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(54) **SYSTEM FOR CONTROLLED FLUID HEATING USING AIR CONDITIONING WASTE HEAT**

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(57) **ABSTRACT**

A system is disclosed which utilizes air conditioning waste to heat a second fluid such as swimming pool water. The second condenser for pool water heating is connected in parallel with the air conditioning condenser. An accumulator is connected between the condensers and the expansion valve to absorb fluctuations in refrigerant level due to different operating conditions caused by the pool water heating, thereby ensuring that liquid refrigerant is always supplied to the expansion valve. A controller reads the ambient air temperature at the air conditioning condenser and reads the air conditioning system condensing pressure and uses an algorithm to compute ambient air fan speed at the air conditioning condenser based on these two inputs to maintain a consistent heated pool water temperature.

An alternate system includes first and second condensers connected in series with an accumulator connected between the second condenser and the expansion valve and a pressure equalization line connected between the compressor and the accumulator. A controller reads the ambient air temperature at the air conditioning condenser and reads the air conditioning system condensing pressure and uses an algorithm to compute ambient air fan speed at the air conditioning condenser based on these two inputs to maintain a consistent heated pool water temperature.

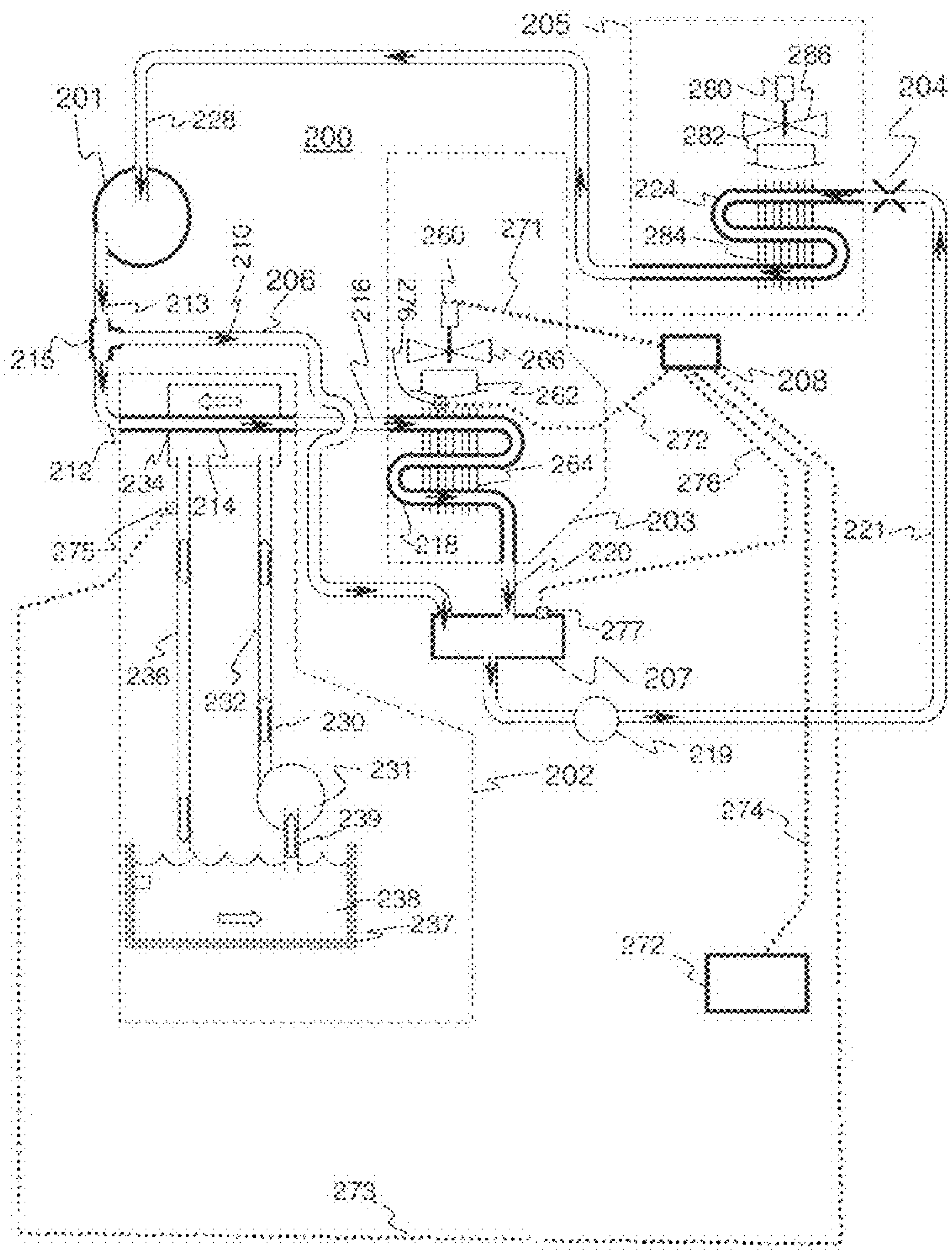

Fig 1A

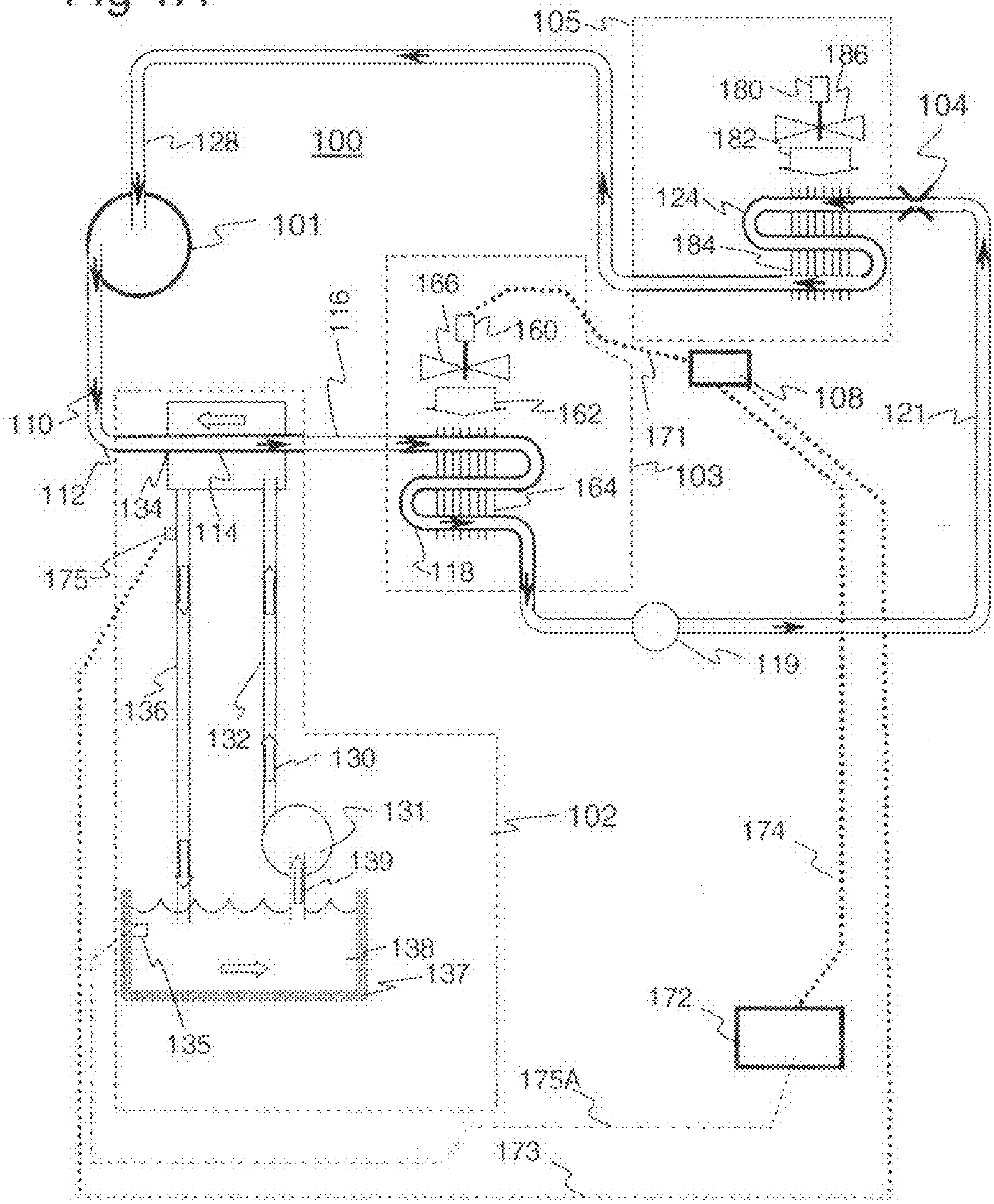
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Fig 1B

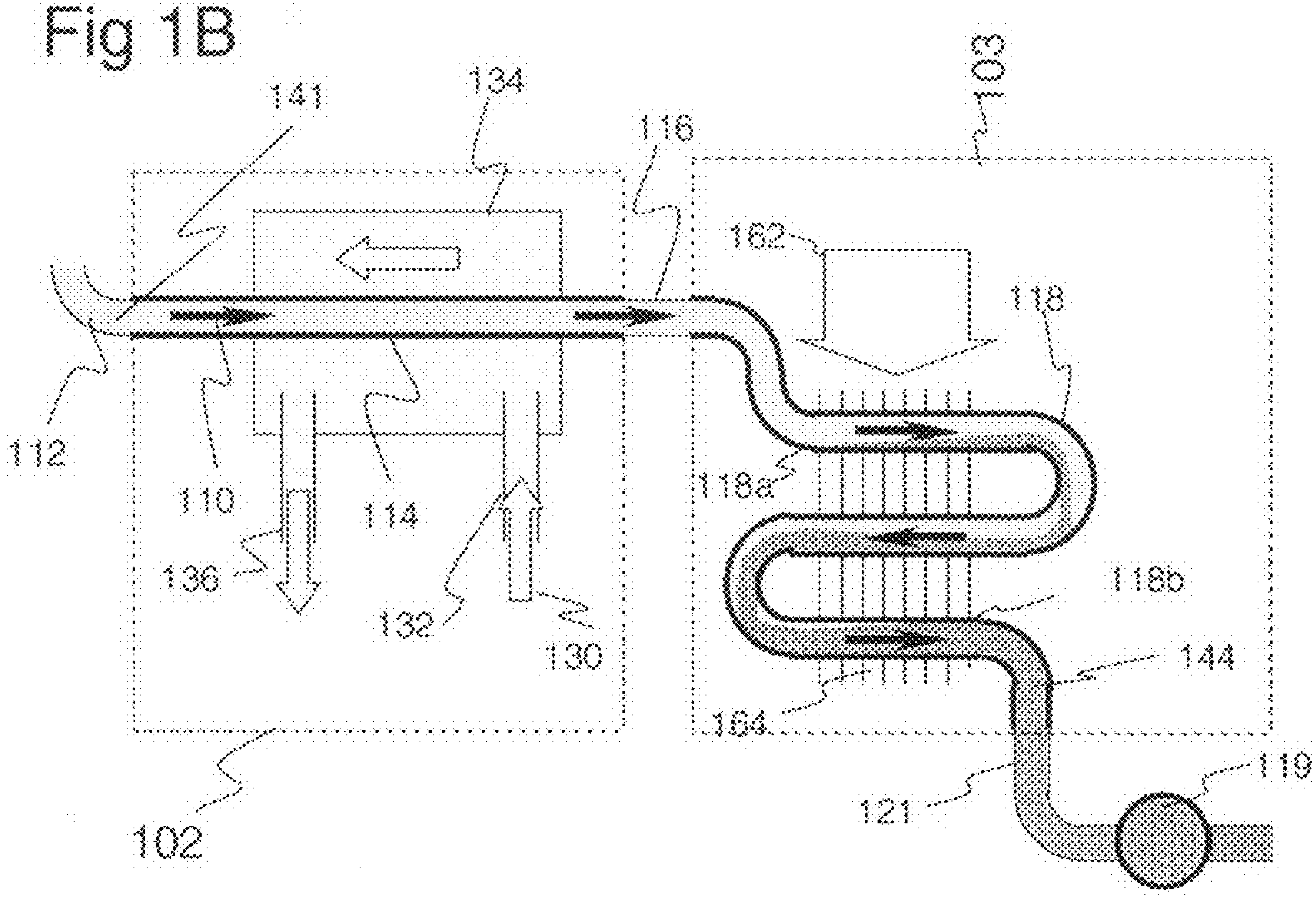
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Fig 1C

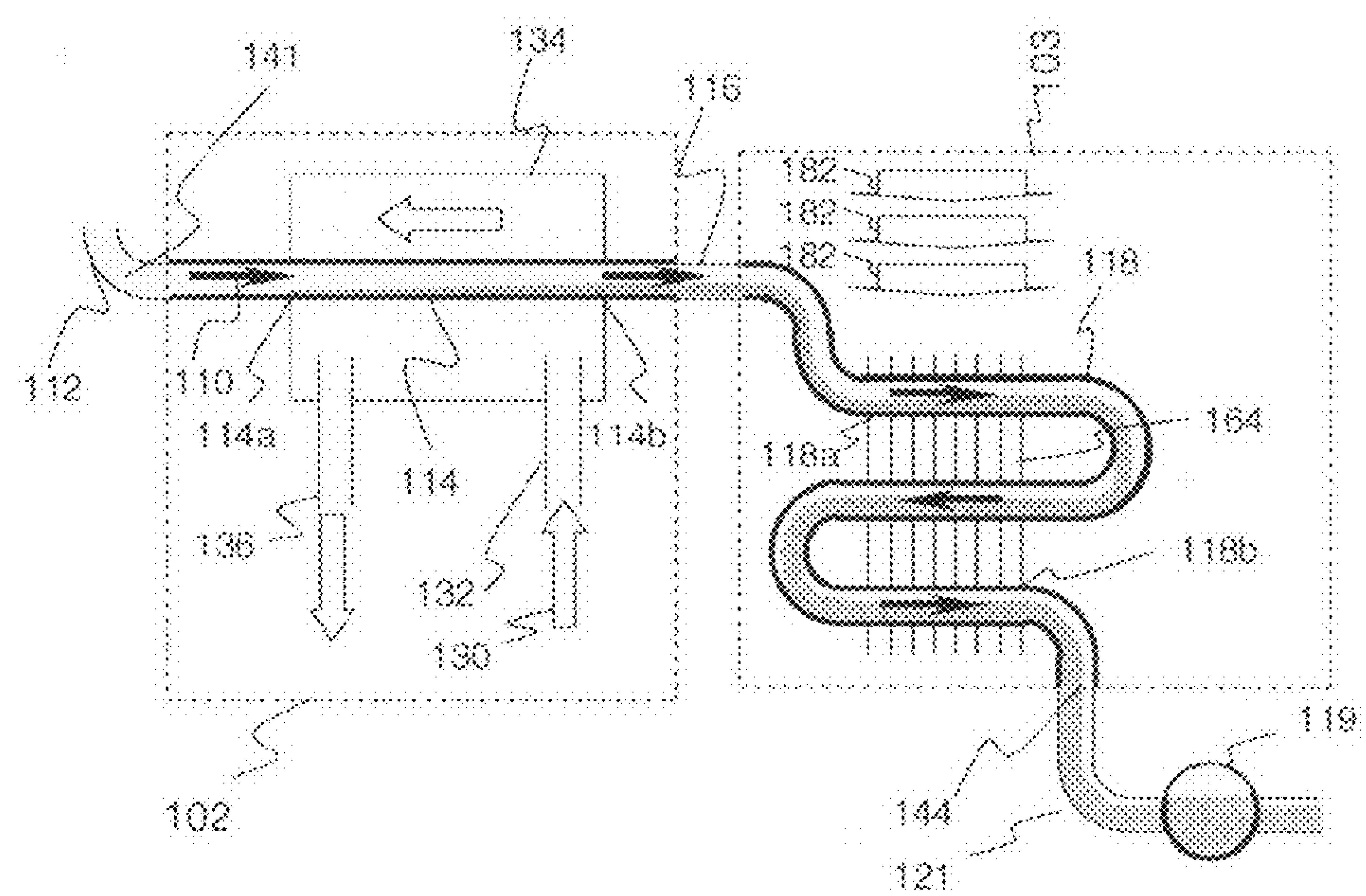
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Fig 1D

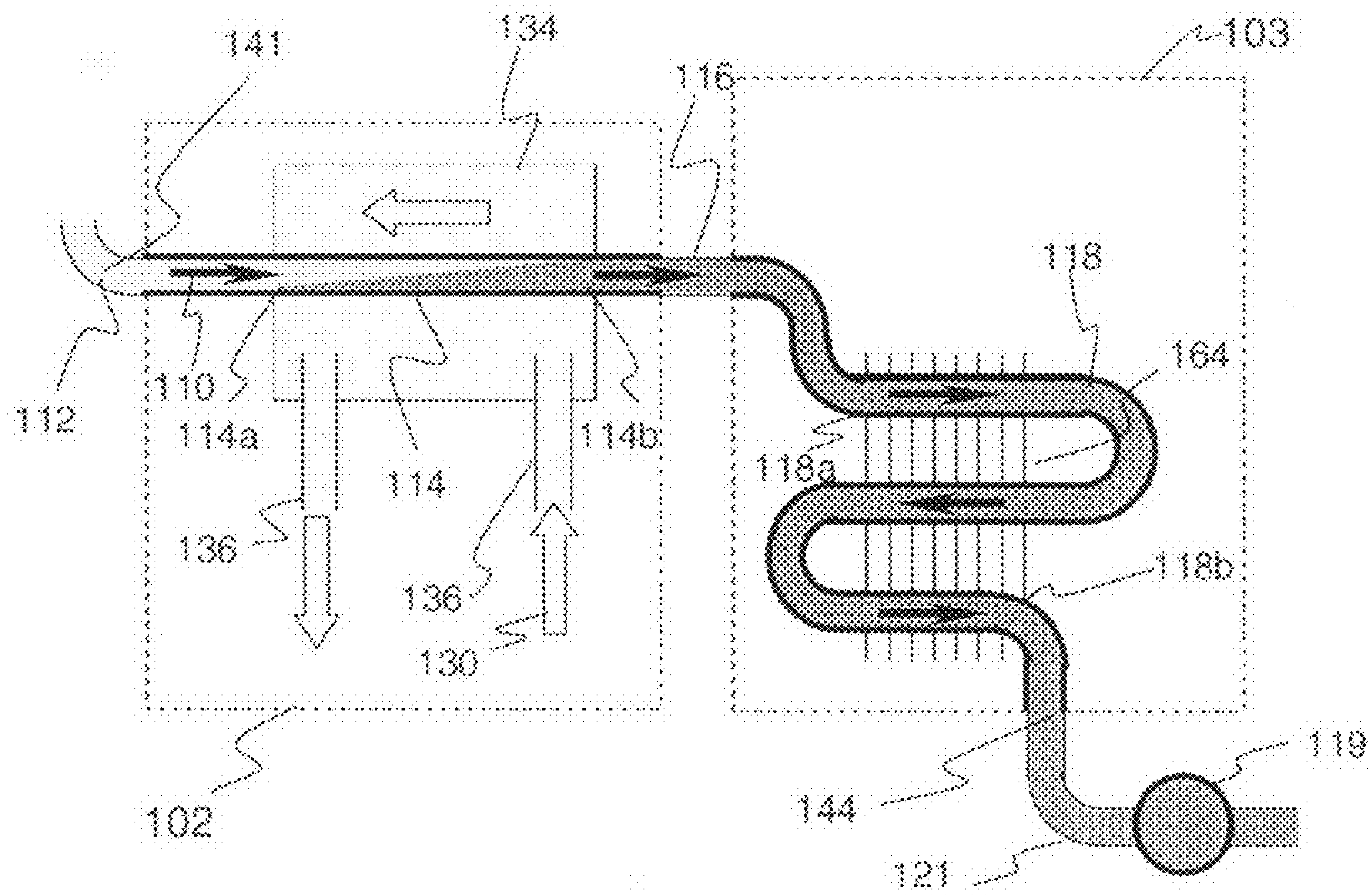
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Fig 1E

Theoretical Outlet Water Temperature, Air Conditioning System Condensing Pressure, Condenser Fan ON/OFF, and Hot Water BTU/Hr Requirements at various Operational Conditions for Fig 1A with 90°F ambient at the refrigerant to air condenser, 60°F water inlet to refrigerant to water condenser, where the refrigerant to water condenser has the same capacity as the air conditioning system.

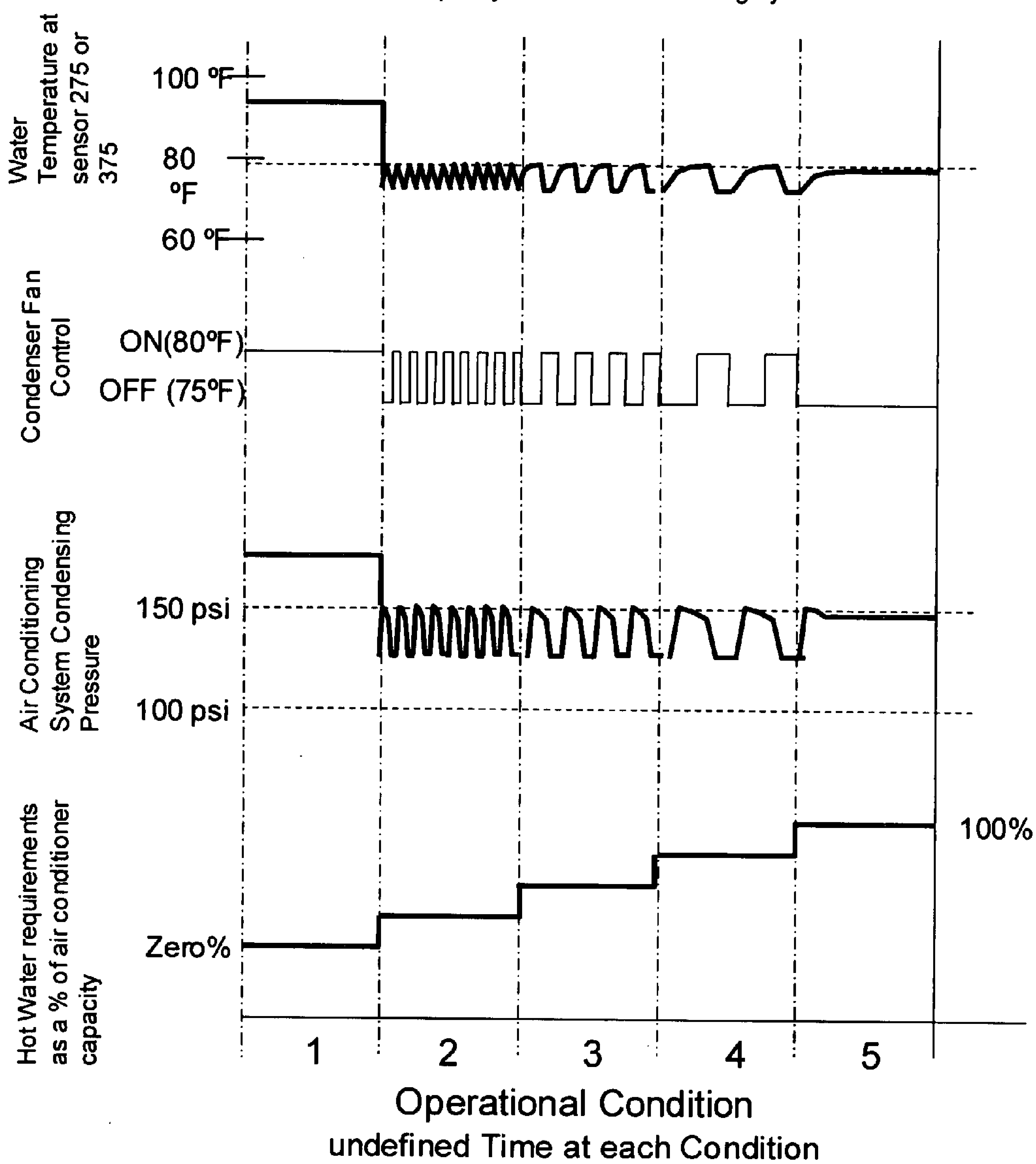

Fig 2A

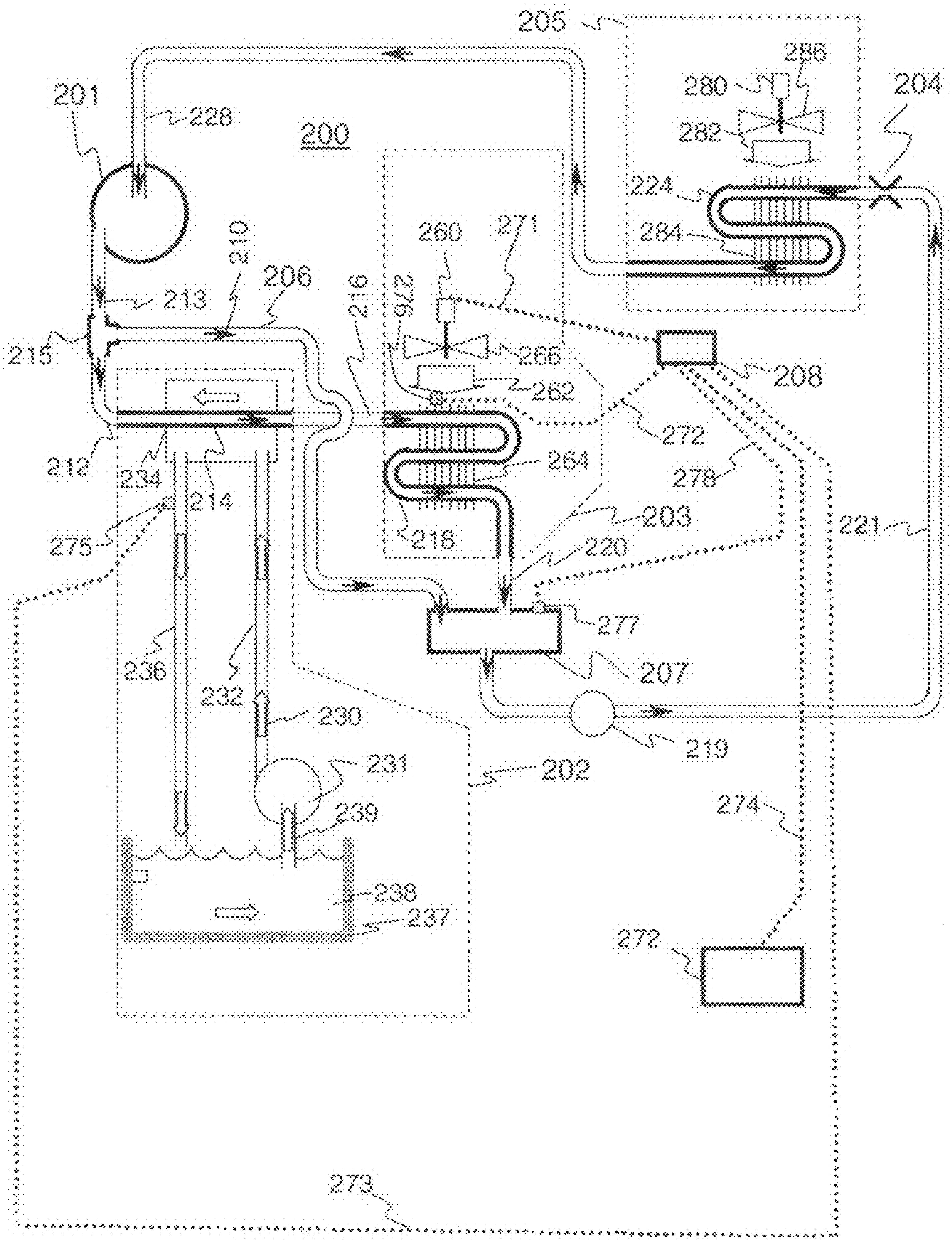
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Fig 2B

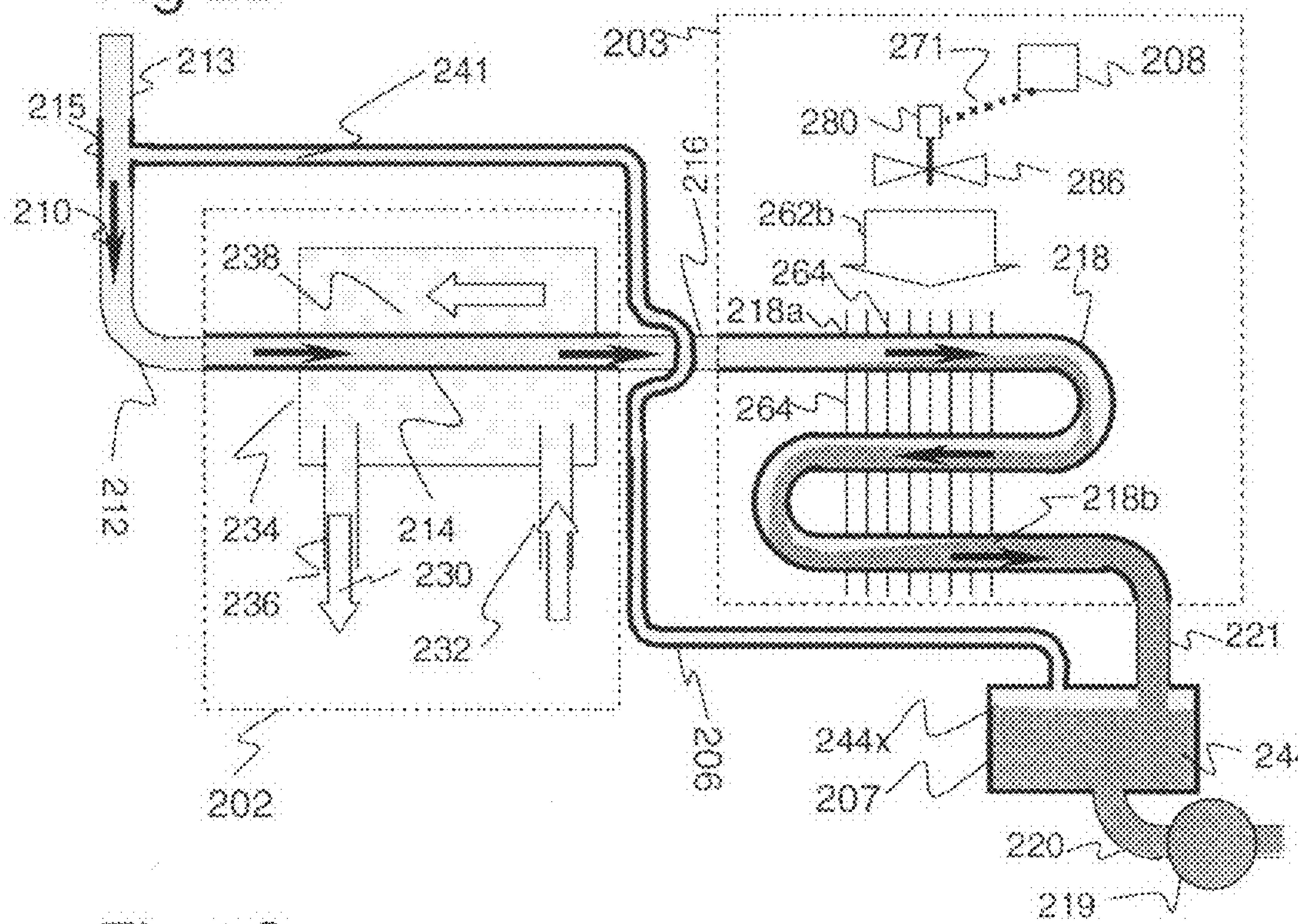
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Fig 2C

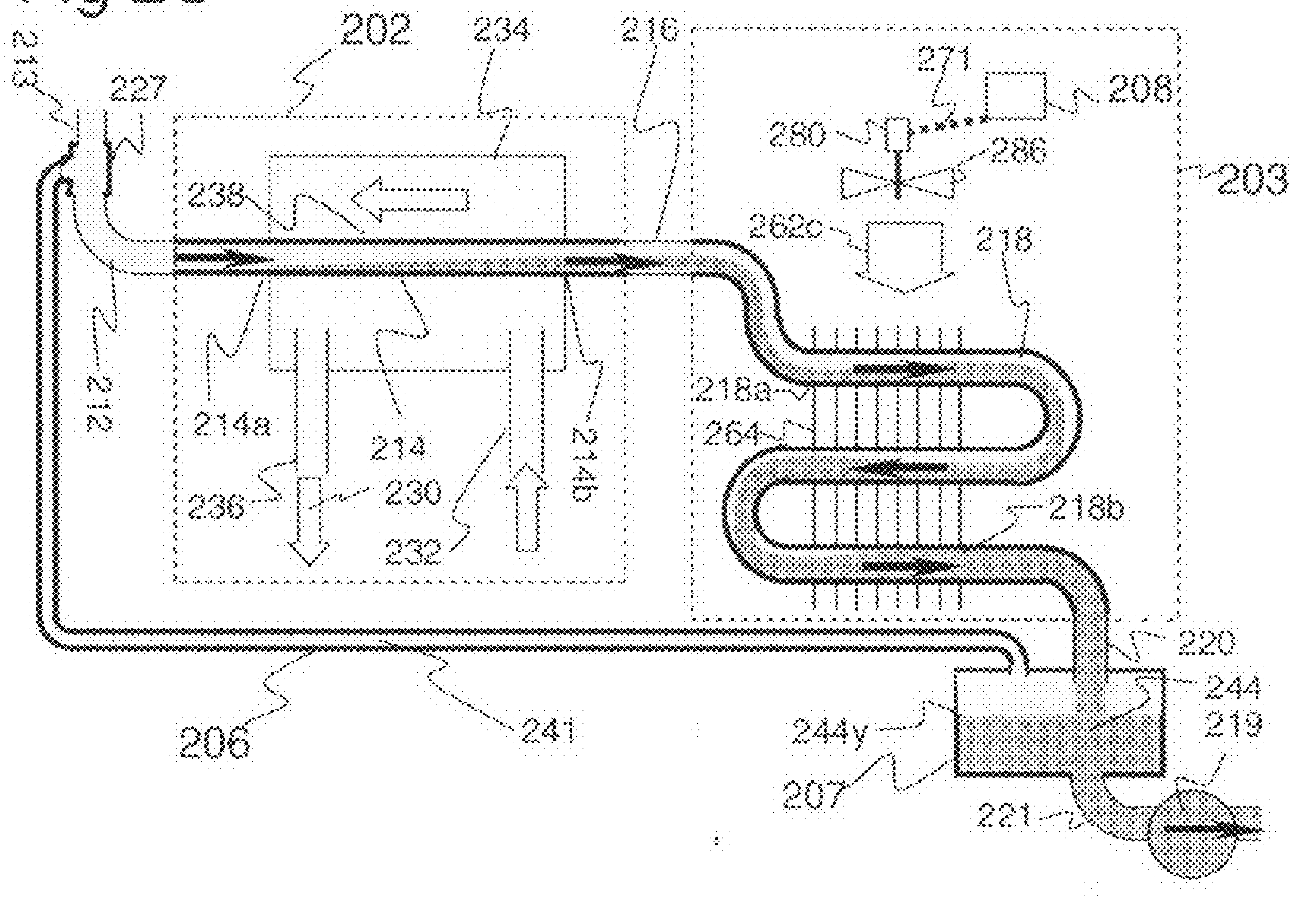
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Fig 2D

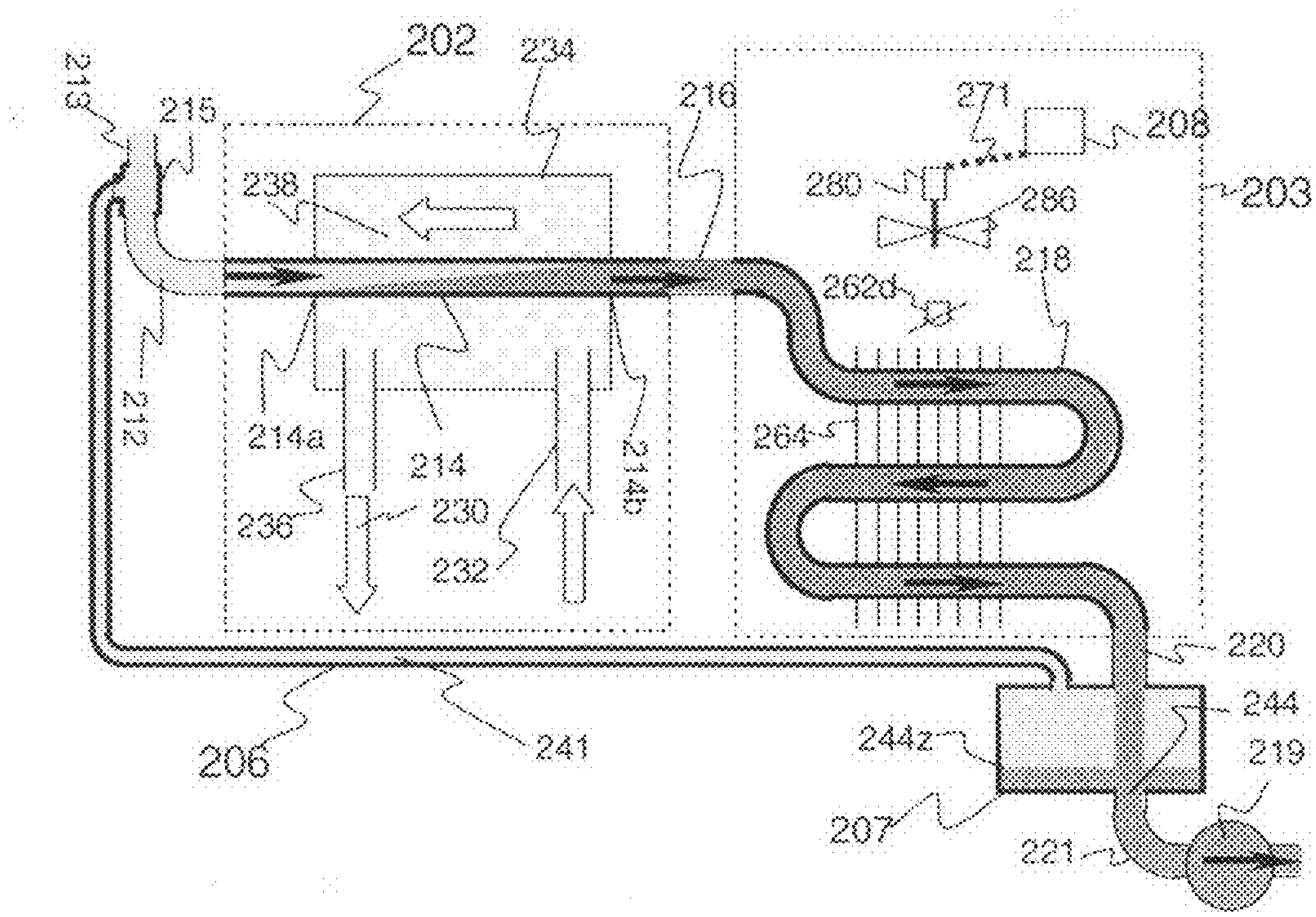
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Fig 3A

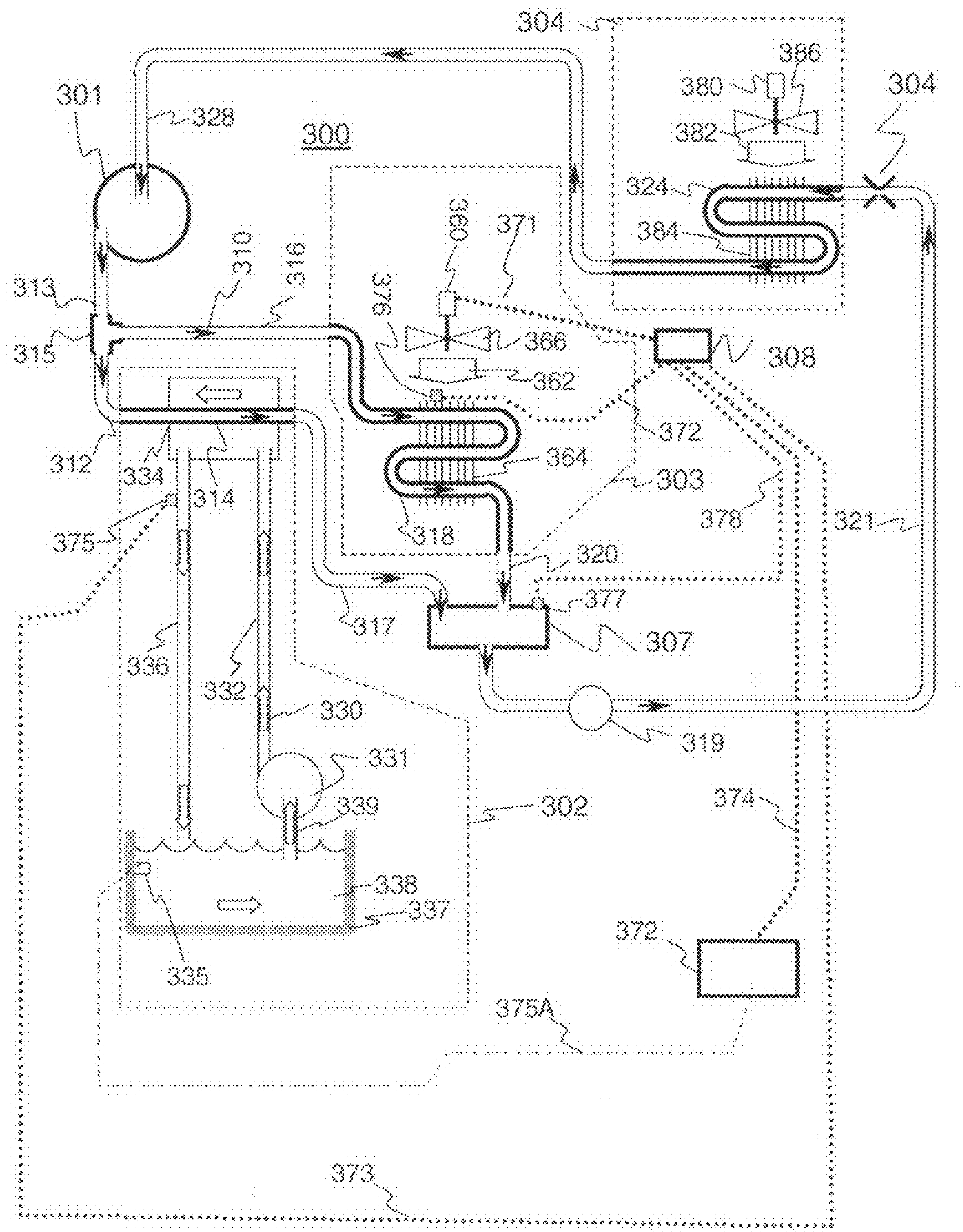

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Fig 3B

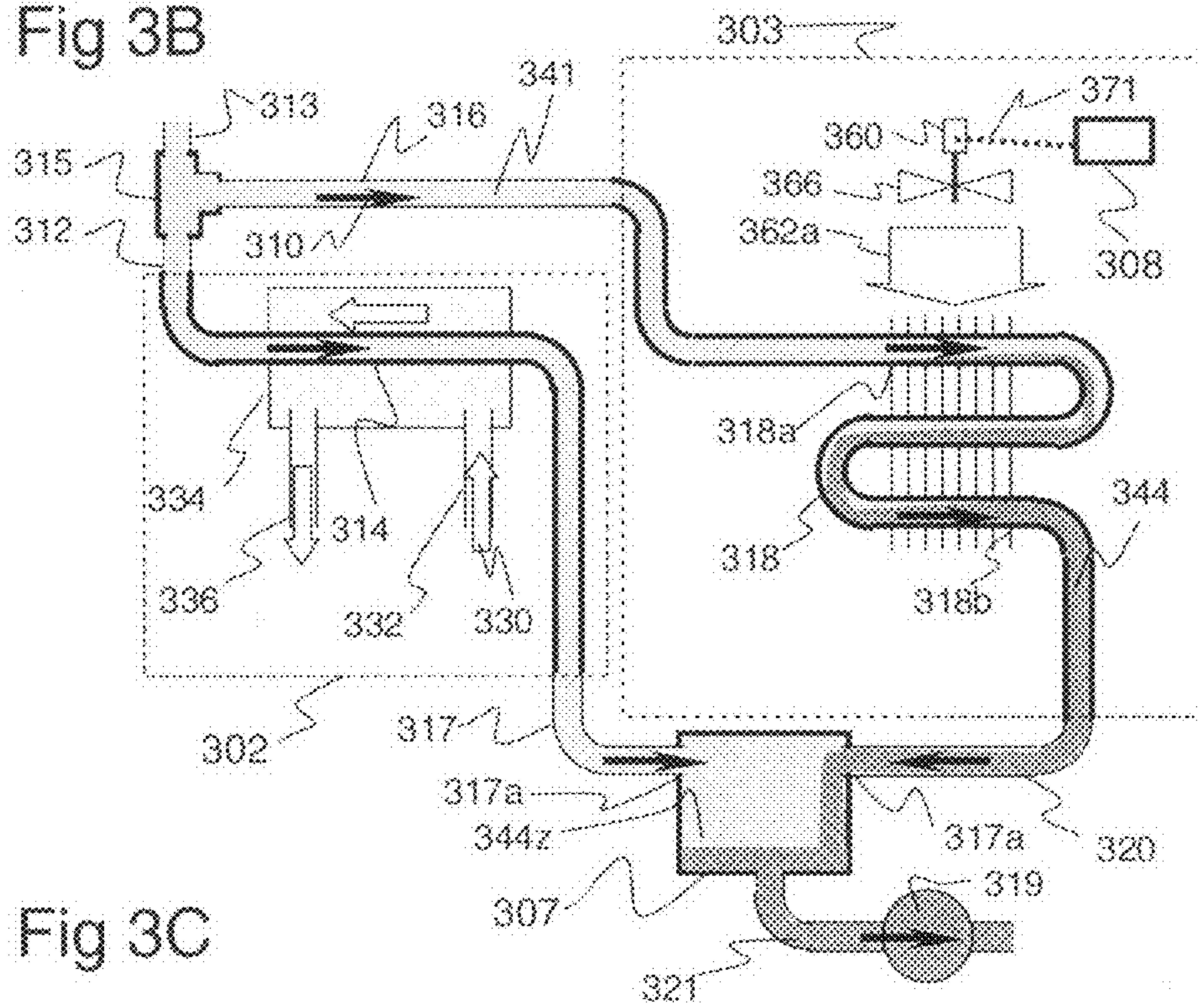
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Fig 3C

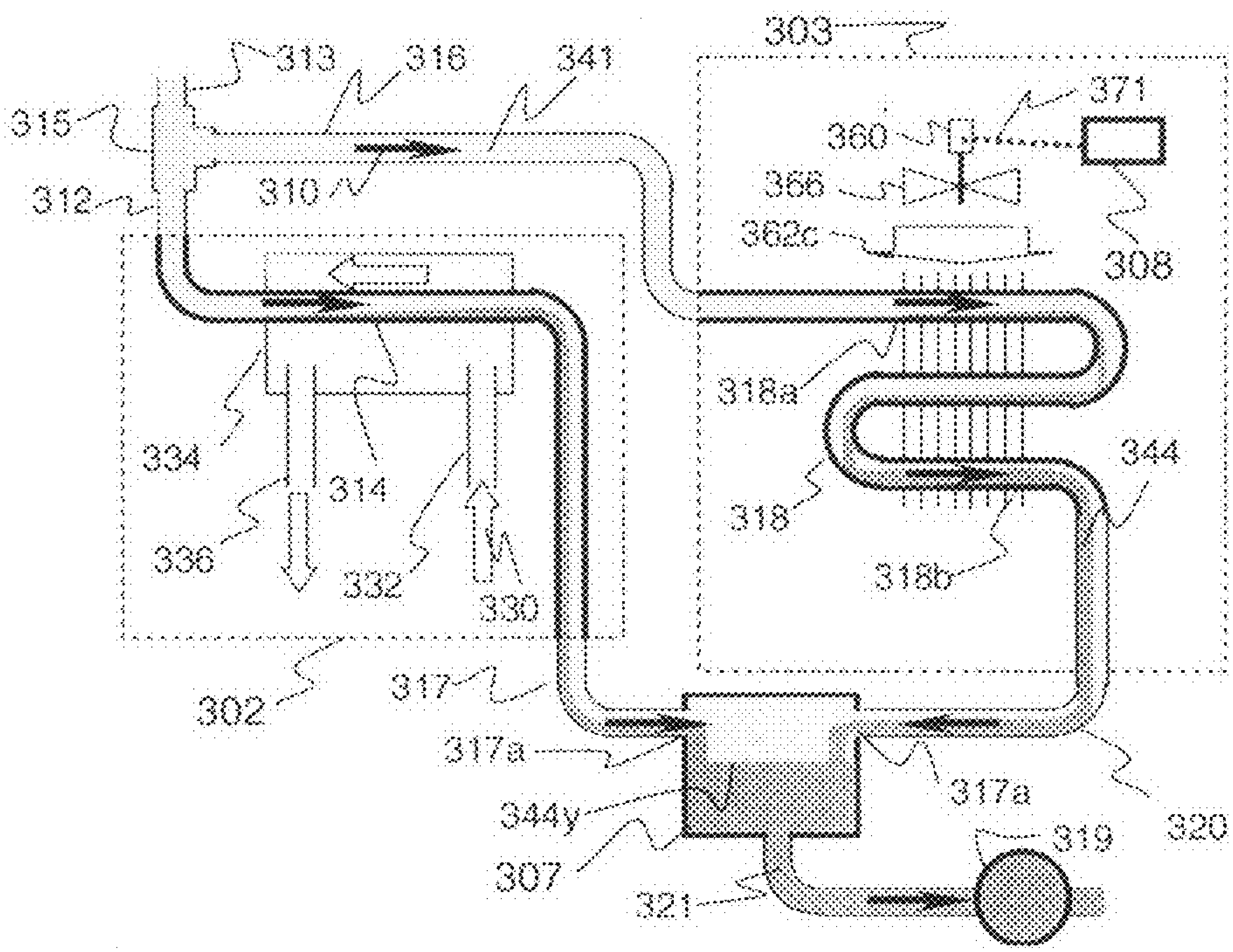
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Fig 3D

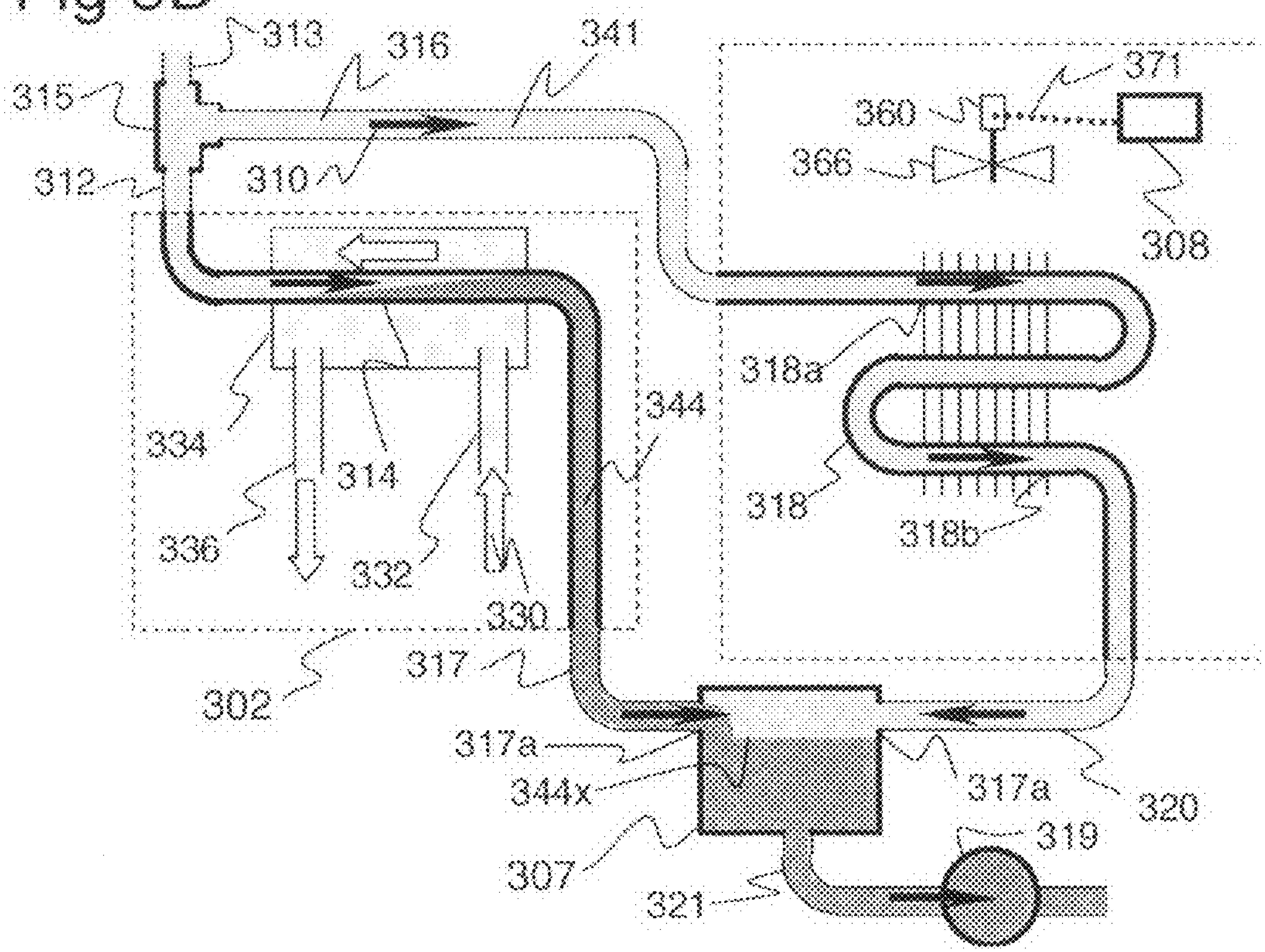
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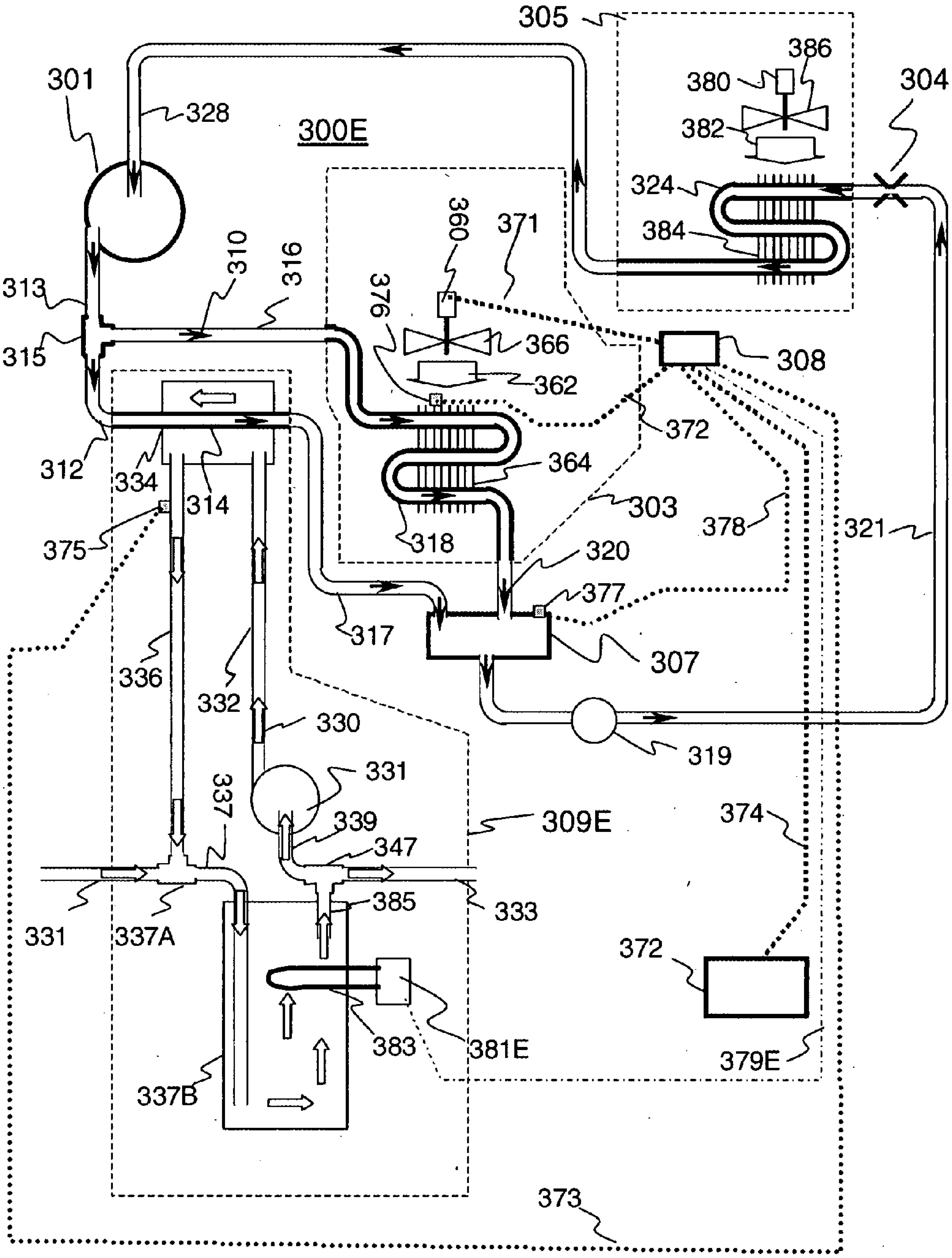
Fig 3E



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337B
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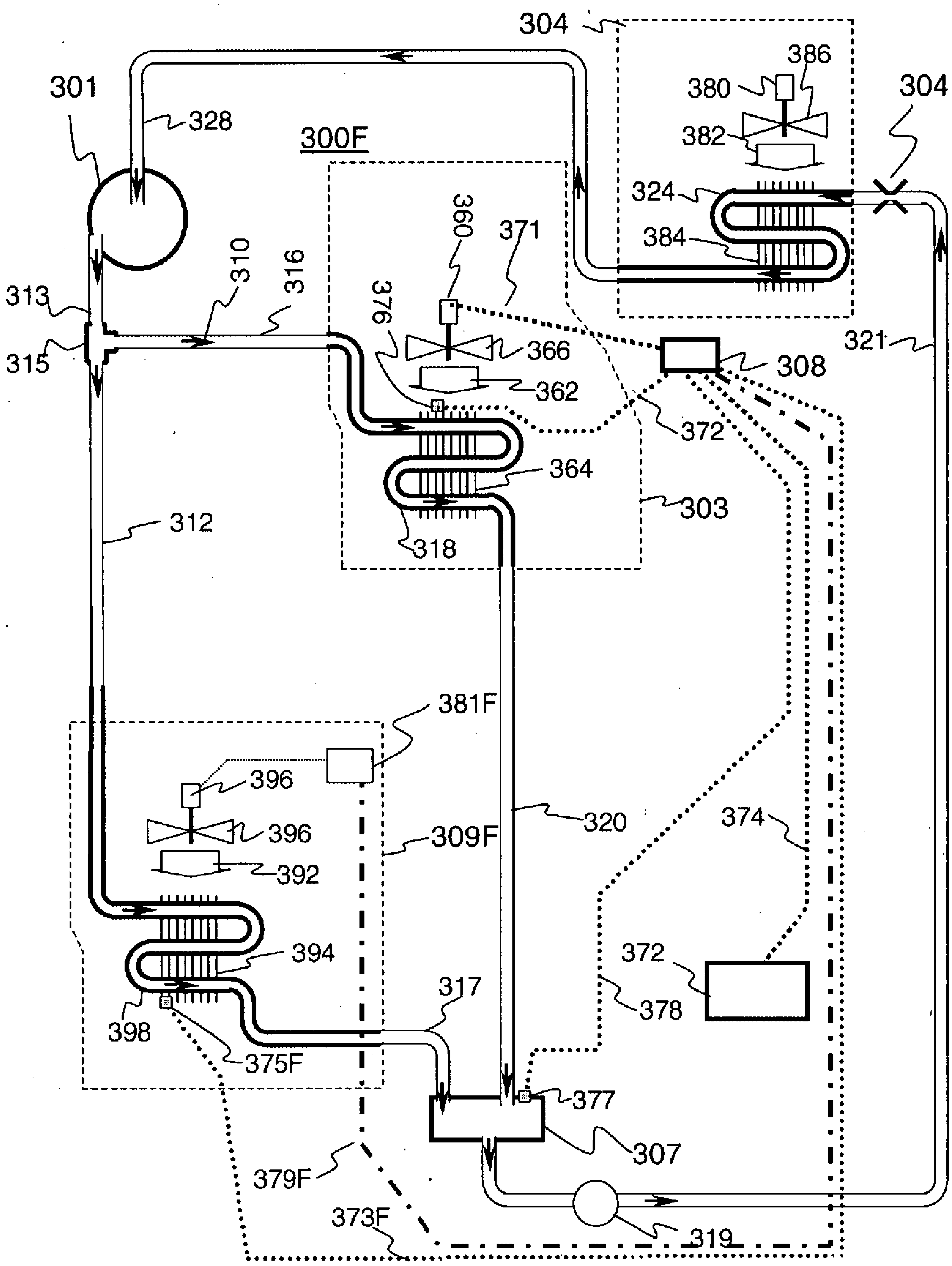
Fig 3F



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379F
373F
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Fig 4A

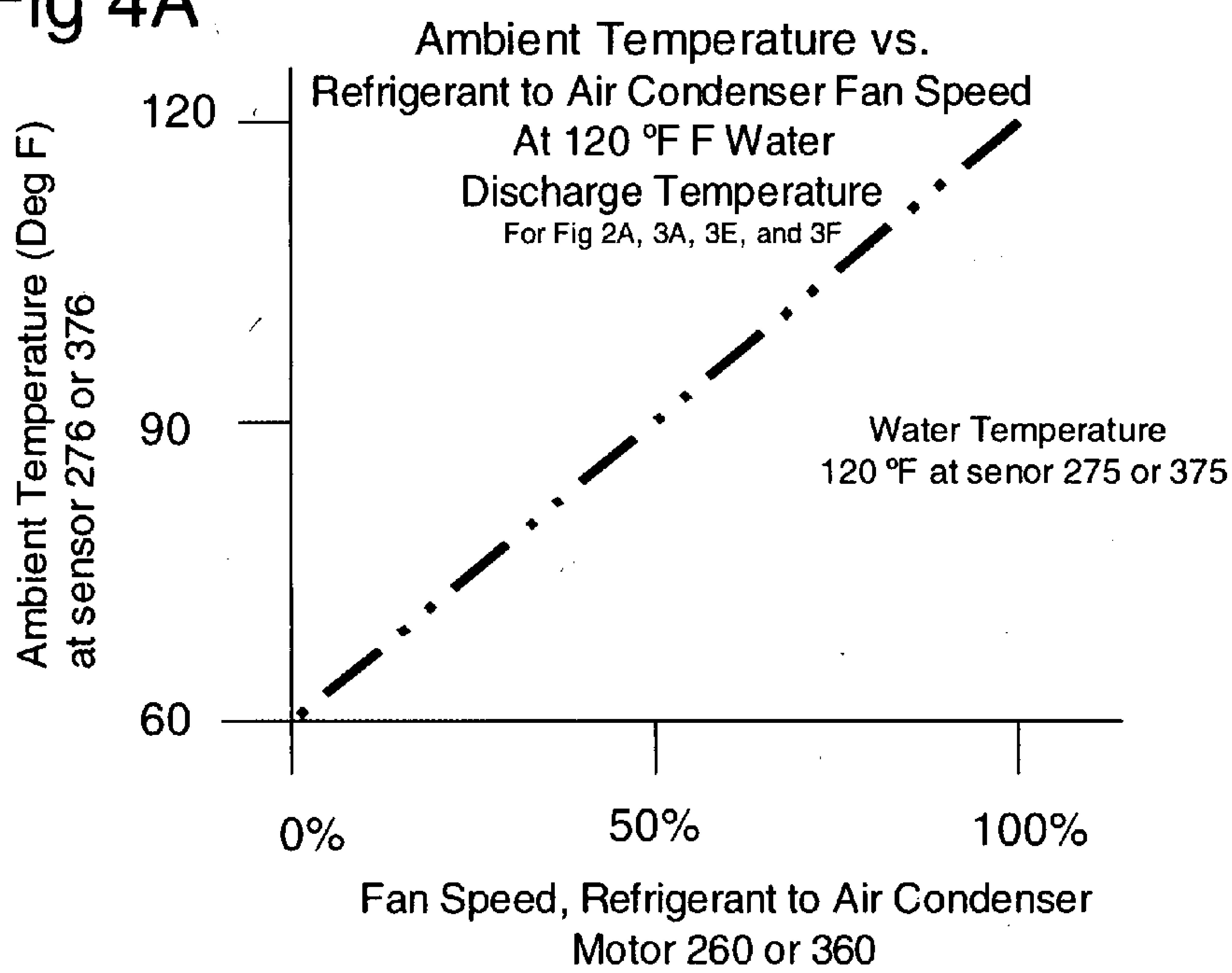

Ambient Temperature vs.
Refrigerant to Air Condenser Fan Speed
At 120 °F F Water
Discharge Temperature
For Fig 2A, 3A, 3E, and 3F
Ambient Temperature (Deg F)
at sensor 276 or 376
120
90
60
Water Temperature
120 °F at senor 275 or 375
0%
50%
100%
Fan Speed, Refrigerant to Air Condenser
Motor 260 or 360

Fig 4B

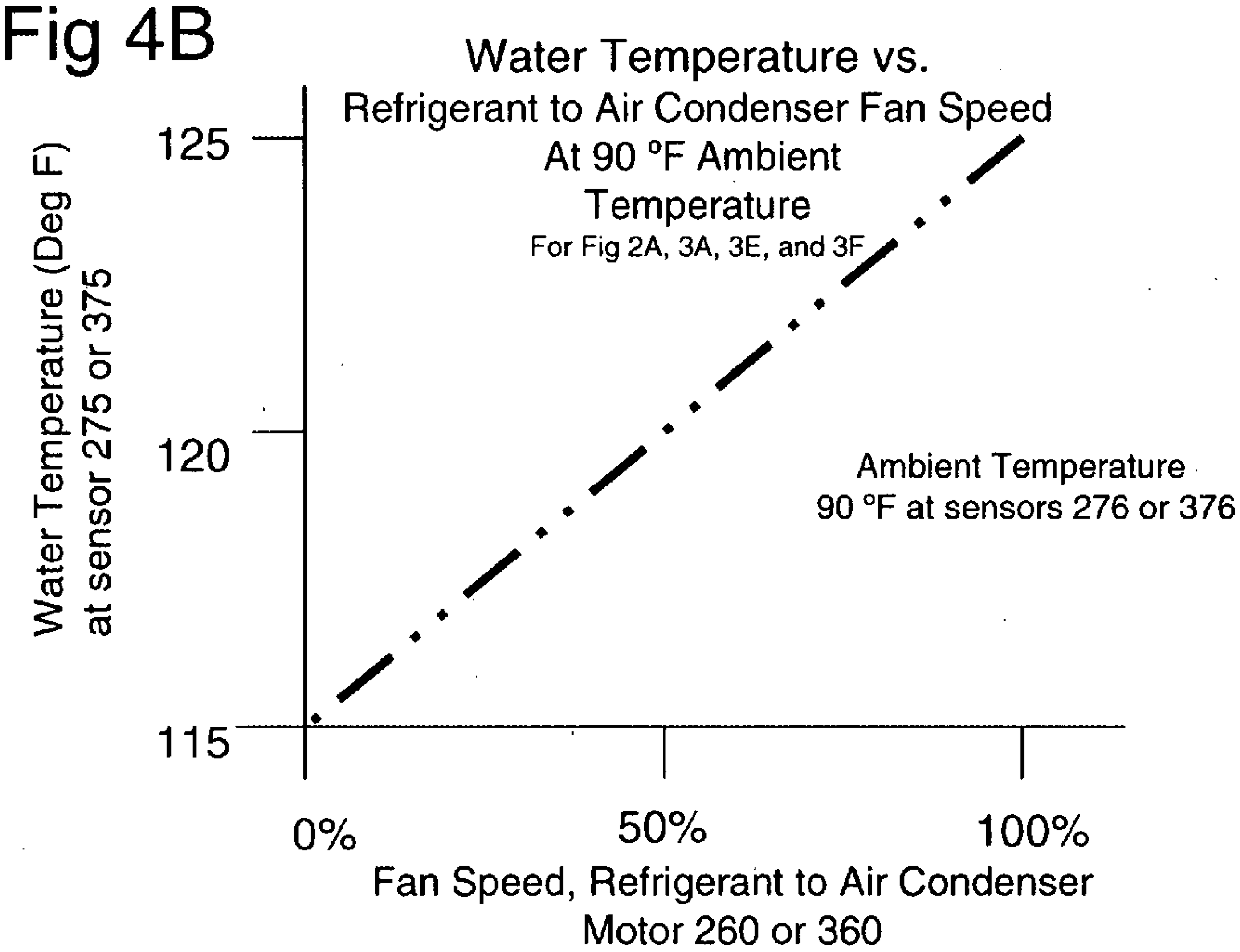

Water Temperature vs.
Refrigerant to Air Condenser Fan Speed
At 90 °F Ambient
Temperature
For Fig 2A, 3A, 3E, and 3F
Water Temperature (Deg F)
at sensor 275 or 375
125
120
115
Ambient Temperature
90 °F at sensors 276 or 376
0%
50%
100%
Fan Speed, Refrigerant to Air Condenser
Motor 260 or 360

Fig 5A

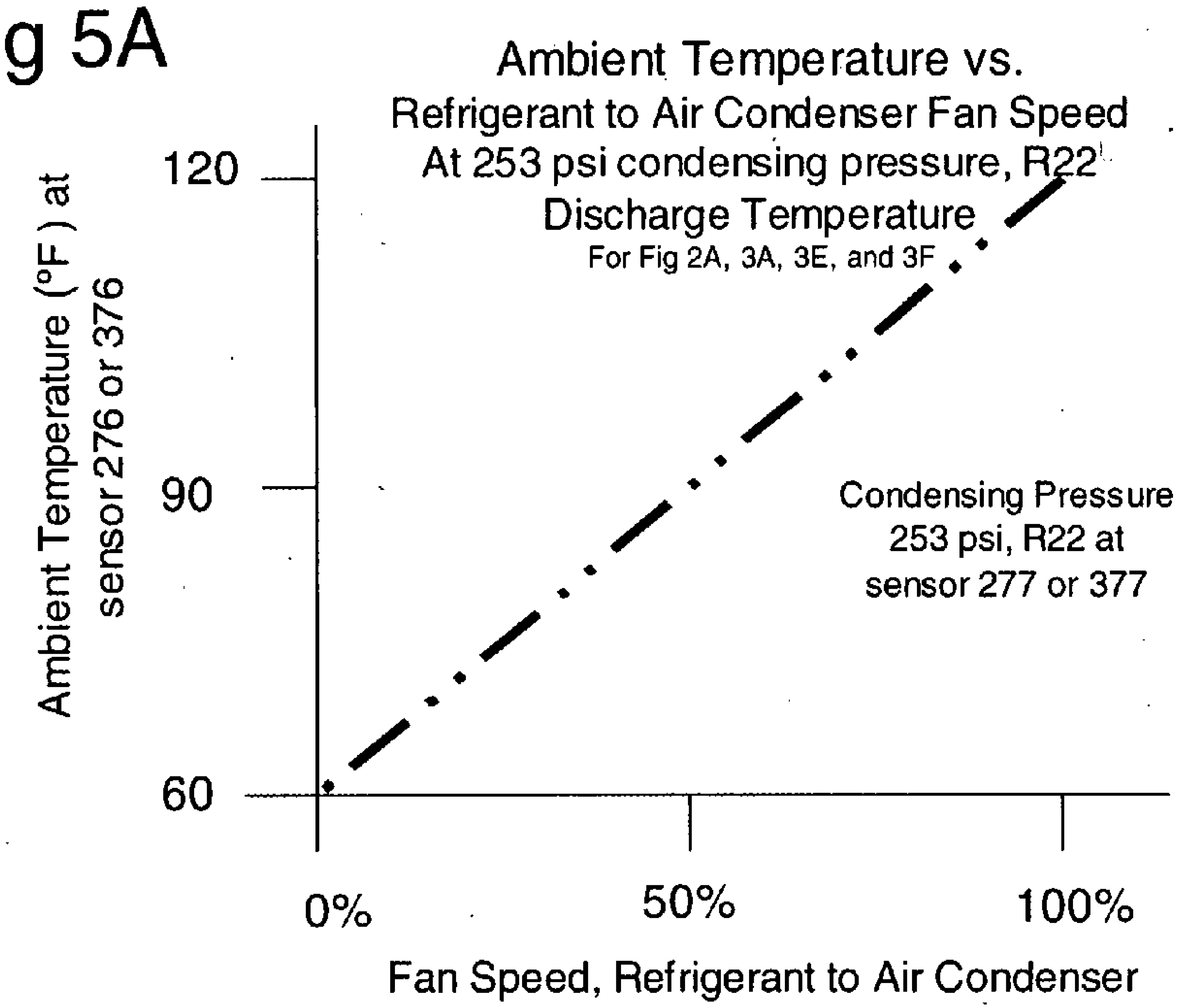

Ambient Temperature vs.
Refrigerant to Air Condenser Fan Speed
At 253 psi condensing pressure, R22
Discharge Temperature
For Fig 2A, 3A, 3E, and 3F
Ambient Temperature (°F) at sensor 276 or 376
120
90
60
Condensing Pressure 253 psi, R22 at sensor 277 or 377
0%
50%
100%
Fan Speed, Refrigerant to Air Condenser

Fig 5B

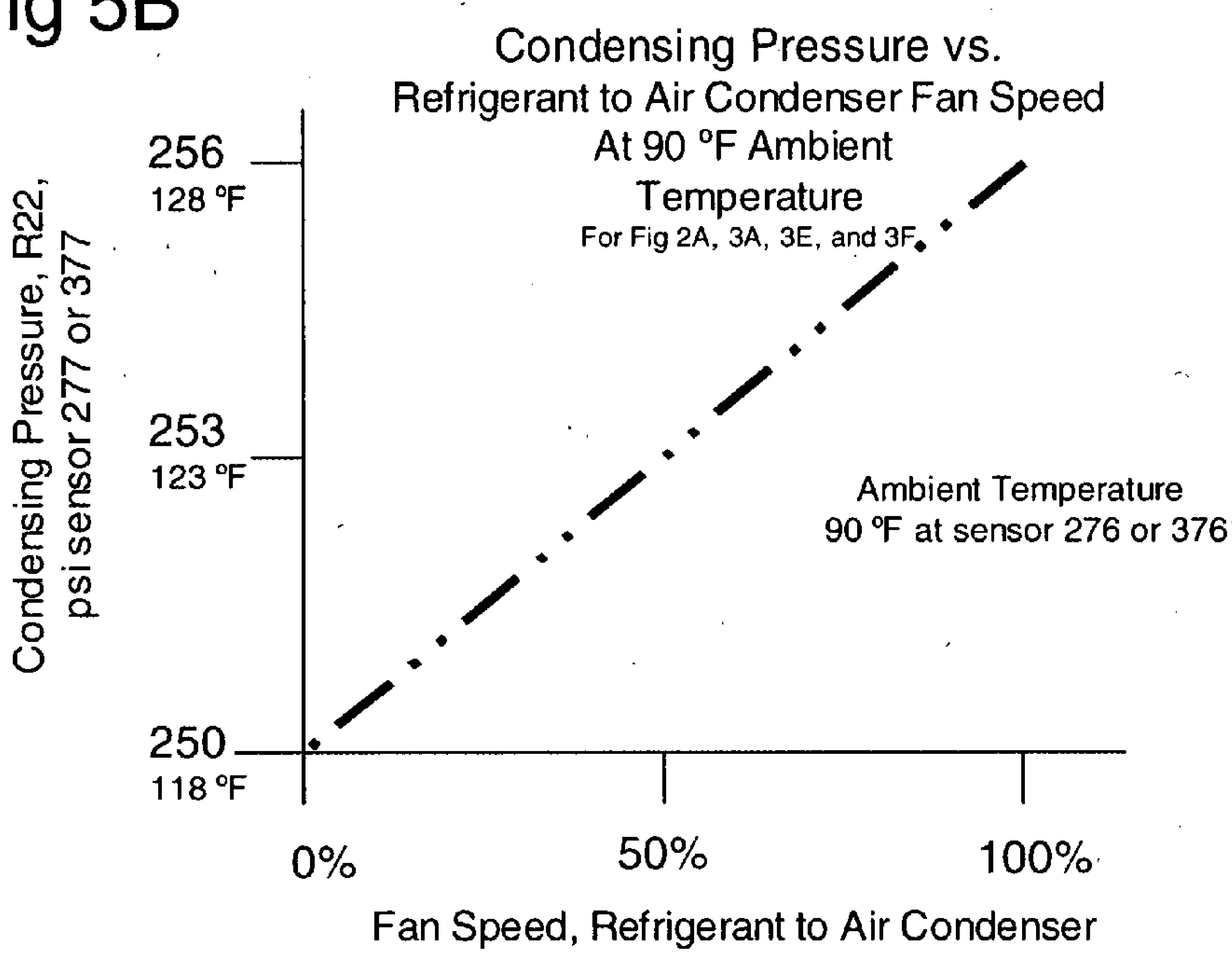
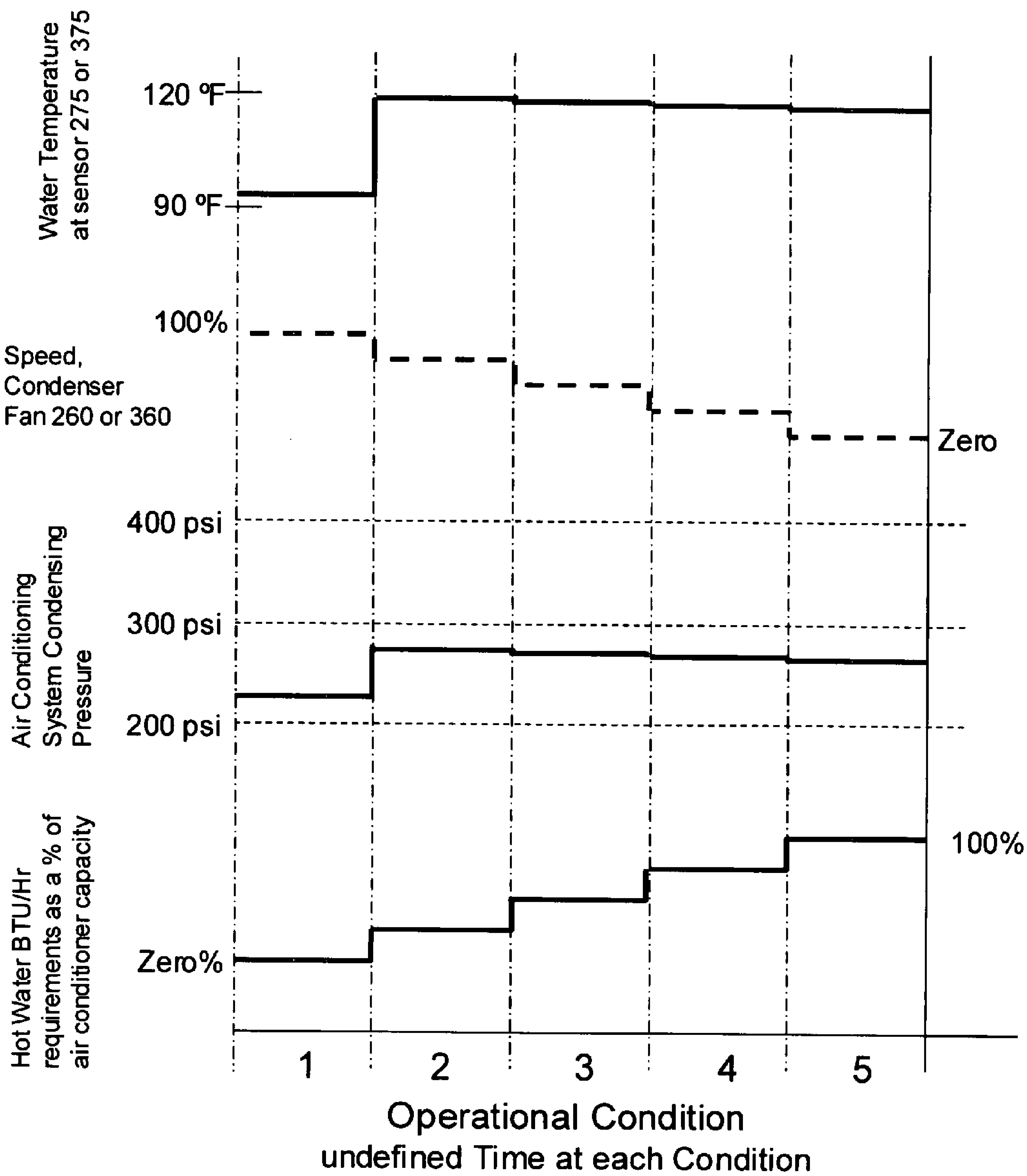

Condensing Pressure vs.
Refrigerant to Air Condenser Fan Speed
At 90 °F Ambient Temperature
For Fig 2A, 3A, 3E, and 3F
Condensing Pressure, R22, psi sensor 277 or 377
256
128 °F
253
123 °F
250
118 °F
Ambient Temperature 90 °F at sensor 276 or 376
0%
50%
100%
Fan Speed, Refrigerant to Air Condenser

Fig 6A

Theoretical Outlet Water Temperature, Air Conditioning System Condensing Pressure, Condenser Fan Speed, and Hot Water BTU/Hr Requirements at various Operational Conditions for Fig For Fig 2A, 3A, 3E, and 3F

with 90°F ambient at the refrigerant to air condenser, where the refrigerant to water condenser has the same capacity as the air conditioning system.



SYSTEM FOR CONTROLLED FLUID HEATING USING AIR CONDITIONING WASTE HEAT

TECHNICAL FIELD

[0001] The present invention relates to the recovery of waste heat from a refrigeration or an air conditioning system, to provide a heated fluid at a controlled, consistent temperature.

BACKGROUND

[0002] The use of a heater to warm swimming pool water is quite common among swimming pool owners. Many existing systems use electric, gas, or fuel oil-heating units, which are costly to operate. Attempts to utilize air conditioning waste heat to provide a safe, economical, and low energy consuming pool water heating system, such as shown in U.S. Pat. No. 3,976,123 issued to Davies, have not been commercially successful as previous systems did not maintain a constant discharge temperature, were inefficient to operate, and could cause equipment damage.

SUMMARY OF THE INVENTION

[0003] It is a general object of the present invention to provide a pool water heater that uses the waste heat from a refrigeration or an air conditioning system to heat pool water, or other fluids, to useful and desired temperatures, and to do such water heating with consistent, controlled output water temperatures, with optimum air conditioning system efficiency, and without equipment damage.

[0004] This and other objects and features are provided, in accordance with one aspect of the present invention, by an air conditioning system comprising a compressor connected to a first condenser and to a second condenser, connected in parallel or in series. The condensers and the compressor are connected to an accumulator, the accumulator connected to an expansion valve, the expansion valve connected to an evaporator, and the evaporator connected to the compressor. A pump draws water from a pool of water and supplies the water to the first condenser and then the water is returned to the pool. A control system adjusts the thermal performance of the second condenser to increase or decrease the condensing pressure and condensing temperature to heat the water to the desired temperature, based on the readings of two sensors, pressure and/or temperature, while the accumulator supplies the proper amount of liquid refrigerant to the expansion valve during all phases of operation. Other applications are presented for hot water heating and clothes drying.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. **1**A shows a prior art air conditioning waste heat recovery system for heating pool water; FIG. **1**B, **1**C, and **1**D show a partial enlargement of FIG. **1**A and show the condition of the hot high temperature gaseous and liquid refrigerant with no pool water heating, partial pool water heating with the system charged with no pool water heating, and partial pool water heating with system charged with full pool water heating, respectively;

[0006] FIG. **1**E shows Theoretical Outlet Water Temperature, Air Conditioning System Condensing Pressure, Condenser Fan ON/OFF, and Hot Water Requirements at various Operational Conditions;

[0007] FIG. **2**A shows a first embodiment of the present invention air conditioning waste heat recovery system for heating pool water where the condensers are connected in series to an accumulator with a pressure equalization line between the compressor and accumulator, and the thermal performance of refrigerant-to-air condenser is controlled by adjusting its fan speed; FIG. **2**B, **2**C, and **2**D show a partial enlargement of FIG. **2**A, and show the condition of the hot high temperature gaseous and liquid refrigerant with no pool water heating, partial pool water heating, and maximum pool water heating, respectively;

[0008] FIG. **3**A shows a second embodiment of the present invention air conditioning waste heat recovery system for heating pool water Where the condensers are connected in parallel between the compressor and accumulator and the thermal performance of refrigerant-to-air condenser is controlled by adjusting its fan speed; FIG. **3**B, **3**C, and **3**D show a partial enlargement of FIG. **3**A, and show the condition of the hot high temperature gaseous and liquid refrigerant with no pool water heating, partial pool water heating, and maximum pool water heating, respectively;

[0009] FIG. 3E is similar as FIG. **3**A except the pool water heater is replaced by domestic or commercial hot water heating;

[0010] FIG. 3F is similar as FIG. **3**A except the pool water heater is replaced by clothes dryer heating;

[0011] FIG. **4**A and **4**B show the control graphs for controlling the water temperature from the refrigerant-to-water condenser using ambient air temperature at the refrigerant-to-air condenser and exit water temperature at the refrigerant-to-water condenser to modulate fan motor speed in FIG. **2**A and **3**A and associated Figures;

[0012] FIG. **5**A and **5**B show the control graphs for controlling the water temperature from the refrigerant-to-water condenser using ambient air temperature at the refrigerant-to-air condenser and the system condensing pressure to modulate fan motor speed in FIG. **2**A and **3**A and associated Figures;

[0013] FIG. **6**A shows Theoretical Outlet Water Temperature, Air Conditioning System Condensing Pressure, Condenser Fan Speed, and Hot Water Requirements at various Operational Conditions.

DETAILED DESCRIPTION

[0014] The use of air conditioning waste heat to heat swimming pool water has been demonstrated and is well know in the art. Davies discloses a system for controlled heating of pool water using waste heat of an air conditioner where the refrigerant-to-air condenser fan is cycled on and off in response to a sensor monitoring the temperature of the water exiting the refrigerant-to-water condenser. If the water temperature is below the Fan Off Set Point, the air conditioning condenser fan will be turned off, increasing the condensing pressure and temperature, increasing the amount of heat going into the refrigerant-to-water condenser, increasing the temperature of the water exiting refrigerant-to-water condenser. When the water temperature reaches the Fan On Set Point, which is higher than the Fan Off Set Point, the air conditioning fan will be turned on, decreasing the condensing pressure and temperature, reducing the amount of heat going into the refrigerant-to-water condenser, lowering the temperature of the water exiting refrigerant-to-water condenser. However, there are a number of inherent disadvantages present in this and other prior art systems. The cycling of the condenser fan is a poor practice as the rate of cycling can become too high, burning out the condenser fan motor. Cycling of the condenser fan increases as the water heating BTU/hr load decreases as when the inlet water temperature approaches the Fan Off Set Point. Increasing the temperature separation between the Condenser Fan On and Off Set Points will reduce the instances of motor burn out but increases the temperature swing in the outlet temperature of the water exiting the refrigerant-to-water condenser which is unacceptable in many applications like domestic hot water heating.

[0015] Davies states "In operation, the transfer of heat to the pool water does not interfere with the refrigeration and cooling capabilities of refrigeration loop". This is a common false belief, because it is assumed that the air conditioning system is more efficient due to the additional condensing capacity of the refrigerant-to-water condenser. But in fact, a 15% degradation has been observed with a small, 1-ton pool water refrigerant-to-water condenser installed on a 3-ton air conditioning system. The degradation is caused by the refrigerant-to-water condenser, which when in operation takes liquid refrigerant from the refrigerant-to-air condenser, disrupting the balance of liquid refrigerant in the system, allowing hot gaseous refrigerant to reach the air conditioner's expansion valve and evaporator. Larger degradations will occur if larger refrigerant-to-water condensers are used, which is one reason why prior air pool water heaters use smaller refrigerant-to-water condensers. The air conditioning system is usually charged with refrigerant without pool water heating. With just the refrigerant-to-air condenser running, refrigerant is added until a solid column of liquid exits the refrigerant-to-air condenser. The solid column of refrigerant liquid can be seen in a sight glass installed after the condenser and the solid column of refrigerant liquid keeps high pressure gaseous refrigerant out of the evaporator, which would degrade the operation of the evaporator. When the pool water is turned on, refrigerant is condensed in the refrigerant to-water condenser and this amount of liquid is removed from the refrigerant-to-air condenser allowing high pressure gaseous refrigerant to reach the expansion valve and evaporator. Gaseous refrigerant will now be seen in the sight glass. The result is the operational efficiency of the air conditioning system is lowered. The amount of gaseous refrigerant reaching the expansion valve and evaporator is dependent upon the amount of refrigerant being condensed in the refrigerant-to-water condenser. Charging the air conditioner when the pool heater is running will keep the refrigerant liquid column up to the expansion valve and evaporator while water is being heated by the refrigerant-to-water condenser. But when the pool heater is turned off excess liquid refrigerant will pass thru the evaporator to the compressor, destroying the compressor, as the compressor cannot compress a liquid. A larger pool water refrigerant-to-water condenser will increase the risk of compressor damage, which is why they are sized to the small side. Air conditioning inefficiency due to high pressure gaseous refrigerant reaching the evaporator and compressor damage risks are additional problems that have limited the use of air conditioning waste heat to heat pool water or other fluids.

[0016] Referring now to FIG. **1**A, a prior art air conditioning waste heat recovery system for heating pool water is shown generally as **100**. The air conditioning waste heat recovery system comprises a compressor **101**, a pool water condenser **102**, a refrigerant-to-air condenser **103**, an expansion valve **104**, an air to refrigerant evaporator **105** and refrigerant-to-air fan motor controller **108**. The refrigerant flow is shown by arrows **110**. Compressor **101** is connected to and supplies gaseous high pressure refrigerant-to-water condenser **134** condensing line **114** with refrigerant line **112**, the refrigerant-to-water condenser **134** condensing line **114** is connected to and supplies high pressure gaseous and/or liquid refrigerant to refrigerant-to-air condenser **103** refrigerant line **118** with refrigerant line **116**, the refrigerant-to-air condenser **103** refrigerant line **118** supplies high pressure liquid refrigerant to expansion valve **104** with refrigerant line **121**, the expansion valve **104** supplies low pressure liquid refrigerant to evaporator **105** refrigerant line **124**, the evaporator **105** refrigerant line **124** supplies low pressure gaseous refrigerant to compressor **101** with refrigerant line **128**. The pool water flow is shown by arrows **130**. Pump **131** is connected to and draws pool water **138** from pool **137** with line **139**, pump **131** is connected to and supplies the pool water **138** to the refrigerant-to-water condenser **134** with water line **132**, the water condenser **134** puts pool water **138** in contact for heat exchange with refrigerant line **114** which heats the pool water **138**, the water condenser **134** supplies heated water to the pool **137** with water line **136**. The waste heat recovery system refrigerant-to-air condenser **103** consists of a refrigerant line **118** with thermally connected fins **164**, fan motor **160** with fan blades **166** that blow ambient air **162** across the fins **164**, heating the ambient air **162**. The waste heat recovery system expansion valve **104** causes the high pressure liquid refrigerant to become low pressure liquid refrigerant. The waste heat recovery system air to refrigerant evaporator **105** consists of a refrigerant line **124** with thermally connected fins **184**, fan motor **180** with fan blades **186** which blow interior home air **182** across fins **184**, cooling the interior home air **186**, supplying low pressure gaseous refrigerant **141** to compressor **201**. Refrigerant-to-air fan motor controller **108** reads the temperature of the exit water at sensor **175** with electrical line **173** and turns fan motor **160** off once the predefined exit water temperature is reached with electrical line **171**. Now, all of the condensing must happen at the refrigerant-to-water condenser **134** refrigerant line **114** which increases the condensing pressure and temperature, heating the pool water **138** to a higher temperature. Fan motor controller **108** continues to read the exit water temperature with sensor **175** and will turn fan motor **160** back on when the exit water temperature increases to the predefined Fan ON temperature. Condensing will now occur in both condensers, lowering the condensing pressure and temperature, heating the pool water **138** to a lower temperature. If the pool water **138** temperature drops below the predefined Fan OFF set point, the OFF/ON cycle will repeat. The in home thermostat **172** tells fan motor controller **108** when system **100** is running.

[0017] Referring now to FIG. **1**B, **1**C, and **1**D, partial enlargements of FIG. **1**A, where refrigerant lines **112**, **114**, **116**, **118**, and **121** are shown coming to, through, and exiting pool water and refrigerant-to-air condenser **103** at various operational conditions. Refrigerant flow direction is shown by arrows **110**.

[0018] Referring now to FIG. **1**B where the pool water condenser is not being used and there is no pool water flow. Only the refrigerant-to-air condenser **103** is in operation and it is supporting the full air conditioning load. Liquid refrigerant **144** is only condensed in the refrigerant-to-air condenser **103**. Condensing starts at point **118***a* when the gaseous high pressure, high temperature refrigerant **141** comes in contact for heat exchange with the portion of refrigerant line **118** that is in contact for heat exchange with the thermally conductive fins **164** that are cooled by ambient air **162**. Condensing basically ends at point **118***b* as refrigerant line **118** continues past thermally conductive fins **164**. Approximately one half of the condenser volume between point's **118***a* and **118***b* are filled with liquid refrigerant **144**. The air conditioning system is normally charged with refrigerant with just the refrigeration to air condenser running, and charging is stopped when the outlet of the refrigerant-to-air condenser is solid liquid as seen in sight glass **119**.

[0019] Referring now to FIG. **1**C, where both the pool water condenser **102** and refrigerant-to-air condenser **103** are in operation. Pool water flow is shown by arrows **130**. Liquid refrigerant **144** is condensed in both condensers. Condensing starts at point **114***a* when the gaseous high pressure, high temperature refrigerant comes in contact for heat exchange with the portion of refrigerant line **114** that is in contact for heat exchange with and cooled by pool water **138**. Now there is liquid refrigerant in both condensers and since the system was charged with only the refrigeration to air condenser **103** running, there is not enough refrigerant in the system to allow a solid column of liquid exiting the refrigerant-to-air condenser **103** as seen in sight glass **119**. Now both gaseous high pressure refrigerant **141** and liquid refrigerant **144** reach the expansion valve **104** and air to refrigerant evaporator **105**, reducing system efficiency

[0020] Referring now to FIG. **1**D, where the air conditioning system has been charged with both the pool water condenser **102** and the refrigerant-to-air condenser **103** running. Now there is a solid column of liquid refrigerant **144** exiting the refrigerant-to-water condenser **134** and there is no high pressure gas **141** reaching the expansion valve **104** or the air to refrigerant evaporator **105**, as shown in sight glass **119**, for proper operational efficiency. However, when the pool water is turned off, the refrigerant liquid volume will revert to that of FIG. **1**B and the liquid refrigerant volume difference between FIG. **1**D and FIG. **1**B will go into the air to refrigerant evaporator **105** and on to the compressor **101**. Any liquid refrigerant **144** reaching the compressor **101** will cause severe damage and is dangerous.

[0021] Referring now to FIG. **1**E, where theoretical Outlet Water Temperature, Air Conditioning System Condensing Pressure, Condenser Fan ON/OFF, and Hot Water Requirements at various Operational Conditions are shown for FIG. **1**A. Five Operational Conditions are presented. The No. **1** Condition is for no pool water heating and the Hot Water requirement is zero. The air conditioning system is working normally as shown is FIG. **1**B. The No. **5** Condition is for full pool water heating and the Hot Water requirement is 100%. Refrigerant condensing is taking place only in the refrigerant-to-water condenser. There is very little cycling of fan motor **160** under this condition and if the system was charged with refrigerant under this operating condition, the liquid refrigerant distribution would be as shown in FIG. **1**D. If the system was charged with refrigerant under operation condition No. **1**, the liquid refrigerant distribution would be as shown in FIG. **1**C and hot gaseous refrigerant would reach the expansion valve, degrading air conditioning performance. The No. **2**, No. **3**, and No. **4** conditions are for 25%, 50% and 75% Hot Water requirements. Fan motor cycling decreases as the Hot Water requirements increase. Fan motor cycling at the lower Hot Water requirements will damage the typical refrigerant-to-air condenser fan motor. Fan motor cycling can be reduced by increasing the difference between the Fan ON and Fan OFF set points but this causes higher hot water temperature differences between Fan ON and Fan OFF operation, which is unacceptable to other applications like hot water heating. If the system was charged with refrigerant under operating condition No **5**, the liquid refrigerant distribution would be as shown in FIG. **1**E, but excess liquid refrigerant, the liquid difference between FIG. **1**D and **1**E, would be available to damage the compressor. Under these conditions, the lower the hot water requirements, the more liquid refrigerant is available to damage the compressor. If the system was charged with refrigerant under operation condition No. **1**, the liquid refrigerant distribution would be as shown in FIG. **1**C and hot gaseous refrigerant would reach the expansion valve, degrading air conditioning performance. If the system is charged under conditions **2**, **3**, or **4**, the system will only operate correctly at these specific operating conditions.

[0022] Accordingly, it is desirable to have an air conditioning waste heat system capable of heating pool water to desired temperatures with good operational efficiency, consistent output temperatures, and no equipment damage.

[0023] Referring now to FIG. **2**A, an air conditioning waste heat recovery system for heating pool water according to the present invention is shown generally as **200**, and comprises a compressor **201**, a pool water condenser **202**, a refrigerant-to-air condenser **203** where the condensers are connected in series; a pressure equalization line **206**, an accumulator **207**, a fan speed control **208** for the refrigerant-to-air condenser **203** fan motor **260**, an expansion valve **204**, and an air to refrigerant evaporator **205**. Arrows **210** show the refrigeration flow. Compressor **201** is connected to and supplies gaseous high pressure refrigerant to refrigerant line tee **215** with refrigerant line **213**, the refrigeration tee **215** is connected to and supplies gaseous high pressure, high temperature refrigerant to refrigerant-to-water condenser **234** condensing line **214** with refrigerant line **212**, the refrigerant-to-water condenser **234** condensing line **214** is connected to and supplies gaseous and or liquid refrigerant-to-air condenser **203** refrigerant line **218** with refrigerant line **216**, the refrigerant-to-air condenser **203** refrigerant line **218** supplies high pressure liquid refrigerant to accumulator **207** with refrigerant line **220**. The tee **215** also supplies gaseous high pressure refrigerant to accumulator **207** with pressure equalization line **206**. The accumulator **207** is connected to and supplies high pressure liquid refrigerant to expansion valve **204** with refrigerant line **221**, the expansion valve **204** supplies low pressure liquid refrigerant to evaporator **205** refrigerant line **224**, the evaporator **205** refrigerant line **224** supplies low pressure gaseous refrigerant to the compressor **201** with refrigerant line **228**. The pool water condenser **202** water flow is shown by arrows **230**. Pump **231** is connected to and draws pool water **238** from pool **237** with line **239**, the pump **231** is connected to and supplies the pool water **238** to the refrigerant-to-water condenser **234** with water line **232**, the water condenser **234** puts the pool water **238** in contact for heat exchange with the refrigerant line **214** which heats the pool water **238**, the water condenser **234** supplies heated pool water **238** to the pool **237** with water line **236**. The waste heat recovery system refrigerant-to-air condenser **203** consists of a refrigerant line **218** with thermally connected fins **264**, fan motor **260** with fan blades **266** that blow ambient air **262** across the fins **264**, heating the ambient air **262**. Fan speed controller **208** is connected to and adjusts fan motor **260** speed from zero to 100%, which controls the amount of condensation taking place in the refrigerant-to-air condenser **203** and raises or lowers the condensing pressure in both condensers to obtain the desired water temperature exiting the refrigerant-to-water condenser **234**. The waste heat recovery system expansion valve **204** causes the high pressure liquid refrigerant to become low pressure liquid refrigerant. The waste heat recovery system air to refrigerant evaporator **205** consists of a refrigerant line **224** with thermally connected fins **284**, fan motor **280** with fan blades **286** which blow interior home air **282** across the fins **284**, cooling the interior home air **286** and supplying gaseous refrigerating to compressor **201** by refrigerant line **228**. The control system **208** that modulates the refrigerant-to-air condenser **203** fan **206** will be discussed in detail later.

[0024] Referring now to FIG. **2**B, **2**C, **2**D, partial enlargements of FIG. **2**A, where refrigerant lines **213**, **212**, **214**, **215**, **216**, **218**, and **221** are shown coming to, through, and exiting pool water condenser **202**, refrigerant-to-air condenser **203** and accumulator **207**; and pressure equalization line **206** is connected between tee **215** a head of pool water refrigerant-to-water condenser **202** and the accumulator **207**. Arrows **210** show refrigerant flow direction.

[0025] Referring now to FIG. **2**B, the pool water condenser **202** is not being used and there is no pool water flow. The refrigerant-to-air condenser **203** is in operation and its condensing capacity is controlled by fan motor controller **208** running fan motor **280** at 100 percent of fan capacity, because water heating is not desired. Liquid refrigerant **244** is condensed only in the refrigerant-to-air condenser **203**. Condensing starts at point **218***a* when the gaseous high pressure, high temperature refrigerant **241** comes in contact for heat exchange with the portion of refrigerant line **218** that is in contact for heat exchange with the cooling fins **264**. Condensing basically ends at point **218***b* as refrigerant line **218** continues past thermally conductive fins **264**. The condensing volume between point's **218***a* and **218***b* are approximately one half filled with liquid refrigerant. The air conditioning system has been charged with the refrigerant with just the pool water condenser **202** running as shown in FIG. **2**D, which is the maximum liquid refrigerant condition and charging, stopped when the outlet of the refrigerant-to-air condenser **203** is solid liquid as seen in sight glass **119**. The accumulator **207** has the capacity to receive the unneeded liquid refrigerant when the pool water condenser is not in operation and pressure equalization line **206** allows accumulator volume changes without forcing the excess liquid refrigerant through the system, to avoid compressor damage.

[0026] Referring now to FIG. **2**C, where both the pool water condenser **202** and refrigerant-to-air condenser **203** are both in operation. Arrows **230** show pool water flow. Condensing starts at point **214***a* when the gaseous high pressure, high temperature refrigerant **241** comes in contact for heat exchange with the portion of refrigerant line **214** that is in contact for heat exchange with and cooled by the pool water **238**. Now there is liquid refrigerant in both condensers and since the system was charged with only the pool water condenser **202** running, there is enough liquid refrigerant **244** in the accumulator **207** to supply liquid refrigerant **244** so that a continuous column of liquid exits the accumulator **207** as seen in sight glass **219**. Now only liquid refrigerant **244** reaches the expansion valve **204** and air to refrigerant evaporator **205**, maintaining system efficiency. Fan motor controller **208** adjusts fan motor **260** speed between zero and 100%, which increases or decreases the condensing pressure and temperature to maintain the desired water temperature at the point **214***b* in the pool water refrigerant-to-water condenser **202**.

[0027] Referring now to FIG. **2**D, where the pool water condenser **202** is running at 100% and carrying the full air conditioning load. Refrigerant-to-air condenser **203** fan motor **280** has been turned off by motor controller **208**. This is the maximum water heating capability of the waste heat recovery system **200** and all of the condensing energy is going into heating the pool water. Arrows **230** show pool water flow. Condensing starts at point **214***a* when the gaseous high pressure, high temperature refrigerant **241** comes in contact for heat exchange with that portion of refrigerant line **214** that is in contact for heat exchange with and cooled by the pool water **238**. Now there is the maximum liquid refrigerant in both condensers and this is the operational condition for proper charging of the air conditioning waste heat recovery system for heating pool water. Now there is enough liquid refrigerant **244** in the accumulator **207** to supply liquid refrigerant **244** to allow a solid column of liquid to exit the accumulator **207** when pool water condenser **202** is not in operation and there is enough accumulator capacity to accept unneeded liquid refrigerant when pool water condenser **202** is running up to 100% of capacity. Since the accumulator maintains a constant liquid refrigerant supply to expansion valve **204** and the accumulator has the capacity to hold unneeded liquid refrigerant **244**, the system works at peak efficiency and there is no risk of compressor damage.

[0028] Referring now to FIG. **2**A again, fan **260** controller **208** receives inputs or sends outputs from water exit temperature sensor **275** by electrical line **273**, from condensing pressure sensor **277** at accumulator **207** by electrical line **278**, from ambient air temperature sensor **276** at refrigerant-to-air condenser **203** by electrical line **272**, and controls fan motor **260** speed with control line **271**. Controller **208** determines if water heating is needed and controller **208** turns on the air conditioning system by electrical line **274** to in home thermostat **272**. Controller then adjusts the speed of fan **260** per control graphs shown in FIG. **4**A and **4**B to maintain the selected water exit temperature from refrigerant-to-water condenser **234** as read at sensor **275**.

[0029] The size of the accumulator is dependent upon the sizes of the system condensers **234** and **203**. Typically the accumulator volume must be at least equal to the volume delta between the liquid volume shown in FIG. **2**B and the liquid volume shown in FIG. **2**D between point **214***a* and the point where line **221** enters accumulator **207**. This will guarantee that the expansion valve only sees liquid refrigerant under all stated operating conditions. A 5 to 10% additional accumulator volume is usually added as a safety factor.

[0030] Referring now to FIG. **3**A, an air conditioning waste heat recovery system for heating pool water accordingly to the present invention is shown generally as **300** where the condensers are connected in parallel and the refrigerant-to-air condenser capacity is controlled by ambient air flow **362**. The assembly **300** comprises a compressor **301**, a pool water condenser **302**, a refrigerant-to-air condenser **303**, an accumulator **307**, a fan speed control **308** for the refrigerant-to-air condenser **303**, an expansion valve **304**, and an air to refrigerant evaporator **305**. Arrows **310** show the refrigeration flow. Compressor **301** is connected to and supplies gaseous high pressure refrigerant to refrigerant line tee **315** with refrigerant line **313**, the refrigeration tee **315** is connected in parallel to and supplies gaseous high pressure refrigerant to both refrigerant-to-water condenser **334** condensing line **314** with refrigerant line **312**, and refrigerant-to-air condenser **303** condensing line **318** with refrigerant line **316**. Both condensers supply high pressure gaseous and/or liquid refrigerant to accumulator **307** with refrigerant lines **317** and **320**. Accumulator **307** supplies liquid refrigerant to expansion valve **305** and evaporator **304** with refrigerant line **321**. Evaporator **304** supplies low pressure gaseous refrigerant to compressor **301** with refrigerant line **328**. The pool water condenser **302** water flow is shown by arrows **330**. Pump **331** is connected to and draws pool water **338** from pool **337** with line **339**, the pump **331** is connected to and supplies the pool water **338** to the refrigerant-to-water condenser **334** with water line **332**, the refrigerant-to-water condenser **334** puts the pool water **338** in contact for heat exchange with the refrigerant line **314** which heats the pool water **338**, the refrigerant-to-water condenser **334** supplies heated water to the pool **337** with water line **336**. The waste heat recovery system refrigerant-to-air condenser **303** consists of a refrigerant line **318** with thermally connected fins **364**, fan motor **360** with fan blades **366** that blow ambient air **362** across the fins **364**, heating the ambient air **362** and fan speed controller **308** which controls the amount of condensation taking place in the refrigerant-to-air condenser **303** by adjusting the amount of ambient air **362** blowing over the fins **364**. The waste heat recovery system expansion valve **304** and air to refrigerant evaporator **305** operate in the conventional manner supplying low pressure gaseous refrigerating to compressor **301** by refrigerant line **328**.

[0031] Referring now to FIG. 3B, 3C, and 3D, partial enlargements of FIG. 3A, where refrigerant lines **315**, **313**, **312**, **314**, **317**, **316**, **318**, **320** and **321** are shown coming to, through, and exiting pool water condenser **302**, refrigerant-to-air condenser **303** and accumulator **307**. Both condensers are connected in parallel. Refrigerant flow is show with arrows **310**.

[0032] Referring now to FIG. 3B, pool water condenser **302** is not in operation and all condensing is occurring at the refrigerant-to-air condenser. Compressor **301** is connected to and supplies gaseous high pressure refrigerant **341** to refrigerant line tee **315** with refrigerant line **313**, the refrigeration tee **315** is connected in parallel to and supplies gaseous high pressure refrigerant **341** to both refrigerant-to-water condenser **334** condensing line **314** with refrigerant line **312**, and refrigerant-to-air condenser **303** condensing line **318** with refrigerant line **316**. Both condensers supply high pressure gaseous **341** and liquid refrigerant **344** to accumulator **307** with refrigerant line **317** and **320**, respectively. Accumulator **307** supplies liquid refrigerant **344** to expansion valve **305** and evaporator **304** with refrigerant line **321**. The pool water condenser **302** is not being used and there is no pool water flow. The refrigerant-to-air condenser **303** is in operation and its condensing capacity is controlled by fan motor controller **308** running fan motor **360** at 100 percent of fan capacity. Liquid refrigerant **344** is condensed only in the refrigerant-to-air condenser **303**. Condensing starts at point **318***a* when the gaseous high pressure, high temperature refrigerant **341** comes in contact for heat exchange with the portion of refrigerant line **318** that is in contact for heat exchange with the cooling fins **364**. Condensing basically ends at point **318***b* as refrigerant line **318** continues past thermally conductive fins **364**. Accumulator **307** accepts or supplies liquid refrigerant **344** as required, maintaining a constant liquid refrigerant flow to expansion valve **304** as shown in sight glass **319**.

[0033] Referring now to FIG. 3C, where both the pool water condenser **302** and refrigerant-to-air condenser **303** are both in operation. Arrows **330** show pool water flow. Condensing starts at point **314***a* when the gaseous high pressure, high temperature refrigerant comes in contact for heat exchange with the portion of refrigerant line **314** that is in contact for heat exchange with and cooled by the pool water **338**. Now there is liquid refrigerant in both condensers and since the system was charged with only the larger volume condenser running, there is enough liquid refrigerant **344** in the accumulator **307** to allow a solid column of liquid to exit the accumulator **307** as seen in sight glass **319**. Now only liquid refrigerant **344** reaches the expansion valve **304** and air to refrigerant evaporator **305**, maintaining system efficiency. Fan motor controller **308** adjusts fan motor **380** speed between zero and 100%, which increases or decreases the condensing pressure and condensing temperature to maintain the desired water temperature at the point **314***b* in the pool water condenser **302**.

[0034] Referring now to FIG. 3D where only the pool water condenser **302** is running. Arrows **330** show pool water flow and refrigerant low is shown by arrows **310**. Condensing starts at point **314***a* when the gaseous high pressure, high temperature refrigerant comes in contact for heat exchange with the portion of refrigerant line **314** that is in contact for heat exchange with and cooled by the pool water **338**. Fan motor controller **308** running fan motor **280** at zero percent of fan capacity, which makes all condensing take place in the pool water condenser **302**. This is the maximum water heating condition. Accumulator **307** accepts or supplies liquid refrigerant as required, maintaining a constant liquid refrigerant flow to expansion valve **304** as shown in sight glass **319**.

[0035] Referring now to FIG. 3E, which is similar to FIG. 3A except the pool water source has been replaced with a hot water heater. Fan **360** controller **308** receives inputs or sends outputs from water exit temperature sensor **375** by electrical line **373**, from refrigerant-to-water condenser **334**, from water heater control module **381**E by electrical line **379**E, from condensing sensor **377** at accumulator **307** by electrical line **378**, from ambient air temperature sensor **376** at refrigerant-to-air condenser **303** by electrical line **372**, and controls fan motor **360** speed with control line **371**. Water heater control module **381** tells controller **308** that water heating is needed and the air conditioning system is turned on by electrical line **374** to in home thermostat **372**. Controller then adjusts the speed of fan **360** per control graphs shown in FIG. **4**A and **4**B or FIG. **5**A and **5**B to maintaining the selected water exit temperature from refrigerant-to-water condenser **334** as read at sensor **375** or **377**.

[0036] Referring now to FIG. 3F, which is similar to FIG. 3A except the pool water source has been replaced with a clothes dryer condenser. Fan **360** controller **308** receives inputs or sends outputs from refrigerant-to-air clothes dryer sensor **379**F by electrical line **373**F, from clothes dryer control module **381** F by electrical line **379**F, from condensing pressure sensor **377** at accumulator **307** by electrical line **378**, from ambient air temperature sensor **376** at refrigerant-to-air condenser **303** by electrical line **372**, and controls fan motor **360** speed with control line **371**. Clothes dryer control module **381** tells controller **308** that air heating is needed and the air conditioning system is turned on by electrical line **374** to in home thermostat **372**. Controller **308** then adjusts the speed of fan **360** per control graphs shown in FIG. **4**A and **4**B or **5**A and **5**B to maintaining the selected air exit temperature from clothes dryer condenser **309**F as read at sensor **375**F. Note that charts **4**A, **4**B, **5**A and **5**B are for controlling the water exit temperature and that these water exit temperatures must be replaced with the wanted clothes dryer air exit temperatures for proper control and operation.

[0037] Other applications could be to Pasteurize milk or beer using the waste heat from a Dairy or Brewery's refrigeration systems or Hospital hot water heating using the Hospital's air conditioning waste heat. These applications could be met year round as their refrigeration or air conditioning systems run year round. Most air conditioned factory or office complexes could have their fluid heating needs met using their refrigeration or air conditioning waste heat.

[0038] System charging of two condensers in parallel is done with only the condenser with the larger liquid requirement running. Typically, this is the refrigerant-to-air condenser **303** in FIG. **3**A. However, there are instances where the other condensers may have the larger liquid requirement and in those cases, system charging must be done with only that condenser running. Charging is complete when the sight glass **319** is full of liquid.

[0039] The size of the accumulator for condensers connected in parallel is determined by subtracting the liquid requirements of each condenser when it alone is running as shown in FIG. **3**B and FIG. **3**D and plus an additional safety factor amount such as 1% of the system's liquid refrigerant volume. For the refrigerant-to-water condenser **334** the volume is typically equal to ½ of the volume between points **314***a* and **314***b* and the volume between points **314***b* and **317***a* as shown in FIG. **3**D. For the refrigerant-to-air condenser **303**, the refrigerant liquid volume is typically equal to ½ the volume between points **318***a* and **318***b* and the volume between points **318***b* and **321***a* as shown in FIG. **3**B.

[0040] Referring now to FIG. **4**A, a graph is shown of ambient temperature measured at sensor **276** or **376** at the refrigerant-to-air condenser **203** or **303** vs. refrigerant-to-air condenser fan speed for maintaining controlled exit water temperature from the pool water condenser **202** or **302** by controller **208** or **308** in FIG. **2**A or FIG. **3**A, respectively. As shown in the previous sentence, the last two digits of an item number are the same between FIG. **2**A and FIG. **3**A, and the first digit is either 2 or 3, respectively. From this point forward, this convention will apply unless otherwise noted. The graph in FIG. **4**A is for an exit water temperature set point of 120° F. as read by sensor **275** at the pool water condenser **202** and an operational ambient temperature range from 60 to 120° F. as read by sensor **276**. The 120° F. exit water temperature set point is chosen by the system operator. The operational ambient temperature range is the expected ambient temperature range at the refrigerant-to-air condenser. As the ambient temperature moves from 60 to 120° F., the fan speed will change from zero fan speed to 100% fan speed with a defined constant exit water temperature from the refrigerant-to-water condenser of 120° F.

[0041] Referring now to FIG. **4**B, a graph is shown of exit water temperature from the refrigerant-to-water condenser as read at sensor **275** vs. refrigerant-to-air condenser fan speed for maintaining controlled exit water temperature from the refrigerant-to-water condenser as read at sensor **275**. This graph is for the mid point ambient of 90° F. at the refrigerant-to-air condenser as read by sensor **276** and an exit water temperature from the refrigerant-to-water condenser range of 10° F. centered about the 120 degree set point. As the exit water temperature from the refrigerant-to-water condenser moves from 115 to 125° F., the fan speed control will change from zero fan speed to 100% fan speed at a constant 90° F. ambient temperature at the refrigerant-to-air condenser.

[0042] The control formula for graphs **4**A and **4**B can be represented by the following mathematical formula:

$$[25+(T_{ambMP}-T_{amb})K_{amb}]+[25+(T_{wSP}-T_{wact})K_w]=\%$$ fan speed at the refrigerant-to-air condenser.

Where:

[0043] All temperatures are in ° F.

[0044] T_{amb} equals the ambient air temperature at the refrigerant-to-air condenser **276**.

[0045] T_{ambMP} equals the mid point of expected ambient air temperatures at the refrigerant-to-air condenser.

[0046] T_{wact} equals the actual exit water temperature from the refrigerant-to-water condenser at sensor **275**.

[0047] T_{wSP} equals exit water temperature set point desired from the refrigerant-to-water condenser.

[0048] K_{amb} equals a constant that sets the control sensitivity to changes in ambient temperature at the refrigerant-to-air condenser. The ambient air temperature at the refrigerant-to-air condenser has a second order effect on the actual exit water temperature from the refrigerant-to-water condenser and Kamb is set at −1.66, a relatively insensitive number.

[0049] K_w equals a constant that sets the control sensitivity to changes in exit water temperature from the refrigerant-to-water condenser. Since controlling the exit water temperature from the refrigerant-to-water condenser is the goal of this control and by definition is the first order effect, K_w is set at −10 for these graphs. The higher the K_{amb} and K_w values, the higher the control reaction to changes in temperature. In the values above, K_w is 16.66 times more sensitive to its temperature changes than K_{amb}. If the system has problems maintaining accurate exit water temperatures from the refrigerant-to-water condenser, Kw should be increased. If Kw is too high, the control will be too sensitive, causing rapid oscillations in fan speed. If Kw is too low, the control will be too insensitive, causing problems maintaining accurate exit water temperatures from the refrigerant-to-water condenser. Kw values from −10 to −20 are usually acceptable.

[0050] The exit water temperature at sensor **275** should run within 2 degrees of the T_{wSP} temperature. If the exit water temperature at sensor **275** runs to the low side, increase T_{wSP}. If, the exit water temperature at sensor **275** runs to the high side, decrease T_{wSP}.

[0051] Referring again to FIG. **4**A and FIG. **4**B, it is possible to change sensor **275** or **375** from reading the water exit temperature to reading the system condensing temperature and to get similar control results with all other conditions being the same.

[0052] The control formula for graphs **4**A and **4**B for using system condensing temperature instead of water exit temperature can be represented by the following mathematical formula:

$$[25+(T_{ambMP}-T_{amb})K_{amb}]+[25+(T_{conT\,SP}-T_{conT\,act})_{KconT}]=\%$$ fan speed at the refrigerant-to-air condenser.

Where:

[0053] All temperatures are in ° F.

[0054] T_{amb} equals the ambient air temperature at the refrigerant-to-air condenser **276**.

[0055] T_{ambMP} equals the mid point of expected ambient air temperatures at the refrigerant-to-air condenser.

[0056] $T_{ConT\ act}$ equals the actual system condensing temperature from the refrigerant-to-water condenser at sensor **275**.

[0057] $T_{ConT\ SP}$ equals system condensing temperature set point need to produce the desired exit water temperature from the refrigerant-to-water condenser.

[0058] K_{amb} equals a constant that sets the control sensitivity to changes in ambient temperature at the refrigerant-to-air condenser. The ambient air temperature at the refrigerant-to-air condenser has a second order effect on the actual exit water temperature from the refrigerant-to-water condenser and K_{amb} is set at −1.66, a relatively insensitive number.

[0059] K_{conT} equals a constant that sets the control sensitivity to changes in system condensing temperature which affects exit water temperature at the refrigerant-to-water condenser. Since controlling the exit water temperature from the refrigerant-to-water condenser is the goal of this control and by definition is the first order effect, K_{conT} is set at −10 for these graphs. The higher the K_{amb} and K_{conT} values, the higher the control reaction to changes in temperature. In the values above, K_{conT} is 16.66 times more sensitive to its temperature changes than K_{amb}. If the system has problems maintaining accurate exit water temperatures from the refrigerant-to-water condenser, K_{conT} should be increased. If K_{conT} is too high, the control will be too sensitive, causing rapid oscillations in fan speed. If K_{conT} is too low, the control will be too insensitive, causing problems maintaining accurate exit water temperatures from the refrigerant-to-water condenser. Kw values from −10 to −20 are usually acceptable.

[0060] The exit water temperature at sensor **275** should run within 2 degrees of the $T_{conT\ SP}$ depending upon the size of the refrigerant-to-water condenser. If the exit water temperature at sensor **275** runs to the low side, increase $T_{conT\ SP}$. If the exit water temperature at sensor **275** runs to the high side, decrease $T_{conT\ SP}$.

[0061] Referring now to FIG. **5**A, a graph is shown of ambient temperature at the refrigerant-to-air condenser vs. refrigerant-to-air condenser fan speed for maintaining controlled exit water temperature from the refrigerant-to-water condenser by controller **208** in FIG. **2**A and **308** in FIG. **3**A. This graph is for a condensing pressure set point of 253 psi and an operational ambient temperature range from 60 to 120° F. As the ambient temperature moves from 60 to 120° F., the fan speed control will change from zero fan speed to 100% fan speed with a defined constant condensing pressure of 253 psi.

[0062] Referring now to FIG. **5**B, a graph is shown of exit water temperature from the refrigerant-to-water condenser vs. condensing for maintaining controlled exit water temperature from the refrigerant-to-water condenser. This graph is for the mid point condensing pressure of 253 psi and a condensing pressure range of 6 psi centered about the 253 psi set point. These pressures are for R-22 and must be representative of the refrigerant being used by the system. As the condensing pressure moves from 250 to 256 psi, the fan speed control will change from zero fan speed to 100% fan speed at a constant 90 degree F. ambient temperature at the refrigerant-to-air condenser.

[0063] The control formula for these two graphs can be represented by the following mathematical formula:

$$[25+(T_{ambMP}-T_{amb})K_{amb}]+[25+(P_{conSP}-P_{act})2.5\ K_{con}]=\%\ \text{refrigerant-to-air condenser fan speed.}$$

Where:

[0064] T_{amb} equals the ambient air temperature at the refrigerant-to-air condenser.

[0065] T_{ambMP} equals the mid point of expected ambient air temperatures at the refrigerant-to-air condenser.

[0066] P_{act} equals the actual condensing pressure at the refrigerant-to-water condenser and is selected based on the refrigerant used and the desired exit temperature of the refrigerant-to-water condenser. In this case the pressure is measured at the accumulator.

[0067] P_{conSP} equals condensing pressure set point desired from the refrigerant-to-water condenser.

[0068] K_{amb} equals a constant that sets the control sensitivity to changes in ambient temperature at the refrigerant-to-air condenser. The ambient air temperature at the refrigerant-to-air(condenser has a second order effect on the actual exit water temperature from the refrigerant-to-water condenser and Kamb is set at −1.66, a relatively insensitive number.

[0069] K_{con} equals a constant that sets the control sensitivity to changes in condensing pressure at the refrigerant-to-water condenser and thereby the exit water temperature from the refrigerant-to-water condenser. Since controlling the exit water temperature from the refrigerant-to-water condenser is the goal of this control and by definition K_{con} is the first order effect, K_{con} is set at −10 for these graphs. The higher the K_{amb} and K_{con} values, the higher the control reaction to changes in temperature and pressure, respectively. In the values above, K_{con} is 16.66 times more sensitive to its changes than K_{amb}. If the system has problems maintaining accurate exit water temperatures from the refrigerant-to-water condenser, K_{con} should be increased. If K_{con} is too high, the control will be too sensitive, causing rapid oscillations in fan speed. If Kw is too low, the control will be too insensitive, causing problems maintaining accurate exit water temperatures from the refrigerant-to-water condenser. Kw values from −10 to −20 are usually acceptable.

[0070] The exit water temperature at sensor **275** should run within 2 degrees of the P_{conSP} based on the pressure-temperature of the refrigerant being used. If the exit water temperature at sensor **275** runs to the low side, increase P_{conSP}. If the exit water temperature at sensor **275** runs to the high side, decrease P_{conSP}.

[0071] Referring now to FIG. **6**A, where Theoretical Outlet Water Temperature, Air Conditioning System Condensing Pressure, Condenser Fan Speed, and Hot Water Requirements at various Operational Conditions are shown for FIG. **2**A and **3**A. Five Operational Conditions are presented. The No. **1** Condition is for no pool water heating and the Hot Water requirement is zero. The air conditioning system is working normally as shown in FIG. **2**B or FIG. **3**B and the refrigerant-to-air fan motor **260** is running at 100%. The No. **5** Condition is for full pool water heating and the Hot Water requirement is 100%. Refrigerant condensing is taking place only in the refrigerant-to-water condenser as shown in FIG. **2**D and **3**D and the refrigerant-to-air fan motor **250** is not running, forcing all condensing to take place at the refrigerant-to-water condenser **234**. The No. **2**, No. **3**, and No. **4** conditions are for

25%, 50% and 75% Hot Water requirements. Fan motor **260** is controlled by controller **208** per control graphs **4**A and **4**B or **5**A and **5**B. The ambient air temperature at sensor **276** is 90° F. and has the fan motor **260** running at 50%. Sensor **275** gives the exit temperature of the heated pool water and controller **208** reads this sensor and adjusts fan **260** speed up or down from the 50% level set by ambient sensor **275** per the control formula given previously or control graphs in FIG. **4**A and **4**B. Since the control formula is 16.66 times more sensitive to the exit water temperature than the ambient air temperature, slight changes in exit water temperature will be corrected by significant changes in refrigerant-to-air condenser fan speed allowing consistent water temperature control over a wide range of operating conditions.

[0072] The same results can be reached by replacing Sensor **275** or **375** readings with condenser pressure sensor **277** or **377** and using control graphs shown in FIG. **5***a* and **5**B and their formula presented previously.

[0073] While the invention has been particularly shown and described with reference to preferred embodiments thereof it is well understood by those skilled in the art that various changes and modifications can be made in the invention without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A heat pump system for refrigeration or air conditioning, and for heating a fluid comprising:
- a compressor for supplying high pressure, high temperature gaseous refrigerant to a first condenser for heat exchange with a first condensing fluid and to a second condenser for heat exchange with a second condensing fluid;
- an expansion valve for receiving high pressure liquid refrigerant from said first and said second condensers;
- an evaporator for receiving low pressure liquid refrigerant from said expansion valve and supplying low pressure gaseous refrigerant to said compressor;
- a controller for adjusting the condensing fluid flow rate of said second condenser based on inputs from a first sensor for reading the condensing fluid condition at the first condenser and from a second sensor reading the ambient condition of the second condensing fluid.

2. The system of claim **1** wherein said first condenser and said second condenser are connected in parallel.

3. The system of claim **2** wherein an accumulator is connected between said first and said second condensers for receiving gaseous and or liquid refrigerant, and said accumulator supplies liquid refrigerant to said expansion valve.

4. The system of claim **1** wherein said first condenser and said second condenser are connected in series, and an accumulator is connected between said second condenser and said expansion valve, and a pressure equalization line is connected between said compressor and said accumulator, and said accumulator supplies liquid refrigerant to said expansion valve.

5. The system of claim **1** wherein said first sensor reads the condensing fluid exit temperature of said first condenser, and said second sensor reads the ambient air temperature at said second condenser, and said second condensing fluid is ambient air.

6. The system of claim **5** wherein said controller adjusts the ambient air flow as a percentage of maximum flow in accordance with the following formula: $[25+(T_{ambMP}-T_{amb})K_{amb}]+[25+(T_{wSP}-T_w)K_w]$.

7. The system of claim **6** wherein said ambient air flow rate at said second condenser is adjusted by changing the ambient air fan speed of said second condenser.

8. The system of claim **1** wherein said first sensor reads the condensing pressure of said refrigeration or air conditioning system, and said second sensor reads the ambient air temperature at said second condenser, and said second condensing fluid is ambient air.

9. The system of claim **8** wherein said controller adjusts the ambient air flow rate as a percentage of maximum flow rate in accordance with the following formula: $[25+(T_{ambMP}-T_{amb})K_{amb}]+[25+(P_{conSP}-P_{act})2.5\ K_{con}]$.

10. The system of claim **9** wherein said ambient air flow rate at said second condenser is adjusted by changing the ambient air fan speed of said second condenser.

11. The system of claim **1** wherein said first sensor reads the condensing temperature of said refrigeration or air conditioning system, and said second sensor reads the ambient air temperature at said second condenser, and said second condensing fluid is ambient air.

12. The system of claim **11** wherein said controller adjusts the ambient air flow as a percentage of maximum flow in accordance with the following formula: $[25+(T_{ambMP}-T_{amb})K_{amb}]+[25+(T_{conT\,SP}-T_{conT})K_{conT}]$.

13. The system of claim **12** wherein said ambient air flow rate at said second condenser is adjusted by changing the ambient air fan speed of said second condenser.

14. A heat pump system for refrigeration or air conditioning, and for heating a fluid comprising:
- a compressor for supplying high pressure, high temperature gaseous refrigerant to a first condenser for heat exchange with a first condensing fluid and to a second condenser for heat exchange with a second condensing fluid;
- said first and second condensers being connected in parallel;
- an accumulator for receiving high pressure gaseous and/or liquid refrigerant from said first and second condensers:
- an expansion valve for receiving high pressure liquid refrigerant from said accumulator;
- an evaporator for receiving low pressure liquid refrigerant from said expansion valve and supplying low pressure gaseous refrigerant to said compressor;
- a controller for adjusting the condensing fluid flow rate of said second condenser based on inputs from a first sensor for reading the condensing fluid condition at the first condenser and from a second sensor reading the ambient condition of the second condensing fluid.

15. A heat pump system for refrigeration or air conditioning, and heating a fluid comprising:
- a compressor supplying high pressure, high temperature gaseous refrigerant to a first condenser for heat exchange with a first condensing fluid;
- said first condenser supplying gaseous and/or liquid refrigerant to a second condenser for heat exchange with a second condenser fluid;
- an accumulator for receiving high pressure liquid refrigerant from said second condenser;
- a pressure equalization line between said compressor and said accumulator:
- an expansion valve for receiving high pressure liquid refrigerant from said accumulator;

an evaporator for receiving low pressure liquid refrigerant from said expansion valve and supplying low pressure gaseous refrigerant to said compressor;

a controller for adjusting the condensing fluid flow rate of said second condenser based on inputs from a first sensor for reading the condensing fluid condition at the first condenser and from a second sensor reading the ambient condition of the second condensing fluid.

16. The system of claim **1** where said first fluid is selected from but not limited to water, milk, beer, oil, or air, and said second fluid is selected from but not limited to air, water, oil, or a water antifreeze mix.

17. The system of claim **14** where said first fluid is selected from but not limited to water, milk, beer, oil, or air, and said second fluid is selected from but not limited to air, water, oil, or a water antifreeze mix.

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