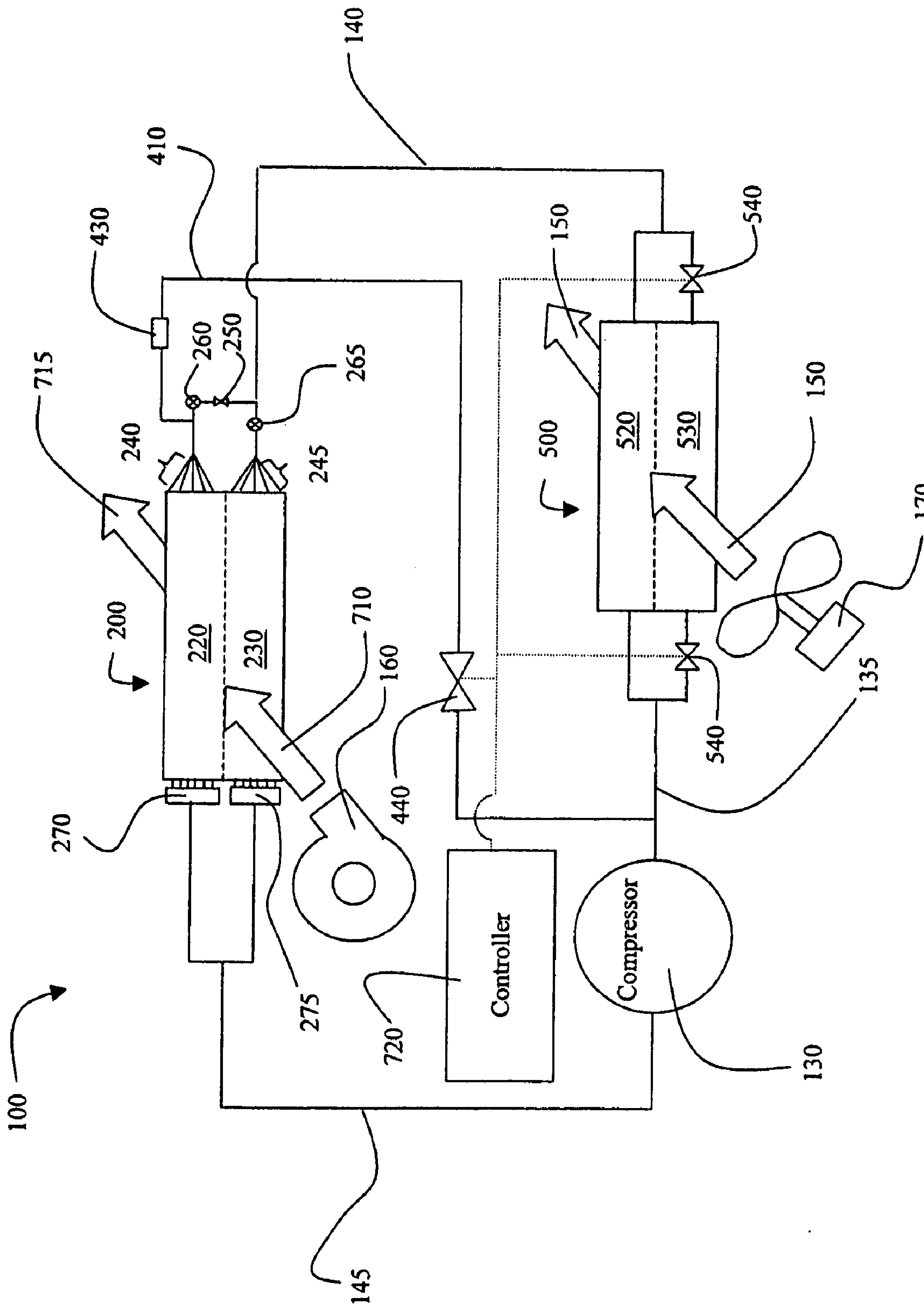

100
140
145
410
430
260
250
265
715
240
245
200
220
230
710
160
440
270
275
720
Controller
Compressor
130
135
500
520
530
150
150
540
540
170

Figure 10

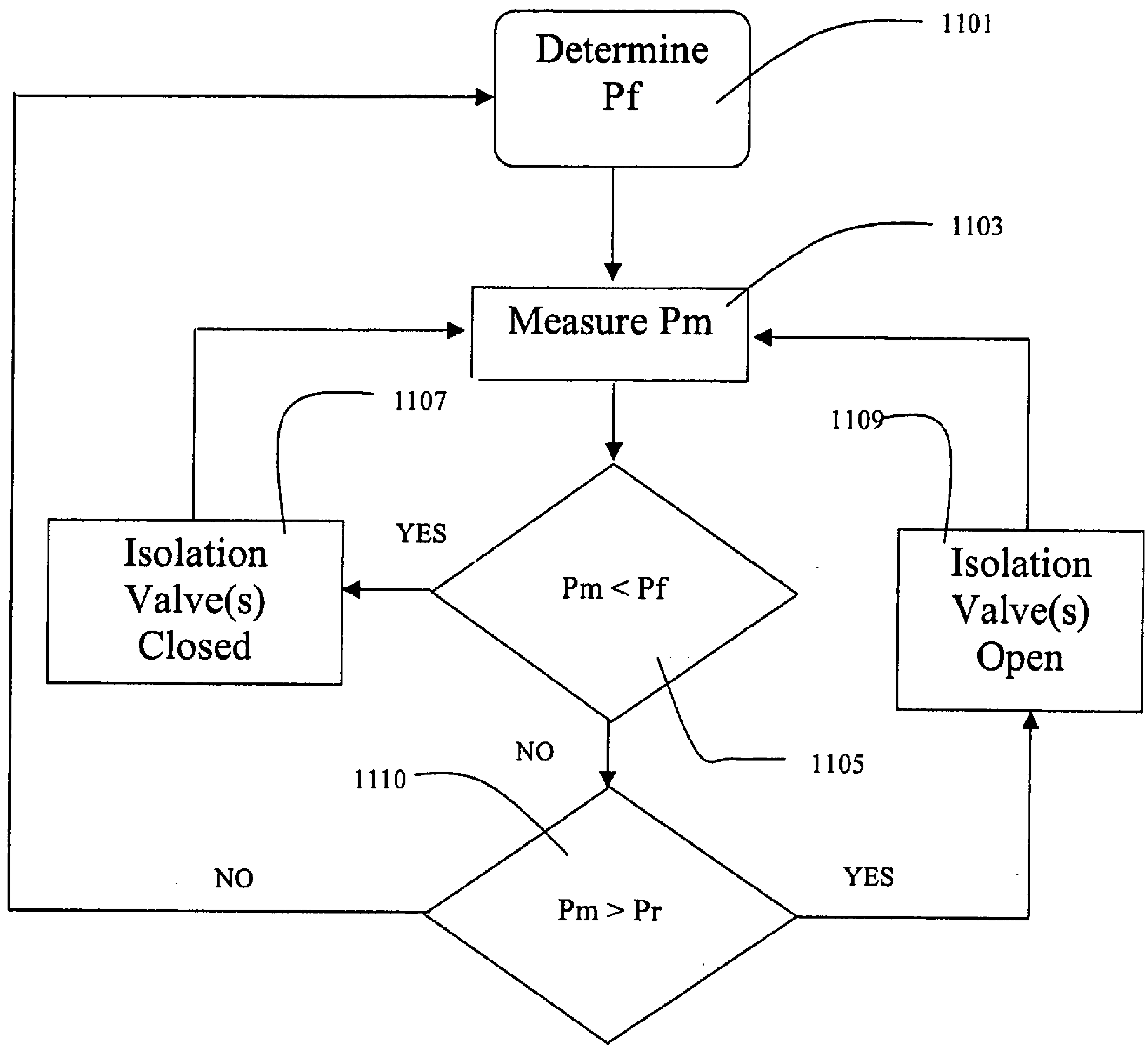

Determine Pf
1101
1103
Measure Pm
1107
1109
YES
Isolation Valve(s) Closed
Pm < Pf
Isolation Valve(s) Open
NO
1105
1110
NO
YES
Pm > Pr

Figure 11

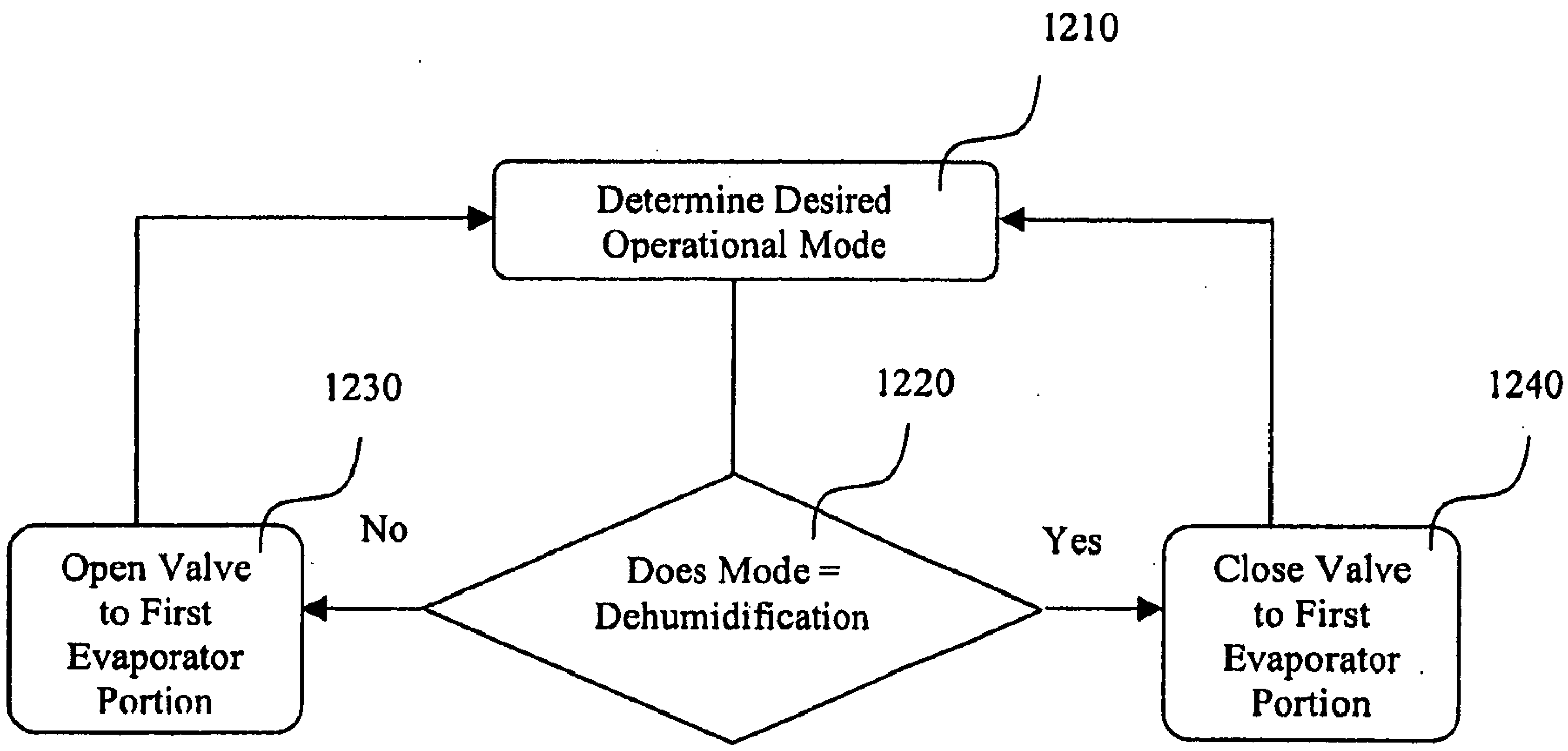

1210
Determine Desired Operational Mode
1230
1220
1240
No
Yes
Open Valve to First Evaporator Portion
Does Mode = Dehumidification
Close Valve to First Evaporator Portion

Figure 12

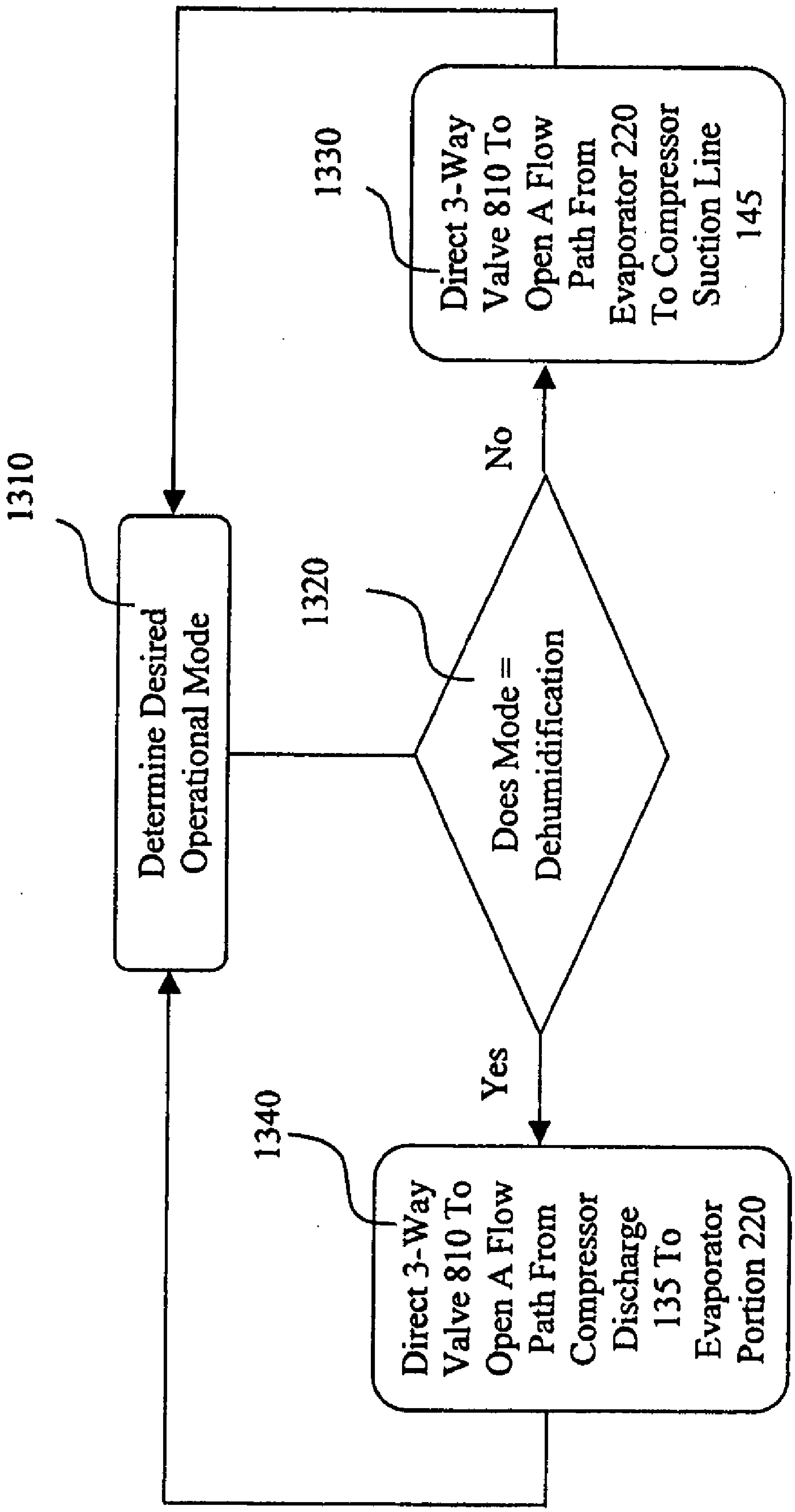

1310
Determine Desired Operational Mode
1320
Does Mode = Dehumidification
No
Yes
1330
Direct 3-Way Valve 810 To Open A Flow Path From Evaporator 220 To Compressor Suction Line 145
1340
Direct 3-Way Valve 810 To Open A Flow Path From Compressor Discharge 135 To Evaporator Portion 220

Figure 13

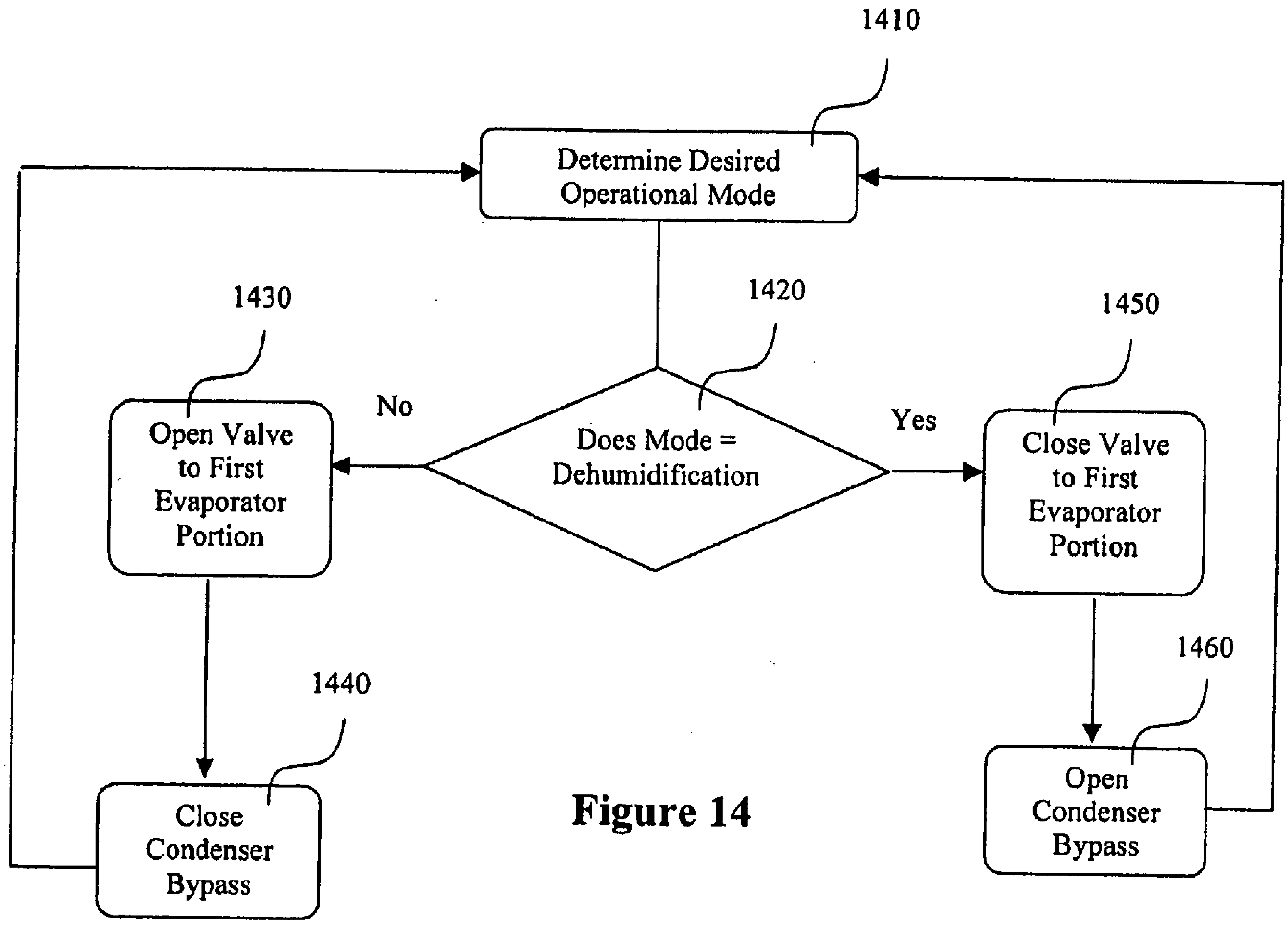

1410
Determine Desired Operational Mode
1420
Does Mode = Dehumidification
No
Yes
1430
Open Valve to First Evaporator Portion
1440
Close Condenser Bypass
1450
Close Valve to First Evaporator Portion
1460
Open Condenser Bypass

Figure 14

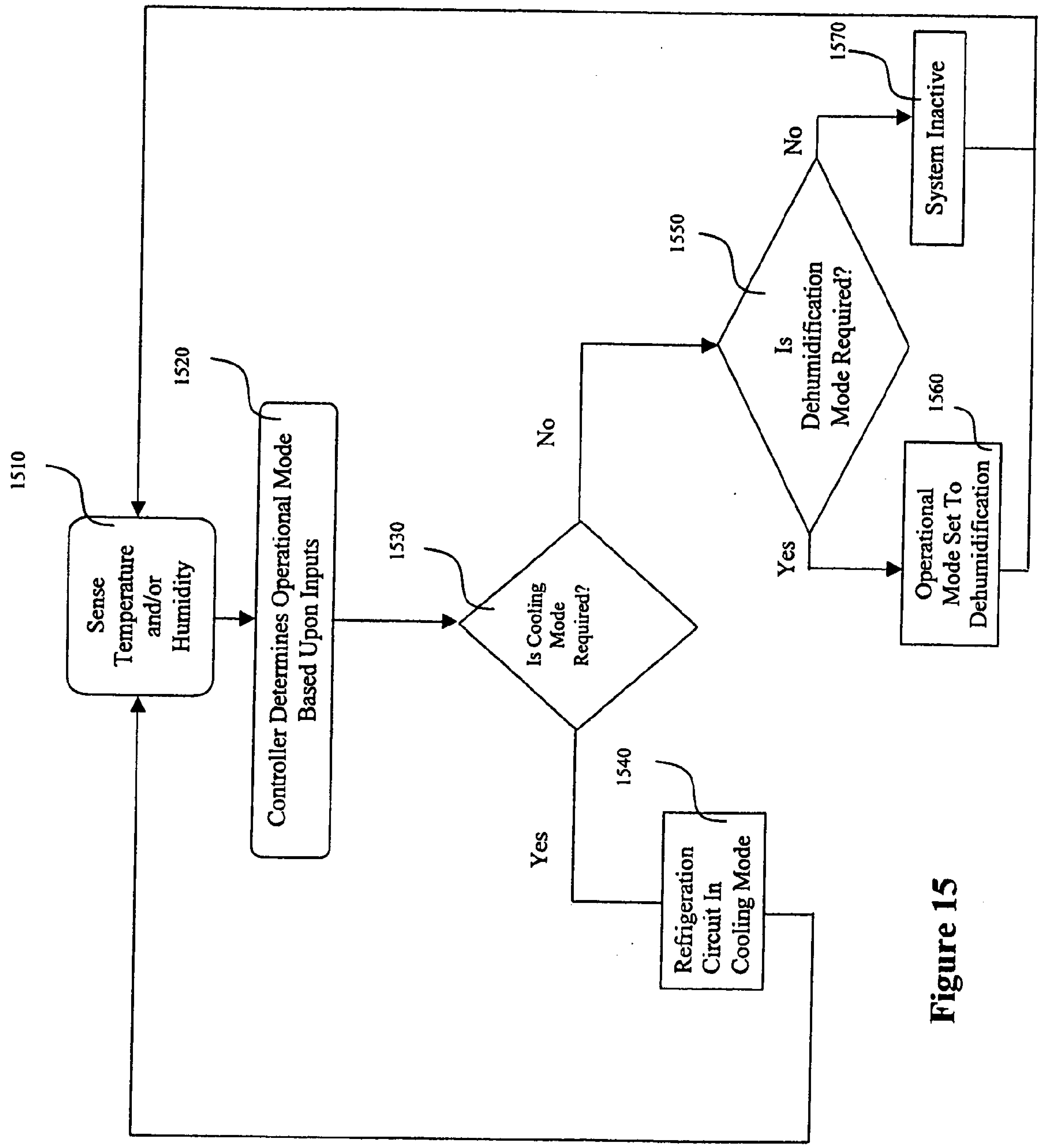

1510
Sense Temperature and/or Humidity
1520
Controller Determines Operational Mode Based Upon Inputs
1530
Is Cooling Mode Required?
Yes
No
1540
Refrigeration Circuit In Cooling Mode
1550
Is Dehumidification Mode Required?
Yes
No
1560
Operational Mode Set To Dehumidification
1570
System Inactive

Figure 15

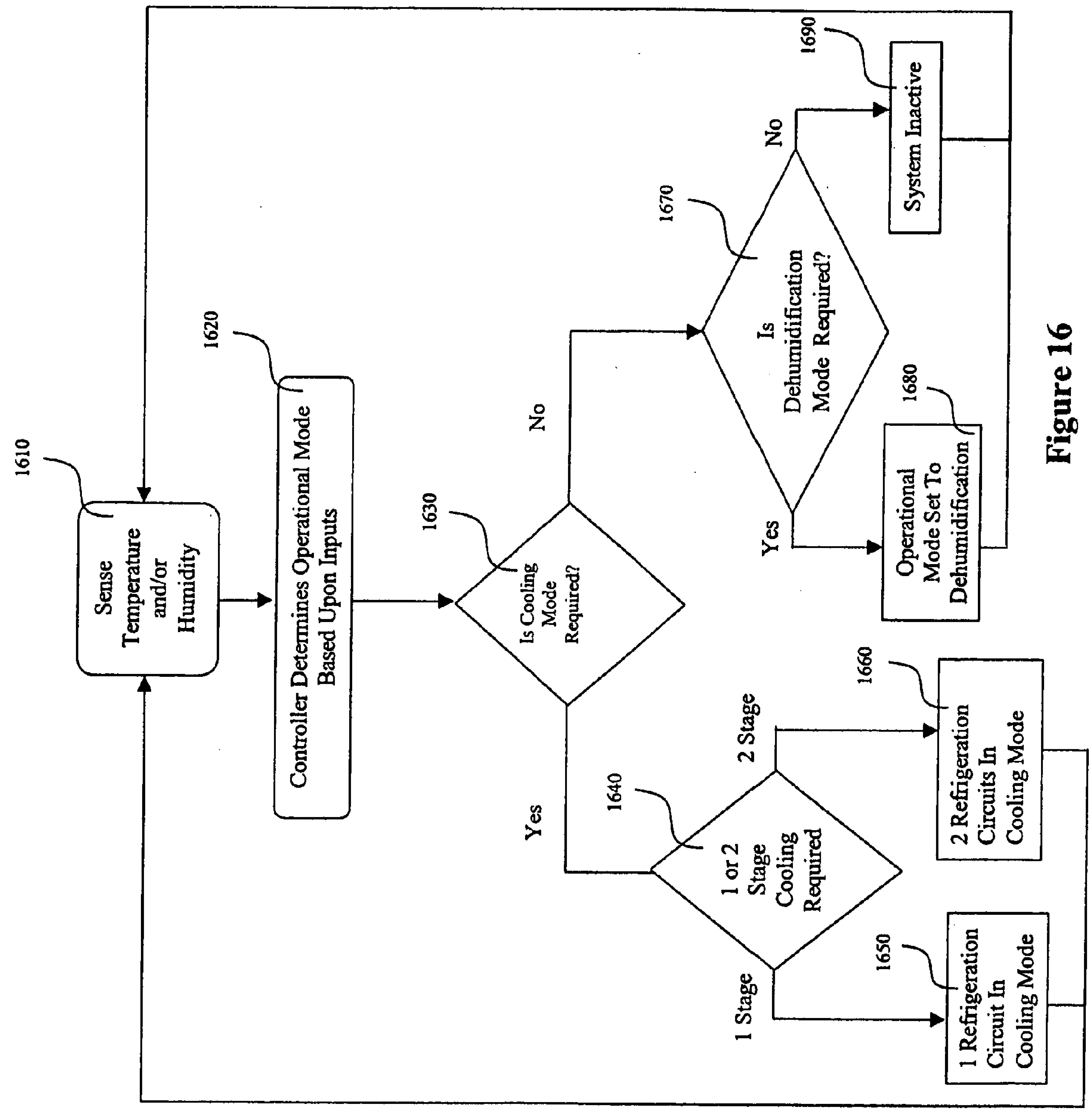

1610
Sense Temperature and/or Humidity
1620
Controller Determines Operational Mode Based Upon Inputs
1630
Is Cooling Mode Required?
Yes
No
1640
1 or 2 Stage Cooling Required
1 Stage
2 Stage
1650
1 Refrigeration Circuit In Cooling Mode
1660
2 Refrigeration Circuits In Cooling Mode
1670
Is Dehumidification Mode Required?
Yes
No
1680
Operational Mode Set To Dehumidification
1690
System Inactive

Figure 16

METHOD AND SYSTEM FOR DEHUMIDIFICATION AND REFRIGERANT PRESSURE CONTROL

FIELD OF THE INVENTION

[0001] The present invention relates generally to heating, ventilation and air conditioner systems (HVAC), including systems that can dehumidify air.

BACKGROUND OF THE INVENTION

[0002] An HVAC system generally includes a closed loop refrigeration system with at least one evaporator, at least one condenser and at least one compressor. As the refrigerant travels through the evaporator, it absorbs heat from a heat transfer fluid and changes from a liquid to a vapor phase. After exiting the evaporator, the refrigerant proceeds to a compressor, then a condenser, then an expansion valve, and back to the evaporator, repeating the loop. The heat transfer fluid to be cooled (e.g. air) passes through the evaporator in a separate fluid channel and is cooled by the evaporation of the refrigerant. The heat transfer fluid can then be sent to a distribution system for cooling the spaces to be conditioned, or it can be used for other refrigeration purposes.

[0003] Other refrigeration purposes may include dehumidification. Dehumidification of air in HVAC systems can occur through the use of the evaporator in the cooling mode. One drawback to using just an evaporator for dehumidification is an excess reduction in air temperature that results, which is commonly referred to as overcooling. Overcooling occurs when air that is subject to dehumidification is cooled to a temperature that is below the desired temperature of the air. Overcooling is a particular problem when dehumidification is required in a room that is already relatively cool and does not require additional cooling. Overcooling generally involves air temperatures of approximately 50° F. to 55° F. or lower.

[0004] The problem of overcooling has been addressed in one solution by utilization of a reheat coil in one solution. Air that is overcooled by the evaporator is passed over the reheat coil in order to increase the temperature of the overcooled, dehumidified air to a desired temperature. The reheat coil can be heated by diverting hot refrigerant through the reheat coil when dehumidification is required. Reheat may also be provided by alternate heat sources, such as electric heat or gas heat. The reheat coil system for providing heat to the dehumidified, overcooled air has several drawbacks including the requirement of additional equipment and/or piping and/or additional energy input.

[0005] Another dehumidification method known in the art is disclosed in U.S. Pat. No. 4,182,133 (the '133 patent). The '133 patent is directed to a dehumidification method that controls refrigerant flow through circuits within the indoor coil of an air conditioning/heat pump unit. The '133 patent system, when providing dehumidification, has a header that distributes the refrigerant across several circuits within the indoor coil. At the opposite end of the indoor coil, the outlets of the various circuits of the coil are allowed to flow into a single common vapor header. The header at the inlet of the indoor coil contains a solenoid valve that may be closed to prevent refrigerant flow to one or more of the circuits within the coil. The '133 patent system operates such that when humidity reaches a certain level, the valve in the inlet header is closed in order to limit the number of available circuits for refrigerant flow. The area of the indoor coil that remains in the active circuit and receives refrigerant flow, experiences an increase in refrigerant flow through a given heat transfer area. The increased flow of refrigerant results in a greater amount of moisture being removed from the air in that portion of the indoor coil. One drawback of the '133 patent system is that the dehumidified air is not reheated and may be overcooled. Another drawback of the '133 patent system is that the inlet header does not distribute flow across the circuits of the evaporator, leading to uneven phase distribution of refrigerant across the evaporator heat exchanger. Another drawback of the '133 patent system is that it is nearly impossible for a properly functioning system to deliver supply air that has not been sensibly cooled.

[0006] One type of HVAC system is a split system where there is an indoor unit or heat exchanger, which is generally the evaporator, and an outdoor unit or heat exchanger, which is generally the condenser. Often, the outdoor unit is placed outdoors and is subject to outdoor ambient conditions, particularly temperature. When the outdoor ambient temperature falls, the amount of heat being removed from the refrigerant in the condenser increases. The increased heat removal in the condenser can result in a decrease in the refrigerant pressure at the suction line to the compressor, commonly referred to as head pressure. The decrease in head pressure results in a lowering of the temperature of the refrigerant at the evaporator. When the temperature of the refrigerant at the evaporator becomes too low, icing of the evaporator can occur. Icing is a condition when the temperature at the exterior of the system is sufficiently low to freeze water present in the atmosphere. The ice formed by the water frozen on the surface reduces the available heat transfer surface and eventually prevents the proper operation of the HVAC system by inhibiting heat transfer and/or damaging system components.

[0007] Some attempts to address the problem of icing have utilized the control of system pressure. In one approach, a variable speed condenser fan or a plurality of condenser fans having independent controls are used to control airflow over the condenser coil. As the amount of air passing over the coil decreases, the amount of heat transfer taking place at the coil decreases. Therefore, the temperature of the refrigerant in the condenser and the pressure of the system increase to allow the indoor coil to cool the air without icing problems. The use of the variable speed condenser fan or a plurality of condenser fans having independent controls has the drawback that it is expensive and requires complicated wiring and controls.

[0008] An alternate approach for the problem of low system pressure or icing is a parallel set of condensers in the refrigerant cycle, as described in U.S. Pat. No. 3,631,686 (the '686 patent). In the '686 patent system a parallel set of refrigerant condensers allows for two modes of operation. One mode of operation allows refrigerant to flow from only one of the refrigerant condensers. During this mode of operation, the condenser that does not permit the flow of refrigerant fills with liquid refrigerant. Because of this flooding, there is a reduction in the effective surface area of the condenser. The reduced surface area thereby reduces the ability of the condenser to remove heat from the refrigerant. Therefore, the temperature of the refrigerant in the condenser and the head pressure of the system increase, allowing the indoor coil to cool the air without icing. The use of parallel refrigerant condensers has the drawback that it requires an additional condenser coil and additional piping, thereby increasing the space and cost required for installation. Another drawback associated with refrigerant flooding of the condenser coil is the resultant decrease in system capacity. Refrigerant normally available in a properly operating system is trapped in the condenser coil and not available to the compressor, thereby decreasing system capacity.

[0009] Therefore, what is needed is a method and system for dehumidification that dehumidifies air without overcooling, provides control of the refrigerant pressure and provides a system that can be retrofitted into existing systems without the drawbacks discussed above.

SUMMARY OF THE INVENTION

[0010] The present invention is directed to a method for dehumidification and controlling system pressure in a refrigeration system. The method comprises the step of providing a refrigeration system having a compressor, a condenser and an evaporator connected in a closed refrigerant loop. Each of the condenser and evaporator have a plurality of refrigerant circuits. A first heat transfer fluid is flowed over the condenser. A second heat transfer fluid is flowed over the evaporator. The flow of refrigerant is controlled in the refrigerant circuits in the condenser to control the amount of heat transfer between refrigerant in the condenser and the first heat transfer fluid. The flow of refrigerant is controlled in the refrigerant circuits in the evaporator to control an amount of heat transfer between refrigerant in the evaporator and the second heat transfer fluid. At least one of the refrigerant circuits of the condenser is isolated to provide a decreased amount of heat transfer area within the condenser and to increase the refrigerant pressure within the refrigeration system when the refrigerant pressure within the refrigeration system is at or below a predetermined pressure. At least one of the refrigerant circuits of the evaporator is isolated to dehumidify the second heat transfer fluid and maintain the temperature of the second heat transfer fluid at or above a predetermined temperature when dehumidification is required.

[0011] Another embodiment of the invention includes a method for dehumidification and controlling refrigerant pressure in a heating, ventilation and air conditioning system. The method comprises providing a closed loop refrigerant system comprising a compressor, a condenser and an evaporator. Each of the condenser and evaporator having a plurality of refrigerant circuits configured and disposed to allow isolation of at least one of the refrigerant circuits from refrigerant flow. Pressure is measured at a predetermined location in the refrigeration system. An operational mode is determined for the refrigeration cycle. The operational mode is selected from the group consisting of cooling and dehumidification. At least one of the refrigeration circuits in the condenser is isolated from refrigerant flow when the measured pressure at the predetermined location is equal to or less than a predetermined pressure. A first set of refrigerant circuits in the evaporator is isolated from flow of refrigerant from the condenser when the operational mode is dehumidification. Flow of refrigerant is permitted from the condenser to both the first and second set of refrigerant circuits in the evaporator when the operational mode is cooling. The refrigerant pressure is increased by isolation of at least one of the refrigerant circuits in the condenser from refrigerant flow until the measured pressure is greater than the predetermined pressure.

[0012] Another embodiment of the invention includes a heating, ventilation and air conditioning system. The system comprises a compressor, a condenser arrangement and an evaporator arrangement. The condenser arrangement comprises a plurality of circuits arranged into a first and second set of circuits, and a valve arrangement configured and disposed to isolate the first set of circuits of the condenser arrangement when the refrigerant pressure is below a predetermined pressure. The evaporator arrangement comprises a plurality of circuits arranged into a first and second set of circuits, at least one distributor configured to distribute and deliver refrigerant to each circuit of the plurality of circuits in the evaporator, and a valve arrangement configured and disposed to isolate the first set of circuits of the evaporator arrangement from refrigerant flow in a dehumidification operation of the HVAC system.

[0013] The present invention provides an inexpensive method and system to control head pressure, while also being capable of reheating dehumidified air. The method and system requires little or no additional piping in order to implement the method and system in an existing HVAC unit. The system requires less in materials and therefore costs less than systems having separate components, such as separate reheat coils.

[0014] Another advantage of the present invention is that the air conditioning or heat pump unit can operate at lower outdoor ambient temperatures by providing an increase in system pressure to avoid icing of the system components.

[0015] Another advantage of the present invention is that the system and method distributes refrigerant substantially uniformly across the evaporator to provide substantially uniform refrigerant phase distribution and heat exchange across the evaporator.

[0016] Another advantage of the present invention is that the system can reheat air and control head pressure without the need for a separate airflow system.

[0017] Another advantage of the system is that the simultaneous control of the head pressure of the system and reheating of the air during dehumidification permits the system to be operated in a manner that increases the efficiency and reliability of the system, while maintaining greater control of the temperature and humidity of the conditioned air.

[0018] Other features and advantages of the present invention will be apparent from the following more detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] **FIG. 1** schematically illustrates a refrigeration or HVAC system.

[0020] **FIG. 2** schematically illustrates one embodiment of an evaporator and piping arrangement of the present invention.

[0021] **FIG. 3** schematically illustrates another embodiment of an evaporator and piping arrangement of the present invention.

[0022] **FIG. 4** schematically illustrates further embodiment of an evaporator and piping arrangement of the present invention.

[0023] **FIG. 5** schematically illustrates one embodiment of a condenser and piping arrangement of the present invention.

[0024] **FIG. 6** schematically illustrates another embodiment of a condenser and piping arrangement of the present invention.

[0025] **FIG. 7** schematically illustrates one embodiment of a refrigeration or HVAC system according to the present invention.

[0026] **FIG. 8** schematically illustrates another embodiment of a refrigeration or HVAC system according to the present invention.

[0027] **FIG. 9** schematically illustrates a refrigeration or HVAC system of another embodiment of the present invention.

[0028] **FIG. 10** schematically illustrates a refrigeration or HVAC system of a further embodiment of the present invention.

[0029] **FIG. 11** illustrates a control method of the present invention.

[0030] **FIG. 12** illustrates a control method of another embodiment of the present invention.

[0031] **FIG. 13** illustrates a control method of a further embodiment of the present invention.

[0032] **FIG. 14** illustrates a control method of a further embodiment of the present invention.

[0033] **FIG. 15** illustrates a control method of a further embodiment of the present invention.

[0034] **FIG. 16** illustrates a control method of a further embodiment of the present invention.

[0035] Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

DETAILED DESCRIPTION OF THE INVENTION

[0036] **FIG. 1** illustrates a HVAC, refrigeration, or chiller system **100**. Refrigeration system **100** includes a compressor **130**, a condenser **120**, and an evaporator **110**. The compressor **130** compresses a refrigerant vapor and delivers it to the condenser **120** through compressor discharge line **135**. The compressor **130** is preferably a reciprocating or scroll compressor, however, any other suitable type of compressor can be used, for example, screw compressor, rotary compressor, and centrifugal compressor. The refrigerant vapor delivered by the compressor **130** to the condenser **120** enters into a heat exchange relationship with a first heat transfer fluid **150**, preferably air, and undergoes a phase change to a refrigerant liquid as a result of the heat exchange relationship with the first heat transfer fluid **150**. The first heat transfer fluid **150** is moved by use of a fan **170**, which moves the first heat transfer fluid **150** through the condenser **120** in a direction perpendicular the cross section of the condenser **120**. In a preferred embodiment, the refrigerant vapor delivered to the condenser **120** enters into a heat exchange relationship with air as the first heat transfer fluid **150**. The refrigerant leaves the condenser through the condenser discharge line **140** and is delivered to an evaporator **110** after passing through an expansion device (not shown). The evaporator **110** includes a heat-exchanger coil. The liquid refrigerant in the evaporator **110** enters into a heat exchange relationship with a second heat transfer fluid **155** to lower the temperature of the second heat transfer fluid **155**. The second heat transfer fluid **155**, preferably air, is moved by use of a blower **160**, which moves the second heat transfer fluid **155** through evaporator **110** in a direction perpendicular the cross section of the evaporator **110**. Although **FIG. 1** depicts the use of a blower **160** and fan **170**, any fluid moving means may be used to move fluid through the evaporator and condenser **120**. In a preferred embodiment, the refrigerant vapor delivered to the evaporator **110** enters into a heat exchange relationship with air as the second heat transfer fluid **155**. The refrigerant liquid in the evaporator **110** undergoes a phase change to a refrigerant vapor as a result of the heat exchange relationship with the second heat transfer fluid **155**. The vapor refrigerant in the evaporator **110** exits the evaporator **110** and returns to the compressor **130** through a suction line **145** to complete the cycle. The conventional refrigerant system **100** includes many other features that are not shown in **FIG. 1**. These features have been purposely omitted to simplify the figure for ease of illustration.

[0037] **FIG. 2** illustrates a partitioned evaporator **200** according to one embodiment of the present invention. The inlet of the partitioned evaporator **200** includes a condenser discharge line **140** from the partitioned condenser **500** (see **FIG. 7**), a first and second thermostatic expansion valve (TXV valve) **260** and **265**, an isolation valve **250**, and a first and second distributor **240** and **245**. Although **FIGS. 2-4** and **7-9** illustrate TXV valves, any suitable pressure reduction or expansion device may be used to control refrigerant flow, such as a fixed orifice. The first TXV valve **260** and the isolation valve **250** are positioned between condenser discharge line **140** and the first distributor **240**. The second TXV valve **265** is positioned between the condenser discharge line **140** and the second distributor **245**. The partitioned evaporator **200** includes refrigerant circuits **210**. Although refrigerant circuits **210** are shown as curved lines in **FIGS. 2-4**, the shape shown is merely schematic and any suitable configuration of refrigerant circuit **210** can be used. Refrigerant circuits **210** can include any configuration of device capable of transferring heat. An example of a suitable device includes a finned tube. The number of refrigerant circuits **210** may be any number of refrigerant circuits **210** that provide sufficient heat transfer to maintain operation of the partitioned evaporator **200** within the refrigeration system **100**. The partitioned evaporator **200** is preferably partitioned into a first and second evaporator portions **220** and **230**. The first and second evaporator portion **220** and **230** may be sized in any proportion. For example, the first evaporator portion **220** may be 60% of the size of the partitioned evaporator **200** and the second evaporator portion **230** may be 40% of the size of the partitioned evaporator **200** or the first evaporator portion **220** may be 40% of the size of the partitioned evaporator **200** and the second evaporator portion **230** may be 60% of the size of the partitioned evaporator **200** or the first and second evaporator portions **220** and **230** may each represent 50% of the size of the partitioned evaporator **200**.

[0038] Although **FIG. 2** shows the partitioned evaporator **200** as only including two portions, any number of portions may be used in the present invention. Where more than two evaporator portions are present, the flow may be regulated to each of the portions. For example, in the embodiment where the evaporator is split into three portions, two of the three portions include valve arrangements that allow independent isolation of each of these portions. One or both of the two portions with valve arrangements may be isolated, dependent on a signal from a controller and/or sensor. The outlet of the partitioned evaporator **200** includes first and second discharge headers **270** and **275**, first and second thermostatic expansion valve bulbs (TXV bulbs) **264** and **269**, and an evaporator discharge line **145** to the compressor **130**. The first discharge header **270** receives refrigerant from the refrigerant circuits **210** in the first evaporator portion **220**. The second discharge header **275** receives refrigerant from the refrigerant circuits **210** present in the second evaporator portion **230**. The first TXV bulb **264** is positioned between the first discharge header **270** and the evaporator discharge line **145**. The first TXV bulb **264** senses the temperature of the refrigerant leaving the first discharge header **270** and compares the temperature of the refrigerant to the temperature of the refrigerant at the first TXV valve **260** through line **262**. The flow of refrigerant through the first TXV valve **260** is increased as the temperature difference at the first TXV bulb **264** and the first TXV valve **260** increases. The flow of refrigerant through the first TXV valve **260** is decreased as the temperature difference at the first TXV bulb **264** and the first TXV valve **260** decreases. The second TXV valve **265** operates in the same manner with respect to the refrigerant discharge from the second discharge header **275** and communicates the temperature measurement to the second TXV valve **265** through line **267**. The isolation valve **250** allows the first evaporator portion **220** of the partitioned evaporator **200** to be isolated from flow of refrigerant. In one embodiment, to accommodate an increased flow of refrigerant to the second evaporator portion **230**, as discussed in detail below, the size of the second TXV valve **265** (i.e., the amount of flow permitted through the valve) is greater than the size of the first TXV valve **260**.

[0039] During operation of the refrigeration system **100** in cooling mode, refrigerant flows from the partitioned condenser **500** to the partitioned evaporator **200** through condenser discharge line **140**. The flow is split into two refrigerant flow paths prior to entering the partitioned evaporator **200**. Although **FIG. 2** shows two paths leading to the first and second distributors **240** and **245**, the refrigerant flow may be split into two or more paths. If the system is in a cooling only mode, isolation valve **250** is open and refrigerant is permitted to flow into both the first and second evaporator portions **220** and **230** of the partitioned evaporator **200**. The two refrigerant flow paths are further split by a first and second distributor **240** and **245** into a plurality of lines, corresponding to the individual refrigerant circuits **210**. The first and second distributors **240** and **245** may include any arrangement that distributes the refrigerant to the individual refrigerant circuits **210** within the partitioned evaporator **200**. The first and second distributors **240** and **245** can preferably distribute the refrigerant to provide uniform phase distribution across the refrigerant circuits **210** of the partitioned evaporator **200** and, thus, provide substantially uniform heat transfer. The first and second distributors **240** and **245** also may include combinations of distributor tubes and orifices to provide the uniform refrigerant flow. The refrigerant flows into the refrigerant circuits **210** of first and second evaporator portions **220** and **230**. The refrigerant circuits **210** permit the refrigerant to enter into a heat transfer relationship with the second heat transfer fluid **155** to cool the second heat transfer fluid **155**. Due to the heat transfer with the second heat transfer fluid **155**, the refrigerant entering the first and second discharge headers **270** and **275** has a higher temperature than the temperature of the refrigerant entering the partitioned evaporator **200**. The refrigerant then travels from the first and second discharge headers **270** and **275** past the first and second TXV bulbs **264** and **269**. The TXV bulbs **264** and **269** sense the temperature of the refrigerant leaving the partitioned evaporator **200** and communicate the temperature to the first and second TXV valves **260** and **265** in order to determine the appropriate refrigerant flow into the partitioned evaporator **200**. After traveling past the first and second TXV bulbs **264** and **269**, the refrigerant is delivered to the compressor **130** through evaporator discharge line **145**.

[0040] If the system shown in **FIG. 2** is operated in a dehumidification mode, isolation valve **250** is closed and refrigerant flow to the first evaporator portion **220** is prevented. The refrigerant flow in the second evaporator portion **230** occurs substantially as described above with respect to evaporator portion **220** in cooling mode. However, the flow of refrigerant to the first evaporator portion **220** is prevented. Since flow to the first evaporator portion **220** is prevented, the flow to the second evaporator portion **230** is increased. Due to the increased flow of the refrigerant through the second evaporator portion **230**, the amount of heat transfer per unit area is increased and the dehumidification per unit area is likewise increased. Therefore, when the second heat transfer fluid **155** is passed through the second evaporator portion **230** the second heat transfer fluid **155** is cooled and dehumidified, and the second heat transfer fluid **155** passing through the first evaporator portion **220** remains substantially unchanged in temperature and humidity from inlet to outlet. The second heat transfer fluid **155** passed through the second evaporator portion **230** is generally overcooled and the second heat transfer fluid **155** passed through the first evaporator portion **220** is about ambient temperature. The ambient second heat transfer fluid **155** that passes though the first evaporator portion **220** mixes with the second heat transfer fluid **155** passing through the second evaporator portion **230** and produces an outlet heat transfer fluid, preferably air, that is dehumidified and not overcooled. As shown in **FIG. 2**, the flow of the second heat transfer fluid **155** is substantially perpendicular to the cross-section of the evaporator. The direction of the flow is such that the heat transfer fluid **155** flows simultaneously through first evaporator portion **220** and second evaporator portion **230**. A single system for moving the second heat transfer fluid **155**, such as an air blower **160**, can be used to simultaneously move air through first evaporator portion **220** and second evaporator portion **230**.

[0041] **FIG. 3** illustrates a partitioned evaporator **200** according to another embodiment of the present invention. The inlet of the partitioned evaporator **200** includes substantially the same arrangement of components as **FIG. 2**, including a condenser discharge line **140** from the partitioned condenser **500**, first and second TXV valves **260** and **265**, and first and second distributors **240** and **245**. **FIG. 3** further includes check valve **255** that prevents flow of refrigerant into evaporator portion **220** and allows flow of refrigerant out of evaporator portion **220**. The partitioned evaporator **200** includes substantially the same arrangement of refrigerant circuits **210** as **FIG. 2**. The outlet of the partitioned evaporator **200** shown in **FIG. 3** includes the first and second discharge headers **270** and **275**, first and second TXV bulbs **264** and **269**, an evaporator discharge line **145** to the compressor **130** and a first discharge header discharge line **310** to a 3-way valve **910** (see **FIG. 8**). The first discharge header **270** receives refrigerant from the refrigerant circuits **210** present in the first evaporator portion **220**. The second discharge header **275** receives refrigerant from the circuits **210** present in the second evaporator portion **230**. The first TXV bulb **264** is positioned on the first discharge header discharge line **310**. The first TXV bulb **264** senses the temperature of the refrigerant leaving the first discharge header **270** and compares the temperature of the refrigerant to the temperature of the refrigerant at the first TXV valve **260** through line **262**. The flow of refrigerant through the first TXV valve **260** is increased as the temperature difference at the first TXV bulb **264** and the first TXV valve **260** increases. The flow of refrigerant through the first TXV valve **260** is decreased as the temperature difference at the first TXV bulb **264** and the first TXV valve **260** decreases. The second TXV valve **265** operates in the same manner with respect to the refrigerant discharge from the second discharge header **275** and communicates the temperature measurement to the second TXV valve **265** through line **267**. The use of independent first and second TXV valves **260** and **265** allows independent control of the flow through each of the portions of the partitioned evaporator **200**.

[0042] During operation in cooling mode, **FIG. 3**, like in the system shown in **FIG. 2**, refrigerant flows from the partitioned condenser **500** into the partitioned evaporator **200** through condenser discharge line **140**, through the valve arrangement, including the first and second TXV valves **260** and **265**, and into the first and second distributors **240** and **245**. The refrigerant circuits **210** permit the refrigerant to enter into a heat transfer relationship with the second heat transfer fluid **155** that flows through the circuits perpendicular to the cross-section shown in **FIG. 3**. Due to the heat transfer with the second heat transfer fluid **155**, the refrigerant entering the first and second discharge headers **270** and **275** has a higher temperature than the temperature of the refrigerant entering the partitioned evaporator **200**. The refrigerant flow through discharge line **310** from the first discharge header **270** travels past the first TXV bulb **264** and travels to a 3-way valve **910**, discussed in greater detail below. The refrigerant flow through evaporator discharge line **145** from the second discharge header **275** travels past the second TXV bulb **269** to the compressor **130**.

[0043] During dehumidification mode, refrigerant flow in the first evaporator portion **220** is received from the 3-way valve **910** through the discharge line **310**, as discussed in greater detail below. The flow from the 3-way valve **910** is hot refrigerant gas taken from the compressor discharge. The flow from the 3-way valve **910** travels through the discharge line **310** in the direction of the first discharge header **270**. From the first discharge header **270**, the hot refrigerant gas enters the first evaporator portion **220** and travels through circuits **210** to the first distributor **240**. The refrigerant in refrigerant circuits **210** of the first evaporator portion **220** can heat the second heat transfer fluid **155** as the fluid passes over the refrigerant circuits **210**. The hot refrigerant gas is at least partially condensed to a liquid in the first evaporator portion **220**. The refrigerant, which is at least partially condensed to a liquid, then bypasses the TXV valve **260** by traveling through check valve **255**. The flow through check valve **255** combines with the condenser discharge line **140** and enters the second evaporator portion **230** through the second distributor **245**. Due to the increased flow of the refrigerant through the second evaporator portion **230**, the amount of heat transfer per unit area is increased and the dehumidification per unit area is likewise increased. Simultaneously, hot gas refrigerant entering the first evaporator portion **220** of the partitioned evaporator **200** provides an increase in the temperature of the first evaporator portion **220** due to the at least partial condensing of the hot gas. Therefore, the second heat transfer fluid **155** passing through the second evaporator portion **230** is cooled and dehumidified, while the second heat transfer fluid **155** passing through the first evaporator portion **220** is heated by the hot gas refrigerant from the compressor discharge. This second heat transfer fluid **155** simultaneously is circulated through first and second evaporator portions **220** and **230** by a fluid moving system, such as an air blower **160**, when the second heat transfer fluid **155** is air. The warmer second heat transfer fluid **155** that passes though the first evaporator portion **220** mixes with the second heat transfer fluid **155** passing through the second evaporator portion **230** and produces an outlet heat transfer fluid, preferably air, that is dehumidified and not overcooled.

[0044] **FIG. 4** illustrates a partitioned evaporator **200** according to a further embodiment of the present invention. The inlet of the partitioned evaporator **200** includes a condenser discharge line **140** from the partitioned condenser **500**, a bypass line **410** (see **FIG. 9**) from the discharge of the compressor **130**, first and second TXV valves **260** and **265**, isolation valve **250**, and first and second distributors **240** and **245**. The first TXV valve **260** and the isolation valve **250** are positioned between condenser discharge line **140** and the first distributor **240**. The bypass line **410** connects to the line between the first TXV valve **260** and the first distributor **240**. Bypass line **410** is from the discharge of the compressor **130** and includes a flow restriction valve **430** and a bypass valve **440**. While **FIG. 4** shows both a flow restriction valve **430** and a bypass valve **440**, either one or both of valves **430** and **440** may be present. The isolation valve **250** is positioned between the condenser discharge line **140** and the first TXV valve **260**. The second TXV valve **265** is positioned between the condenser discharge line **140** and the second distributor **245**. The partitioned evaporator **200** includes substantially the same arrangement of refrigerant circuits **210** as shown in **FIG. 2**. The outlet of the partitioned evaporator **200** includes first and second discharge headers **270** and **275**, first and second TXV bulbs **264** and **269**, and evaporator discharge line **145** to the compressor **130**. The first discharge header **270** receives refrigerant from the refrigerant circuits **210** present in the first evaporator portion **220**. The second discharge header **275** receives refrigerant from the refrigerant circuits **210** present in the second evaporator portion **230**. The first TXV bulb **264** is positioned between the first discharge header **270** and the evaporator discharge line **145**.

The first TXV bulb **264** senses the temperature of the refrigerant leaving the first discharge header **270** and compares the temperature of the refrigerant to the temperature of the refrigerant at the first TXV valve **260** through line **262**. The flow of refrigerant through the first TXV valve **260** is increased as the temperature difference at the first TXV bulb **264** and the first TXV valve **260** increases. The flow of refrigerant through the first TXV valve **260** is decreased as the temperature difference at the first TXV bulb **264** and the first TXV valve **260** decreases. The second TXV valve **265** operates in the same manner with respect to the refrigerant discharge from the second discharge header **275** and communicates the temperature measurement to the second TXV valve **265** through line **267**. The isolation valve **250** allows the first evaporator portion **220** of the partitioned evaporator **200** to be isolated from flow of refrigerant. In one embodiment, to accommodate the increased flow of refrigerant to the second evaporator portion **230**, the size of the second TXV valve **265** (i.e., the amount of flow permitted through the valve) is greater than the size of the first TXV valve **260**.

[**0045**] During operation in cooling mode, **FIG. 4**, like in the system shown in **FIG. 2**, refrigerant flows from the partitioned condenser **500** into the refrigerant circuits **210** of the partitioned evaporator **200** through the condenser discharge line **140**, through the valve arrangement, including the first and second TXV valves **260** and **265**, and the isolation valve **250**, and into the first and second distributors **240** and **245**. In cooling mode, substantially no flow of refrigerant takes place into or out of the bypass line **410** because the bypass valve **440** is closed. The operation of the refrigerant circuits **210** and the outlet of the partitioned evaporator **200**, including the first and second headers **270** and **275**, the first and second TXV bulbs **264** and **269** and the evaporator discharge line **145** to the compressor is substantially similar to the operation described above with respect to **FIG. 2**.

[**0046**] However, if the system shown in **FIG. 4** is in dehumidification mode, isolation valve **250** is closed and refrigerant flow to the first TXV valve **260** is prevented. Refrigerant flow from the discharge of the compressor **130** through bypass line **410** flows into the first distributor **240** and into the first evaporator portion **220**. The hot gas refrigerant entering the first evaporator portion **220** of the partitioned evaporator **200** provides an increase in the temperature of the first evaporator portion **220**. Due to the increased flow of the refrigerant through the second evaporator portion **230** by closing isolation valve **250**, the amount of heat transfer per unit area is increased and the dehumidification per unit area is likewise increased. Therefore, the second heat transfer fluid **155** passing through the second evaporator portion **230** is cooled and dehumidified, while the second heat transfer fluid **155** passing through the first evaporator portion **220** is warmed by the hot gas refrigerant from the compressor discharge. The second heat transfer fluid **155** simultaneously is circulated through first and second evaporator portions **220** and **230** by a fluid moving system, such as a blower **160**. The warmer second heat transfer fluid **155** that passes though the first evaporator portion **220** mixes with the second heat transfer fluid **155** passing through the second evaporator portion **230** and produces an outlet heat transfer fluid, preferably air, that is dehumidified and not overcooled.

[**0047**] Although the partitioned evaporator **200** has been illustrated as containing two evaporator portions **220** and **230**, the partitioned evaporator **200** is not limited to two portions. Any number of portions may be used, so long as one or more of the portions includes valving to isolate the respective portion from refrigerant flow.

[**0048**] In another embodiment, refrigerant circuits **210** may also be isolated individually within the first and/or second distributor. The refrigerant circuits **210** may be isolated with flow blocking means or flow restriction means on first and second distributors **240** and **245**. In this embodiment, a controller is used to determine the number of circuits isolated. The number of refrigerant circuits **210** isolated relates to the amount of cooling and/or heating of dehumidified air required and may be adjusted by the controller.

[**0049**] **FIG. 5** illustrates a partitioned condenser **500** according to one embodiment of the invention. Partitioned condenser **500** includes a plurality of heat transfer circuits **510**. The heat transfer circuits **510** are preferably partitioned into a first condenser portion **520** and a second condenser portion **530**. Although heat transfer circuits **510** in the partitioned condenser **500** are shown as lines in **FIGS. 5-6**, the shape shown is merely schematic. Heat transfer circuits **510** are preferably of any suitable configuration capable of transferring heat. An example of a suitable device includes a finned tube. The first and second condenser portions **520** and **530** may be sized in any proportion. For example, the first condenser portion **520** may be 60% of the size of the partitioned condenser **500** and the second condenser portion **530** may be 40% of the size of the partitioned condenser **500** or the first condenser portion **520** may be 40% of the size of the partitioned condenser **500** and the second condenser portion **530** may be 60% of the size of the partitioned condenser **500** or the first and second condenser portions **520** and **530** may each represent 50% of the size of the partitioned condenser **500**. When the first and second condenser portions **520** and **530** are different sizes, e.g., 60%/40% split, the refrigerant flow may be directed in any manner that provides efficient condenser **500** operation. For example, the first condenser portion **520** may constitute 60% of the size of the partitioned condenser **500** and the second condenser portion **530** may constitute 40% of the partitioned condenser **500**. When desirable, the flow may be directed to either the 60% portion or the 40% portion and the designation of the first and second condenser portions **520** and **530** may be alternated to the isolated portion that provides the desired condenser **500** operation.

[**0050**] Inlet flow **550** includes vaporous refrigerant from the compressor **130**. Inlet flow **550** enters the partitioned condenser **500** and travels through the heat transfer circuits **510**, where the heat transfer circuits **510** can enter into a heat exchange relationship with a heat transfer fluid such as air. The partitioned condenser **500** preferably has two condenser portions; however, the present invention is not limited to two condenser portions. The present invention may include more than two condenser portions. Where more than two condenser portions are present, the flow may be regulated to each of the portions. For example, in an embodiment where the condenser is split into three portions, two of the three portions include valve arrangements that allow independent isolation of each of these portions. One or both of the two portions with valve arrangements may be isolated, dependent on a signal from a controller and/or sensor. In **FIG. 5**, isolation valves **540** are positioned in the vapor header **590** and liquid header **592** of the partitioned condenser **500**. When isolation valves **540** are closed, the refrigerant is prevented from flowing into the second condenser portion **530**. When isolation valves **540** are open, refrigerant is permitted to flow to both the first condenser portion **520** and the second condenser portion **530**. The outlet flow **560** leaving the partitioned condenser **500** comprises liquid refrigerant resulting from the heat exchange relationship with the heat transfer fluid and the resultant phase change. The outlet flow **560** is then circulated to the partitioned evaporator **200**.

[0051] **FIG. 6** illustrates a partitioned condenser **500** according to an alternate embodiment of the invention. Partitioned condenser **500** includes a plurality of heat transfer circuits **510**. The heat transfer circuits **510** are partitioned into a first condenser portion **520** and a second condenser portion **530**. Although **FIG. 6** shows two condenser portions, the present invention is not limited to two condenser portions. The present invention may include more than two condenser portions. Inlet flow **550** is vaporous refrigerant from the compressor **130** that is split into two refrigerant streams. The two refrigerant streams enter the partitioned condenser **500** through two vapor headers **593** and **594** and travel into the heat transfer circuits **510**. Heat transfer circuits **510** can enter into a heat exchange relationship with a heat transfer fluid such as air. The two refrigerant streams then exit the partitioned condenser **500** through two liquid headers **595** and **596**. Isolation valves **540** are positioned on the piping to the vapor header **594** and on the piping from the liquid header **596** of the partitioned condenser **500**. When isolation valves **540** are closed, the refrigerant is prevented from flowing into the second condenser portion **530**. When isolation valves **540** are open, refrigerant is permitted to flow to both the first condenser portion **520** and the second condenser portion **530**. The outlet flow **560** leaving the partitioned condenser **500** includes liquid refrigerant that is circulated to the partitioned evaporator **200**.

[0052] The system for controlling the refrigerant pressure of an air conditioning or heat pump unit according to the present invention includes an HVAC unit that can operate at lower ambient temperatures. The present invention involves a piping arrangement that partitions the circuits within the condenser of a refrigeration system. The piping arrangement includes valves positioned so that one or more of the circuits within the condenser may be isolated from flow of refrigerant. The piping arrangement may be applied to a new system or may be applied to an existing system. Applying the piping arrangement to the existing system has the advantage that it allows control of the refrigerant pressure without the addition of expensive piping, equipment and/or controls.

[0053] When the temperature around the partitioned condenser **500** decreases (e.g., when the outdoor temperature decreases), the system refrigerant pressure also decreases. To help increase refrigerant head pressure, the present invention uses the valves connected to the refrigerant circuits **510** of the partitioned condenser **500** to isolate a portion of the partitioned condenser **500** from flow of refrigerant. The portion of the partitioned condenser **500** that is not isolated remains in the active circuit and receives refrigerant. Because the refrigerant is only permitted to flow into a portion of the partitioned condenser **500**, the heat transfer area and the corresponding amount of heat transfer is reduced. Therefore, less heat is removed from the refrigerant. Likewise, less heat is transferred to the first heat transfer fluid **150**, thereby maintaining a higher refrigerant temperature. Additionally, because the temperature of the refrigerant is higher, the corresponding pressure of the refrigerant is also higher. Therefore, the refrigerant pressure of the system is increased.

[0054] The piping arrangement of the partitioned condenser **500** of the present invention includes piping sufficient to isolate the one or more heat transfer circuits **510** within the condenser. In one embodiment, the isolation valves **540** are positioned inside the vapor header **590** of the partitioned condenser **500**. In an alternate embodiment, the isolation valves **540** are positioned on piping upstream from the vapor headers **594** of the partitioned condenser **500**.

[0055] The lack of additional piping for both the partitioned evaporator **200** and the partitioned condenser **500** also allows retrofitting of the system of the present invention into existing systems. Because the system utilizes the same components as existing systems, the system takes up approximately the same volume as existing HVAC systems. Therefore, the method and system of the present invention may be used in existing systems whose piping is arranged according to the present invention.

[0056] **FIG. 7** shows a refrigeration system **100** incorporating a partitioned evaporator **200** and a partitioned condenser **500** according to the present invention. **FIG. 7** shows the refrigeration system **100**, including evaporator discharge line **145**, blower **160**, compressor **130**, compressor discharge line **135**, partitioned condenser **500**, fan **170**, condenser discharge line **140**, and first heat transfer fluid **150**, substantially as described above in the description of **FIG. 1**. **FIG. 7** also shows the partitioned evaporator **200**, including first and second TXV valves **260** and **265**, isolation valve **250**, check valve **255**, first and second distributors **240** and **245**, first and second discharge headers **270** and **275**, arranged as discussed above in the description of **FIG. 2**. For illustration purposes, **FIGS. 7-10** divides second heat transfer fluid **155** flow into an inlet flow **710** and an outlet flow **715**. The inlet flow **710**, preferably air, flows into the partitioned evaporator **200** substantially evenly across the first and second evaporator portions **220** and **230**. Blower **160** moves inlet flow **710**. Although **FIG. 7** depicts a blower, any fluid moving means is suitable for moving the fluid across the first and second evaporator portions **220** and **230**. The heat transfer fluid enters into a heat exchange relationship with the first and second evaporator portions **220** and **230** and exits the partitioned evaporator as outlet flow **715**. During cooling mode, refrigerant is circulated from the partitioned condenser **500** to the partitioned evaporator **200**, through the first and second evaporator portions **220** and **230** and to the compressor **130** through evaporator discharge line **145**. The inlet flow **710** of heat transfer fluid is cooled by both the first and second evaporator portions **220** and **230**, providing outlet flow **715** of heat transfer fluid that has been cooled. During dehumidification mode, isolation valve **250** is closed, preventing flow of refrigerant into the first evaporator portion **220**. The inlet flow **710** is cooled and dehumidified by the second evaporator portion **230** and is substantially untreated by the isolated first evaporator portion **220**. The outlet flow **715** is a mixture of the cooled, dehumidified air that flowed through the second evaporator portion **230** and the substantially untreated air that flowed though the first evaporator portion **220**. The resultant outlet flow **715** is dehumidified air that is not overcooled.

[0057] The partitioned condenser **500** shown in **FIG. 7** is a partitioned condenser having two partitions, shown as the first and second condenser portions **520** and **530**. Although **FIG. 7** shows two condenser portions, the present invention is not limited to two condenser portions. The present invention may include more than two condenser portions. The piping to the partitioned condenser **500** includes isolation valves **540** on the inlet side and the outlet side of the second condenser portion **530** inside the partitioned condenser **500**. Closing the isolation valves **540** prevents the flow of refrigerant to the second condenser portion **530**. The isolation valves **540** may be operated by a controller **720**. One or more controllers **720** facilitates the closing of isolation valves **540**. The controller **720** may receive inputs from pressure measuring or temperature measuring devices and position the isolation valves **540**, e.g., open or closed. When the pressure on the compressor suction line **145** from the partitioned evaporator **200** to the compressor **130** reaches a predetermined level, the isolation valves **540** can be closed to the second condenser portion **530**. Once isolation valves **540** are closed, the refrigerant is only permitted to flow through the first condenser portion **520**. Because the refrigerant is only permitted to flow into first condenser portion **520**, the heat transfer area and the corresponding amount of heat transfer occurring in the partitioned condenser **500** is reduced. Therefore, less heat is removed from the refrigerant. Likewise, less heat is transferred to the first heat transfer fluid **150**, thereby maintaining a higher refrigerant temperature. Additionally, because the temperature of the refrigerant is higher, the corresponding pressure of the refrigerant is also higher. Therefore, the refrigerant pressure of the system is increased.

[0058] **FIG. 8** shows a refrigeration system according to an alternate embodiment. **FIG. 8** includes substantially the same piping arrangement as **FIG. 7**. In addition, **FIG. 8** has a line with a drain valve connecting the condenser portion **530** to the suction of compressor **130**. The refrigerant remaining in the second condenser portion **530** after isolation valves **540** are closed may be stored in the second condenser portion **530** or may be drawn into the refrigeration system **100** by opening drain valve **840** and permitting the refrigerant in condenser portion **530** to be drawn into the active system. Because the refrigerant from the isolated portion of the partitioned condenser **500** adds to the amount of refrigerant per unit volume of the refrigeration system **100**, the pressure of the refrigerant in increased. Therefore, this addition of refrigerant into the system from the isolated portion of the partitioned condenser **500** further assists in raising the system pressure.

[0059] **FIG. 9** shows a refrigeration system **100** incorporating a partitioned evaporator **200** and a partitioned condenser **500** according to the present invention. **FIG. 9** shows the refrigeration system including evaporator discharge line **145**, blower **160**, compressor **130**, compressor discharge line **135**, partitioned condenser **500**, fan **170**, condenser discharge line **140**, and first heat transfer fluid **150**, substantially as described above in the description of **FIG. 7**. In addition, **FIG. 9** includes a 3-way valve **910** and a discharge line **310**. The 3-way valve **910** connects to the first discharge header **270** of the first evaporator portion **220**, to the evaporator discharge line **145** and to the compressor discharge line **135**. **FIG. 9** also shows the partitioned evaporator **200** including first and second TXV valves **260** and **265**, check valve **255**, first and second distributors **240** and **245**, first and second discharge headers **270** and **275**, arranged as discussed above in the description of **FIG. 3**. Heat transfer fluid flow **710**, preferably air, flows into the partitioned evaporator **200** substantially evenly across the first and second evaporator portions **220** and **230**. A blower **160** moves heat transfer fluid flow **710**. Although, **FIG. 9** depicts a blower, any fluid moving system is suitable for moving the fluid across the first and second evaporator portions **220** and **230**. The inlet flow **710** enters into a heat exchange relationship with the first and second evaporator portions **220** and **230** and exits the partitioned evaporator as outlet flow **715**. During cooling mode, the refrigerant is circulated from the partitioned condenser **500** to the partitioned evaporator **200**, through the first and second evaporator portions **220** and **230** and to the compressor through evaporator discharge line **145** and 3-way valve **910**. The inlet flow **710** of heat transfer fluid is cooled by both the first and second evaporator portions **220** and **230**, providing outlet flow **715** of heat transfer fluid that has been cooled. During dehumidification mode, hot gas refrigerant from the discharge of the compressor flows into the 3-way valve **910**, which is opened to allow flow through the first discharge header discharge line **310** and into the first discharge header **270** of the first evaporator portion **220**. One or more controllers **720** facilitate the positioning of 3-way valve **910**. The controller **720** may receive inputs from pressure measuring or temperature measuring devices and position the 3-way valve **910**. The hot gas refrigerant from the discharge of the compressor **130** enters the refrigerant circuits **210** of the first evaporator portion **220** and at least partially condenses to a liquid. The condensing refrigerant heats the first evaporator portion **220** and warms the inlet flow **710** to produce a higher temperature outlet flow **715**. The refrigerant, which is at least partially condensed, travels through the check valve **255** and combines with line **140** into the second evaporator portion **230**. The inlet flow **710** of heat transfer fluid is cooled and dehumidified by the second evaporator portion **230** and is heated by the isolated first evaporator portion **220**, as the refrigerant gas is at least partially condensed. The outlet flow **715** is a mixture of the cooled, dehumidified air that flowed through the second evaporator portion **230** and the heated air that flowed though the first evaporator portion **220**. To summarize, the resultant outlet flow **715** is dehumidified air that is not overcooled. In cooling mode, first evaporator portion **220** and second evaporator portion **230** of partitioned evaporator **200**, act as evaporators. However, in dehumidification mode, first evaporator portion **220** acts as a condenser, while second evaporator portion **230** acts as an evaporator. The partitioned condenser **500** shown in **FIG. 9** operates substantially as described above in the discussion of **FIG. 7**.

[0060] **FIG. 10** shows a refrigeration system **100** incorporating a partitioned evaporator **200** according to the present invention. **FIG. 10** further shows the refrigeration system **100** including evaporator discharge line **145**, blower **160**, compressor **130**, compressor discharge line **135**, partitioned condenser **500**, fan **170**, condenser discharge line **140**, and first heat transfer fluid **150**, substantially as described above in the description of **FIG. 7**. In addition, **FIG. 10** includes one or both of a bypass valve **440**, and a flow restriction valve **430** on bypass line **410**. Bypass line **410** connects the compressor discharge line **135** of the compressor **130** to the inlet of the first evaporator portion **220** between the first TXV valve **260** and the first distributor **240**. One or more controllers **720** facilitate the positioning of isolation valves **540** and of the bypass valve **440**. The controller **720** may receive inputs from pressure measuring or temperature measuring devices and position the isolation valves **540** and bypass valve **440**, e.g., open or closed. **FIG. 10** shows the partitioned evaporator **200**, including first and second TXV valves **260** and **265**, isolation valve **250**, first and second distributors **240** and **245**, and first and second discharge headers **270** and **275**, arranged as discussed above in the description of **FIG. 4**. Inlet flow **710**, preferably air, flows into the partitioned evaporator **200** substantially evenly across the first and second portions **220** and **230**. The inlet flow **710** enters into a heat exchange relationship with the first and second evaporator portions **220** and **230** and exits the partitioned evaporator as outlet flow **715**. During cooling mode, the refrigerant is circulated from the partitioned condenser **500** to the partitioned evaporator **200**, through the first and second evaporator portions **220** and **230** and to the compressor **130** through evaporator discharge line **145**. The bypass valve **440** and the flow restriction valve **430** are set to prevent flow of refrigerant through the bypass line **410**. The inlet flow **710** of heat transfer fluid is cooled by both the first and second evaporator portions **220** and **230**, providing outlet flow **715** of heat transfer fluid that has been cooled. During dehumidification mode, isolation valve **250** is closed, preventing flow of refrigerant into the first evaporator portion **220**. The bypass valve **440** is opened and the flow restriction valve **430** is set to allow flow of refrigerant. Although **FIG. 10** is shown with both a bypass valve **440** and a flow restriction valve **430**, either the bypass valve **440** or flow restriction valve **430** may be removed from the bypass line **410**, so long as the flow of the refrigerant may be stopped during cooling mode and permitted during dehumidification mode. Hot gas refrigerant from the discharge of the compressor **130** is then allowed to flow from the compressor discharge line **135** through the bypass line **410** into the first distributor **240** and the first evaporator portion **220**. The hot gas refrigerant from the discharge of the compressor **130** heats the first evaporator portion **220** and combines with the outlet flow from the second evaporator portion **230** into the evaporator discharge line **145**. The inlet flow **710** of heat transfer fluid is cooled and dehumidified by the second evaporator portion **230** and is heated by the hot gas from the discharge of the compressor in the isolated first evaporator portion **220**. The outlet flow **715** is a mixture of the cooled, dehumidified air that flowed through the second evaporator portion **230** and the heated air that flowed though the first evaporator portion **220**. The resultant outlet flow **715** is dehumidified air that is not overcooled. The partitioned condenser **500** shown in **FIG. 10** operates substantially as described above in the discussion of **FIG. 7**.

[0061] **FIG. 11** illustrates a flow chart detailing a method of the present invention relating to head pressure control in a HVAC system for use with the systems shown in **FIGS. 7-10**. The method includes a determination of the minimum system head pressure, Pf, at step **1101**. The minimum head pressure is set to the desired operating pressure of the refrigeration system **100**. The minimum head pressure is preferably greater than the pressure corresponding to temperature of evaporator icing. Evaporator icing may occur when the surface temperature of the evaporator and suction piping is less than 32° F. Pf is preferably the system high side pressure that results in saturated suction temperatures above freezing under most load conditions. For R22 refrigerant, a typical value of Pf is 180 psig. Subsequent to determining the minimum system head pressure, Pf, the actual system head pressure, Pm, is measured at step **1103**. Any suitable pressure measurement method can be used for determining Pm. Preferably, the measurement takes place on a line between the TXV valve **265** and the compressor **130**. Subsequent to the measurement taken at step **1103**, a determination of whether the measured refrigerant pressure is less than the minimum system head pressure, Pf, at step **1105**. If the measured pressure of the refrigerant, Pm, is less than the pressure for evaporator freezing, which corresponds to Pf, (i.e., "YES" on the flowchart show in **FIG. 11**), isolation valve(s) **540** are closed and refrigerant flow is blocked to one or more of the refrigerant circuits inside of the partitioned condenser **500** in step **1107**. If the measured pressure of the refrigerant, Pm, is greater than the minimum system head pressure, Pf, (i.e., "NO" on the flowchart shown in **FIG. 11**), a determination of whether the measure head pressure, Pm, is less than the system reset pressure, Pr as shown in step **1110**. If the measured pressure, Pm, is greater than the system reset Pressure, Pr, (i.e., "YES" on the flowchart shown in **FIG. 11**), the isolation valves **540**, if closed, will be opened. If the measured pressure, Pm, is less than the system reset pressure, Pr, (i.e. "NO" on the flowchart shown in **FIG. 11**), then no action will be taken regarding the isolation valves **540**. If open, the isolation valves **540** will remain open. If closed, the isolation valves **540** will remain closed. The value Pr−Pf represents a pressure buffer for the system so that the isolation valves **540** will not be inclined to open and close rapidly. The opening of the isolation valves **540** in step **1109** allows refrigerant to flow to all refrigerant circuits within the condenser. When the refrigerant flows through all the refrigerant circuits **510** of the condenser, the heat transfer to the first heat transfer fluid **150** from the refrigerant is at a maximum. If the isolation valves **540** are closed in step **1107**, the refrigerant is only permitted to flow through a portion of the partitioned condenser **500**. Each portion has a predetermined heat transfer surface area. Because the refrigerant is only permitted to flow into a portion of the condenser and some portions are isolated, the heat transfer area and the corresponding amount of heat transfer is reduced. Therefore, less heat is removed from the refrigerant. Likewise, less heat is transferred to the first heat transfer fluid **150**, thereby maintaining a higher refrigerant temperature. Additionally, because the temperature of the refrigerant is higher, the corresponding pressure of the refrigerant is also higher. Therefore, the refrigerant pressure of the system is increased.

[0062] In the HVAC system according to the present invention, when the head pressure in the suction line **145** to the compressor **130** decreases, the temperature of the refrigerant in the evaporator **110** likewise decreases. When the head pressure has decreased to a certain level, the partitioned evaporator **200** operates at temperatures that may result in icing of the partitioned evaporator **200**. Icing is a condition when the temperature at the exterior of the refrigerant circuits of the evaporator is sufficiently low to freeze water present in the heat transfer fluid. In particular, in a residential system, the heat transfer fluid is typically air and the water that freezes is humidity present in the air. The ice formed by the water frozen on the surface of the refrigerant circuits eventually prevents the proper operation of the HVAC system by inhibiting heat transfer and/or damaging system components. This icing generally begins at refrigerant saturated suction temperatures from about 25° F. to about 32° F. In order to prevent the freezing of the evaporator, the pressure in the suction line **145** is preferably maintained above the temperature that corresponds to the freezing point of the partitioned evaporator **200**.

[**0063**] In one method according to the invention, the pressure of the refrigerant is measured and compared to a predetermined pressure. The pressure measurement may be taken from any point in the refrigeration system **100**. However, the preferred point of measurement of refrigerant pressure is on the evaporator discharge line **145** to the compressor. The evaporator discharge line **145** to the compressor also corresponds to the outlet of the partitioned evaporator **200**. The outlet of the partitioned evaporator **200** represents a low pressure point in the refrigeration system **100**, due to the phase change of the refrigerant to a vapor resulting from the heat exchange relationship existing between the refrigerant and the second heat transfer fluid **155** in the partitioned evaporator **200**. The predetermined pressure is preferably a pressure that is greater than or equal to the pressure that corresponds to a temperature that results in icing at the partitioned evaporator **200**.

[**0064**] **FIG. 12** shows a control method according to one embodiment of the present invention for use with the system shown in **FIGS. 7-8**. The method includes a mode determination step **1210** where the operational mode of the system is determined or selected. The operational mode can be provided by the controller and/or user, where the mode can either be cooling only or require dehumidification. Examples of control systems for determination of the operational mode are described in further detail below in the discussion of **FIGS. 15 and 16**. The method then includes a decisional step **1220** wherein it is determined whether dehumidification is required or not. If the determination in step **1220** is "NO" (i.e., no dehumidification required), then the method proceeds to opening step **1230** wherein the valve to the first evaporator portion **220** is opened or remains open in step **1230**. The opening of the first evaporator portion **220** to the flow of refrigerant permits both the first and second evaporator portions **220** and **230** to provide cooling to the inlet flow **710**. If the decisional step **1220** is a "YES" (i.e., dehumidification is required), then the valve to the first evaporator portion **220** is closed or remains closed in step **1240**. The closing of the first evaporator portion **220** to the flow of refrigerant allows the first evaporator portion **220** to equilibrate at a temperature substantially equal to the temperature of the heat transfer fluid entering the partitioned evaporator **200**. After either the opening step **1230** or the closing step **1240**, the method returns to the determination step **1210** and the method repeats.

[**0065**] Although **FIG. 12** shows that the decisional step **1220** provides a "YES" or "NO" to steps **1230** or **1240**, the method is not limited to an open or closed isolation valve **250**. A flow-restricting valve may also be used. The use of a flow-restricting valve allows the amount of flow into the first evaporator portion **220** to be varied. For example, the flow restricting valve may be used in an operational mode that is open to full flow, partially restricted flow or closed to flow, depending on the signal from a controller. Controller **720**, using inputs, such as refrigerant temperature, heat transfer fluid temperatures, and humidity readings, provides a signal to the restricting valve to determine the amount of refrigerant flow permitted through the isolation valve **250**.

[**0066**] **FIG. 13** shows another control method according to the present invention for use with the system shown in **FIG. 9**. The method includes a mode determination step **1310** where the operational mode of the system is determined. As in the method shown in **FIG. 12**, the operational mode can be provided by the controller and/or user, where the mode can either be cooling only or dehumidification. Examples of control systems for determination of the operational mode are described in further detail below in the discussion of **FIGS. 15 and 16**. The method then includes a decisional step **1320** wherein it is determined whether dehumidification is required or not. If the determination in step **1320** is "NO" (i.e., no dehumidification required), then the method proceeds to step **1330** wherein the 3-way valve **910** is set to provide refrigerant flow from the discharge line **310** of the evaporator portion **220** to the compressor suction line **145**. The setting of the 3-way valve **910** allows the flow of refrigerant to both the first and second evaporator portions **220** and **230** to provide cooling to the inlet flow **710**. If the decisional step **1320** is a "YES" (i.e., dehumidification is required), then the 3-way valve **910** is set to provide refrigerant flow from the discharge of the compressor to the discharge line **310** of the evaporator portion **220**. The hot gas refrigerant from the discharge of the compressor **130** flows into the first evaporator portion **220** and provides heat to the first evaporator portion **220**. The directing of hot gas refrigerant to the first evaporator portion **220** allows the first evaporator portion **220** to exchange heat with the heat transfer fluid **155** entering the partitioned evaporator **200**. The inlet flow **155** of heat transfer fluid is cooled and dehumidified by the second evaporator portion **230** and is heated by heat exchange with the hot gas from the discharge of the compressor **130** in the isolated first evaporator portion **220**. The outlet flow **715** is a mixture of the cooled, dehumidified air that flowed through the second evaporator portion **230** and the heated air that flowed though the first evaporator portion **220**. The resultant outlet flow **715** is dehumidified air that is not overcooled. After either the 3-way valve **910** directing steps **1330** or **1340**, the method returns to the determination step **1310** and the method repeats.

[**0067**] Although **FIG. 13** shows that the decisional step **1320** provides a "YES" or "NO" to steps **1330** or **1340**, the method is not limited to an open or closed isolation valve **250**. A flow restriction valve may also be used. The use of a flow restriction valve allows the amount of flow into the first evaporator portion **220** to be varied. For example, the flow restriction valve may be used in an operational mode that is open to full flow, partially restricted flow or closed to flow, depending on the signal from controller **720**. Alternatively, the flow into the first evaporator portion **220** from the discharge of the compressor **130** in dehumidification mode may be varied through use of the 3-way valve **910**, depending on the signal from a controller. The 3-way valve **910** may also include flow restriction abilities that allow the flow of refrigerant to be varied. A controller, using inputs, such as refrigerant temperature, heat transfer fluid temperatures, and humidity readings, provides a signal to the restriction valve or the 3-way valve **910** to determine the amount of refrigerant flow permitted through the isolation valve **250** or the amount of hot gas refrigerant permitted through the first evaporator portion **220**.

[0068] **FIG. 14** shows a control method according to the present invention for use with the system shown in **FIG. 10**. The method includes a mode determination step **1410** where the operational mode of the system is determined. As in the method shown in **FIGS. 12 and 13**, the operational mode can be provided by controller **720** and/or user, where the mode can either be cooling only or dehumidification. The method then includes a decisional step **1420** wherein it is determined whether dehumidification is required or not. If the determination in step **1420** is "NO" (i.e., no dehumidification required), then the method proceeds to step **1430** wherein the valve **250** to the first evaporator portion **220** is opened or remains open. After or concurrently with step **1430**, a bypass line **410** is closed from refrigerant flow in step **1340**. The opening of the first evaporator portion **220** and the closing of the bypass line **410** allow the flow of refrigerant to both the first and second evaporator portions **220** and **230** to provide cooling to the inlet flow **710**. If the decisional step **1420** is a "YES" (i.e., dehumidification is required), then the valve to the first evaporator portion **220** is closed or remains closed. After or concurrently with step **1450**, the bypass line **410** is opened to flow of refrigerant in step **1460**. Hot gas refrigerant from the discharge of the compressor **130** flows through the bypass **410** and into the first evaporator portion **220** and provides heat to the first evaporator portion **220**. The closing of the first evaporator portion **220** to the flow of refrigerant from the condenser **130** and the directing of hot gas refrigerant to the first evaporator portion **220** allows the first evaporator portion **220** to exchange heat with the refrigerant circuits **510** entering the partitioned evaporator **200**. The inlet flow **710** of heat transfer fluid is cooled and dehumidified by the second evaporator portion **230** and is heated by heat exchange with the hot gas from the discharge of the compressor in the isolated first evaporator portion **220**. The outlet flow **715** is a mixture of the cooled, dehumidified air that flowed through the second evaporator portion **230** and the heated air that flowed though the first evaporator portion **220**. The resultant outlet flow **715** is dehumidified air that is not overcooled. After either the bypass-closing step **1440** or the bypass-opening step **1460**, the method returns to the determination step **1410** and the method repeats.

[0069] Although **FIG. 14** shows that the decisional step **1420** provides a "YES" or "NO" to steps **1430** or **1450**, the method is not limited to an open or closed isolation valve **250**. A flow restriction valve may also be used. The use of a flow restriction valve allows the amount of flow into the first evaporator portion **220** to be varied. For example, the flow restriction valve may be used in an operational mode that is open to full flow, partially restricted flow or closed to flow, depending on the signal from controller **720**. Additionally, the flow through the bypass line **410** may be varied through use of the bypass valve **440** and/or flow restriction valve **430**, depending on the signal from controller **720**. Controller **720**, using inputs, such as refrigerant temperature, heat transfer fluid temperatures, and humidity readings, provides a signal to isolation valve **250**, bypass valve **440** and flow restriction valve **430** to determine the amount of refrigerant flow permitted through the flow restriction valve **430** in place of isolation valve **250** and the amount of hot gas refrigerant permitted through the first evaporator portion **220**.

[0070] **FIG. 15** illustrates a control method according to the present invention that determines the operation mode of the partitioned evaporator **200**. The determination of the operational mode is made through the use of controller **720**. This determination may be used in steps **1210**, **1310** and **1410** of **FIGS. 12, 13** and **14**, respectively. The determination takes place by first sensing temperature and/or humidity in an enclosed space in step **1510**. The temperature and/or humidity measurements are made for a controller to determine whether the enclosed space requires cooling or dehumidification. The inputs from temperature sensors and humidity sensors are provided to controller **720** in step **1520**, where the controller uses the sensed temperatures and/or humidity to determine the operational mode. In step **1520**, the controller determines whether cooling is required and whether dehumidification is required. In a first decisional step **1530**, it is determined whether the controller has determined that cooling is required. If the first decisional step **1530** determines "YES", cooling mode is required, the partitioned evaporator **200** in the refrigeration system **100** is set to allow flow into all of the refrigerant circuits **210** in the partition evaporator **200** and cool across both the first and second evaporator portions **220** and **230** in step **1540**. In addition to cooling, cooling mode also performs dehumidification. However, in a cooling mode, the second heat transfer fluid is only cooled and is not heated to increase the temperature of the second heat transfer fluid **155** once the second heat transfer fluid **155** travels through the partitioned evaporator **200**. If the first decisional step **1530** determines "NO", then a second decisional step **1550** is made. The second decisional step **1550** determines whether the controller has determined that dehumidification mode (i.e., dehumidification without overcooling) is required. If the second decisional step **1550** determines "YES", dehumidification mode is required, the operational mode is set to dehumidification in step **1560**. If the second decisional step **1550** determines "NO", dehumidification mode is not required, the operational mode is set to inactive and the system operates neither a cooling nor a dehumidification cycle in step **1570**.

[0071] **FIG. 16** shows an alternate control method according to the present invention that determines the operation mode of a multiple refrigerant circuit system. In the system controlled in **FIG. 16**, multiple refrigerant systems **100** are utilized and one or more of the refrigerant systems **100** include a partitioned evaporator **200** according to the invention. The control method shown in **FIG. 16** operates in a similar manner to **FIG. 15** in that the controller receives inputs from temperature and/or humidity sensors in step **1610** and determines the operational mode of the system in step **1620**. Likewise, if the first decisional step **1630** determines "NO", then a second decisional step **1650** is performed. The second decisional step **1670** determines whether the controller has determined that a dehumidification mode (i.e., dehumidification without overcooling) is required. If the second decisional step **1670** determines "YES", dehumidification mode is required, the operational mode is set to dehumidification in step **1680**. If multiple refrigerant systems **100** are present, the controller **720** independently determines which of the refrigerant systems **100** are active or inactive, based upon temperature and/or humidity measurements. When multiple refrigeration systems **100** are present, at least one refrigerant system **100** includes a partitioned evaporator **200**. The controller **720** independently determines which partitioned evaporator **200** is subject to isolation of the first evaporator portion **220**, based upon temperature and/or humidity measurements. However, if the second decisional step **1670** determines "NO", dehumidification is not required, the operational mode is set to inactive and the system operates neither a cooling nor a dehumidification cycle in step **1690**. If the first decisional step **1630** determines "YES", cooling is required, a third decisional step **1640** is performed. In the third decisional step **1640**, a determination is made as to the number of stages to be activated in order to provide the cooling. Each stage has an evaporator capable of providing cooling to the second heat transfer fluid **155**. The greater the number of stages activated, the greater the amount of cooling provided. At least one of the multiple refrigerant circuits includes a partitioned evaporator **200**. If the controller determines that the cooling demand only requires one refrigerant system **100** to be active, one refrigerant system **100** will be used to cool second heat transfer fluid **155** in step **1650**. When the partitioned evaporator **200** is used to operate in cooling mode, the partitioned evaporator **200** is configured to allow flow into all of the refrigerant circuits **210** in the partition evaporator **200** and cool across both the first and second evaporator portions **220** and **230** in step **1660**. If multiple partitioned evaporators **200** are present, all of the refrigerant circuits **210** in each of the partition evaporators **200** allow flow of refrigerant into both the first and second evaporator portions **220** and **230** and cool the second heat transfer fluid **155**.

[**0072**] The present invention is not limited to the control methods shown in **FIGS. 11-16**. The partitioned evaporator **200** and the partitioned condenser **500** may be used in one or more refrigerant circuits of multiple refrigerant circuit systems, where the control of the reheating capabilities within the first evaporator portion **220** of the partitioned evaporator **200** and the head pressure control within the first condenser portion **520** may each be independently controlled to provide the desired temperature and/or humidity within the conditioned space and the desired refrigerant pressure within the system. Any combination of cooling, reheating, or modulation of combinations of cooling and reheating may be used with the present invention. In addition, operational modes controlling the refrigerant pressure may be used in conjunction with the cooling and dehumidification modes of operation.

[**0073**] While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A method for dehumidification and controlling system pressure in a refrigeration system comprising the steps of:

providing a refrigeration system having a compressor, a condenser and an evaporator connected in a closed refrigerant loop, each of the condenser and evaporator having a plurality of refrigerant circuits;

flowing a first heat transfer fluid over the condenser;

flowing a second heat transfer fluid over the evaporator;

controlling a flow of refrigerant in the plurality of refrigerant circuits in the condenser to control an amount of heat transfer between refrigerant in the condenser and the first heat transfer fluid;

controlling a flow of refrigerant in the plurality of refrigerant circuits in the evaporator to control an amount of heat transfer between refrigerant in the evaporator and the second heat transfer fluid;

isolating at least one of the refrigerant circuits of the condenser to provide a decreased amount of heat transfer area within the condenser and to increase refrigerant pressure within the refrigeration system when the refrigerant pressure within the refrigeration system is at or below a predetermined pressure; and

configuring the plurality of refrigerant circuits of the evaporator to provide dehumidification of the second heat transfer fluid without overcooling the second heat transfer fluid.

2. The method of claim 1, further comprising drawing refrigerant from the at least one of the circuits isolated from refrigerant flow in the condenser by fluidly connecting the isolated portion of the condenser to the suction of the compressor.

3. The method of claim 2, wherein refrigerant from the isolated portion of the condenser is drawn into the refrigeration system to increase the refrigerant pressure.

4. The method of claim 1, further comprising measuring refrigerant pressure at a predetermined location in the refrigeration system.

5. The method of claim 1, the method further comprising:

providing a first control valve fluidly connected to a first set of circuits of the plurality of circuits of the evaporator, wherein the first control valve controls flow of refrigerant to the first set of circuits of the evaporator; and

providing a second control valve fluidly connected to a second set of circuits of the plurality of circuits of the evaporator, wherein the second refrigerant control valve controls flow of refrigerant to the second set of circuits of the evaporator.

6. The method of claim 5, wherein the second control valve permits a greater amount of refrigerant flow than the first control valve.

7. The method of claim 6, wherein the first and second control valves are thermostatic expansion valves.

8. The method of claim 5, the method further comprising:

isolating the first set of circuits of the evaporator from flow of refrigerant from the condenser; and

providing at least a portion of refrigerant discharged from the compressor to the first set of circuits of the evaporator without flowing through the condenser.

9. The method of claim 8, wherein the step of providing at least a portion of refrigerant includes flowing refrigerant from the compressor through a fluid connection to an inlet of the first set of circuits of the evaporator.

10. The method of claim 9, wherein the step of providing at least a portion of refrigerant includes:

connecting a discharge of the compressor to an outlet of the first set of circuits of the evaporator,

flowing refrigerant from the compressor through a fluid connection to the first set of circuits, the flow of refrigerant from the compressor through the first set of circuits of the evaporator being countercurrent to a flow of refrigerant in the second set of circuits of the evaporator, and

combining the flow of refrigerant through the first set of circuits with the inlet flow of refrigerant of the second set of circuits of the evaporator.

11. The method of claim 10, further comprising condensing the refrigerant flowing in the first set of circuits countercurrent to the flow of refrigerant in the second set of circuits from a gas to a liquid, wherein the liquid flows into the second set of circuits of the evaporator.

12. A method for dehumidification and controlling refrigerant pressure in a heating, ventilation and air conditioning system comprising:

providing a closed loop refrigerant system comprising a compressor, a condenser and an evaporator, each of the condenser and evaporator having a plurality of refrigerant circuits configured and disposed to allow isolation of at least one of the refrigerant circuits from refrigerant flow;

measuring refrigerant pressure at a predetermined location in the refrigeration system;

determining an operational mode for the refrigeration cycle, the operational mode being a selected from the group consisting of cooling and dehumidification;

isolating at least one of the refrigeration circuits in the condenser from refrigerant flow when the measured pressure at the predetermined location is equal to or less than a predetermined pressure;

isolating a first set of refrigerant circuits in the evaporator from flow of refrigerant from the condenser when the operational mode is dehumidification;

permitting flow of refrigerant from the condenser to both the first set of circuits and a second set of refrigerant circuits in the evaporator when the operational mode is cooling; and

wherein the refrigerant pressure is increased by isolation of at least one of the refrigerant circuits in the condenser from refrigerant flow until the measured pressure is greater than the predetermined pressure.

13. The method of claim 12, further comprising dehumidifying a heat transfer fluid flowing over both the first and second set of circuits when the operational mode is dehumidification.

14. The method of claim 12, wherein the predetermined location is the outlet of the evaporator.

15. The method of claim 14, wherein the predetermined pressure is a pressure corresponding to an icing condition of the evaporator.

16. The method of claim 12, further comprising drawing refrigerant from the at least one circuit isolated from refrigerant flow in the condenser by fluidly connecting a portion of the condenser including the at least one circuit isolated from refrigerant flow to the suction of the compressor.

17. The method of claim 16, wherein refrigerant from the portion of the condenser including the at least one circuit isolated from refrigerant flow is added to the refrigeration system to increase the refrigerant pressure.

18. The method of claim 12, further comprising:

providing a first control valve fluidly connected to the first set of circuits of the plurality of circuits of the evaporator, wherein the first control valve controls flow of refrigerant to the first set of circuits of the evaporator; and

providing a second control valve fluidly connected to the second set of circuits of the plurality of circuits of the evaporator, wherein the second refrigerant control valve controls flow of refrigerant to the second set of circuits of the evaporator.

19. The method of claim 18, wherein the second control valve permits a greater amount of refrigerant flow than the first control valve.

20. The method of claim 19, wherein the first and second control valves are thermostatic expansion valves.

21. The method of claim 18, further comprising:

providing at least a portion of refrigerant discharged from the compressor to the first set of circuits of the evaporator without first flowing through the condenser.

22. The method of claim 21, wherein the providing at least a portion of refrigerant step includes flowing refrigerant from the compressor through a fluid connection to an inlet of the first set of circuits of the evaporator.

23. The method of claim 21, wherein the providing at least a portion of refrigerant step includes:

connecting a discharge of the compressor to an outlet of the first set of circuits of the evaporator;

flowing refrigerant from the compressor through a fluid connection to the first set of circuits, the flow of refrigerant from the compressor through the first set of circuits of the evaporator being countercurrent to the flow of refrigerant in the second set of circuits of the evaporator; and

combining the flow of refrigerant through the first set of circuits with an inlet flow of refrigerant to the second set of circuits of the evaporator.

24. The method of claim 23, further comprising condensing the refrigerant flowing in the first set of circuits countercurrent to the flow of refrigerant in the second set of circuits from a gas to a liquid, wherein the liquid is flowed into the second set of circuits of the evaporator.

25. A heating, ventilation and air conditioning system comprising:

a compressor;

a condenser arrangement comprising:

a plurality of circuits arranged into a first and second portion; and a valve arrangement configured and disposed to isolate the first portion of the condenser arrangement when the refrigerant pressure is below a predetermined pressure; and

an evaporator arrangement comprising:

a plurality of circuits arranged into a first and second portion;

at least one distributor configured to distribute and deliver refrigerant to each circuit of the plurality of circuits in the evaporator; and

a valve arrangement configured and disposed to isolate the first portion of the evaporator arrangement from refrigerant flow in a dehumidification operation.

26. The system of claim 25, further comprising:

a first control valve fluidly connected to the first portion of the evaporator, wherein the first control valve controls flow of refrigerant to the first portion of the evaporator arrangement; and

a second control valve fluidly connected to the second portion of the evaporator arrangement, wherein the second control valve controls flow of refrigerant to the second portion of the evaporator arrangement.

27. The system of claim 26, wherein the second control valve permits a greater amount of refrigerant flow than the first control valve.

28. The system of claim 27, wherein the first and second control valves are thermostatic expansion valves.

29. The system of claim 25, further comprising a fluid connection to connect the compressor to the first portion of the evaporator arrangement, the fluid connection being configured to allow flow of at least a portion of refrigerant discharged from the compressor to the first portion of the evaporator arrangement without traveling through the condenser arrangement during a dehumidification operation.

30. The system of claim 29, wherein the fluid connection connects a discharge of the compressor to an inlet of the first portion of the evaporator arrangement.

31. The system of claim 29, wherein the fluid connection connects a discharge of the compressor to an outlet of the first portion of the evaporator arrangement, wherein flow of refrigerant from the compressor through the first portion of the evaporator arrangement is permitted to flow countercurrent to the flow of refrigerant in the second portion of the evaporator arrangement, refrigerant flowing in the first portion of the evaporator arrangement combines with refrigerant at an inlet of the second portion of the evaporator arrangement.

32. The system of claim 31, wherein the refrigerant flowing countercurrent to the flow of refrigerant in the second portion of the evaporator arrangement condenses from a gas to a liquid and the liquid flows into the second portion of the evaporator arrangement.

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