

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
23 October 2008 (23.10.2008)

PCT

(10) International Publication Number
WO 2008/127228 A1

(51) International Patent Classification:
F25B 29/00 (2006.01)

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(21) International Application Number:

PCT/US2007/009033

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(22) International Filing Date: 13 April 2007 (13.04.2007)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: A METHOD AND SYSTEM FOR REJECTING HEAT IN AN ABSORPTION CHILLER

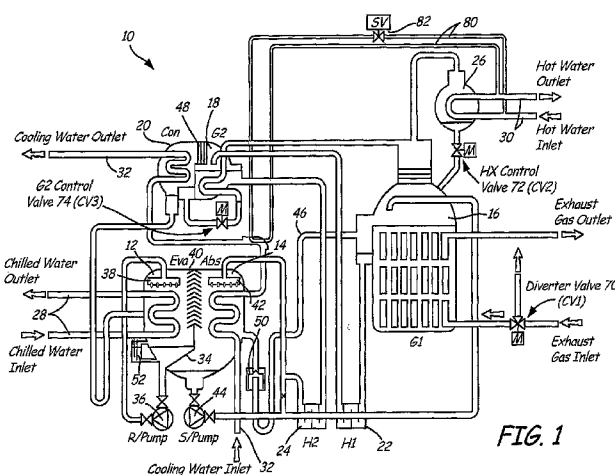


FIG. 1

(57) Abstract: A method and system for rejecting heat from a hot water source (30) capable of being used for heating in a simultaneous heating and cooling absorption chiller (10) includes a bypass loop (80) configured in parallel with a heat exchanger (26) used to increase a temperature of hot water (30) passing through the heat exchanger (26). The bypass loop (80) is connected to an inlet (84) and an outlet (90) of the heat exchanger (26) and is configured to receive at least a portion of the hot water (30) flowing to the heat exchanger (26). The bypass loop (80) includes a radiator (100) positioned inside a portion of a cooling water loop (32), and the radiator (100) is configured to reject or transfer heat from the hot water (30) to cooling water in the cooling water loop (32). The system further includes a valve (82) for controlling a flow of hot water (30) through the bypass loop (80) as a function of a temperature of the hot water (30) at the outlet (90) of the heat exchanger (26).

WO 2008/127228 A1



Published:

— *with international search report*

A METHOD AND SYSTEM FOR REJECTING HEAT IN AN ABSORPTION CHILLER

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BACKGROUND

[0001] The present disclosure relates to an absorption chiller system. More particularly, the present disclosure relates to a method and system for rejecting heat from a hot water source in an absorption chiller capable of simultaneous heating and cooling.

[0002] A simultaneous heating and cooling absorption chiller may be configured for providing heating and cooling to a building using, respectively, a hot water source and a chilled water source. The absorption chiller may include a heat exchanger configured for receiving the hot water and thereby increasing a temperature of the hot water. The building may have heating and cooling demands that vary frequently. There may be periods of time when the building is not requiring any heating; thus, the absorption chiller does not have a heating demand during that time. In those cases, if there is a cooling demand, the absorption chiller is still operating, and a pump that delivers the hot water to the heat exchanger may continue to circulate the hot water through the heat exchanger. Due in part to friction heat inside piping of the heat exchanger and energy from the pump, a temperature of the hot water may increase. If the building does not have a heating load to consume the energy from the hot water, the hot water may rise to an undesirable temperature.

[0003] There is a need for a system and method of rejecting heat from the hot water source when the hot water temperature at an outlet of the heat exchanger rises above a predetermined level.

SUMMARY

[0004] The present disclosure relates to a method and system for rejecting heat from a hot water source capable of being used for heating in a simultaneous heating and cooling absorption chiller having an absorber, a generator, a heat exchanger, a condenser, an evaporator, and a cooling water loop passing through the absorber and the condenser. The system includes a bypass loop configured in parallel with the heat exchanger and connected to an inlet and an outlet of the heat exchanger. The bypass loop is configured to receive at least a portion of hot water flowing to the heat exchanger, and includes a radiator positioned inside a portion of the cooling water loop. Hot water directed into the bypass loop flows through the radiator so that heat from the hot water is transferred to cooling water in the

cooling water loop. The system further includes a valve for controlling a flow of hot water through the bypass loop.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 is a schematic diagram of an exemplary embodiment of a simultaneous heating and cooling absorption chiller, which includes a heat exchanger and a bypass loop configured for rejecting heat from a hot water source being delivered to the heat exchanger.

[0006] FIG. 2 is a schematic diagram of the heat exchanger of FIG. 1 and a portion of the bypass loop.

[0007] FIG. 3 is another schematic diagram of the heat exchanger and the bypass loop of FIGS. 1 and 2, as well as a valve configured for regulating flow through the bypass loop.

[0008] FIG. 4 is a schematic diagram of a portion of the chiller of FIG. 1 including an absorber, a condenser, a cooling water loop, and the bypass loop, which includes a heat rejection radiator that passes through piping of the cooling water loop.

[0009] FIG. 5 is a schematic diagram of a control system for controlling operation of the absorption chiller of FIG. 1.

DETAILED DESCRIPTION

[0010] FIG. 1 is a schematic diagram of absorption chiller system 10, which includes evaporator 12, absorber 14, high stage generator 16, low stage generator 18, condenser 20, high temperature solution heat exchanger 22, low temperature solution heat exchanger 24, and auxiliary heat exchanger 26. In the exemplary embodiment of FIG. 1, chiller system 10 is a double-effect absorption chiller with simultaneous heating and cooling capabilities, and as such, system 10 may be used to supply heating and cooling to a building. It is recognized that the method and system described herein for rejecting heat in chiller system 10 may also apply to any type of absorption chiller having simultaneous heating and cooling capabilities, including, but not limited to, a single-effect or a triple-effect absorption chiller.

[0011] Chiller system 10 is configured to provide cooling to a building by decreasing a temperature of chilled water source 28, which passes through evaporator 12. System 10 is able to simultaneously provide heating to the building by increasing a temperature of hot water source 30, which passes through auxiliary heat exchanger 26. As is commonly used with absorption chillers, system 10 also includes cooling water loop 32 for flowing water from a cooling tower through absorber 14 and condenser 20 such that the cooling water is used for heat removal.

[0012] As is known in the art, absorption chiller systems, like system 10, are configured to use an absorbent solution, such as lithium bromide, and a refrigerant, such as

water, to provide a cooling and/or a heating effect. Although chiller system 10 is described using lithium bromide and water, it is recognized that other combinations (for example, water as the absorbent and ammonia as the refrigerant) may alternatively be used in system 10.

[0013] Evaporator 12 is configured to receive refrigerant in liquid form (i.e. water) from condenser 20 and store the water in evaporator sump 34. With the use of refrigerant pump 36, evaporator 12 pumps water from sump 34 to sprayer 38, located at a top of evaporator 12, or to a dripper system in evaporator 12. As a result of chilled water 28 running through tubes inside evaporator 12, water from sprayer 38 is vaporized, and chilled water 28 decreases in temperature. As shown, system 10 is a closed loop system and maintained in a vacuum such that water from sprayer 38 boils at a lower temperature. The refrigerant (water), now in vaporized form, travels to absorber 14 through eliminator 40, at which point the water is absorbed by a concentrated lithium bromide solution being sprayed through sprayer 42 at a top of absorber 14. A diluted lithium bromide solution then is delivered to high stage generator 16 using solution pump 44. High and low temperature solution heat exchangers 22 and 24, which transport lithium bromide solution to and from low stage generator 18, increase a temperature of the diluted lithium bromide solution flowing to generator 16, and thereby increase an efficiency of generator 16.

[0014] Exhaust gas is supplied to high stage generator 16 to boil water from the lithium bromide solution, thus generating steam. In the exemplary embodiment of FIG. 1, exhaust gas is supplied from a microturbine or another type of prime mover. A benefit of system 10 is that it utilizes waste heat from another component used in the building. It is recognized that other types of heat sources may be used for supplying heat energy to generator 16. For example, in alternative embodiments, generator 16 may be direct-fired, steam fired or hot-water driven. Steam generated by generator 16 may then be directed to low stage generator 18 and to auxiliary heat exchanger 26. Moreover, steam from generator 16 may also reside in overflow piping 46.

[0015] Steam from high stage generator 16 flows to a tube side of low stage generator 18. Lithium bromide solution from high stage generator 16 flows through heat exchanger 22 and then flows to a shell side of low stage generator 18. The lithium bromide solution in generator 18 then boils off additional steam due to transferred heat from the steam on the tube side of generator 18. The additional steam on the shell side of generator 18 then travels to condenser 20 through eliminator 48 located between generator 18 and condenser 20. In condenser 20, cooling water 32 flows through a tube side of condenser 20. As the steam

from generator 18 enters the shell side of condenser 20, the steam condenses and the condensate is recycled back to evaporator 12.

[0016] Steam in the tube side of generator 18 condenses and the condensate is recycled back to evaporator 12, along with the condensate from condenser 20. Lithium bromide from generator 18, which is again at a high concentration, flows through heat exchanger 24 and is recycled back to absorber 14. The cycle is repeated as concentrated lithium bromide is sprayed in absorber 14, thereby absorbing water from evaporator 12.

[0017] Because system 10, in the exemplary embodiment of FIG. 1, is a simultaneous heating and cooling absorption chiller, system 10 also includes auxiliary heat exchanger 26, which may be used for heating. Steam from high stage generator 16 travels to a shell side of auxiliary heat exchanger 26, where the steam condenses, thus transferring heat to hot water source 30 flowing through a tube side of heat exchanger 26. After the steam condenses, the liquid condensate is recycled back to generator 16, where it may be reabsorbed by the lithium bromide solution in generator 16.

[0018] In the embodiment shown in FIG. 1, chiller system 10 includes overflow piping 46 connected between high stage generator 16 and absorber 14. Overflow piping 46, used in conjunction with steam trap 50, may be used to recycle excess absorbent solution in generator 16, which may accumulate under certain operating conditions, back to absorber 14. As also shown in FIG. 1, system 10 includes liquid level sensors 52 for monitoring a level of refrigerant in evaporator sump 34 to control operation of refrigerant pump 36. It is recognized that overflow piping 46, steam trap 50 and sensors 52 are not required in chiller system 10, but may be used for improving operation of system 10, particularly under a low cooling or heating load.

[0019] As shown in FIG. 1, system 10 includes three main valves that are used to control operation of system 10 – diverter valve 70 (also referred to as CV1), heat exchanger control valve 72 (also referred to as CV2), and low stage generator control valve (also referred to as CV3). Valve 70 (CV1) is configured to regulate an amount of exhaust gas supplied to high stage generator 16 based on the heating and/or cooling demands on system 10. Valve 72 (CV2) is configured to regulate an amount of liquid condensate in heat exchanger 26 recycled back to generator 16, as a function of the heating demand. Valve 74 (CV3) is configured to regulate an amount of liquid condensate in low stage generator 18 recycled back to evaporator 12, based on the heating and/or cooling demands and the conditions inside high stage generator 16. System 10 also includes bypass loop 80, configured in parallel with heat exchanger 26, and valve 82, both of which are described in

further detail below. It is recognized that additional valves not specifically shown in FIG. 1 or described herein are included in system 10.

[0020] FIG. 2 is a schematic diagram of heat exchanger 26 from FIG. 1. Heat exchanger 26 is used to increase a temperature of hot water 30 passing through heat exchanger 26 via heat exchanger inlet 84 and heat exchanger outlet 90. In one embodiment, heat exchanger 26 may be a shell and tube type heat exchanger, in which case hot water 30a entering through inlet 84 is directed through multiple tubes 86 inside heat exchanger 26. Steam from generator 16 enters a shell side of heat exchanger 26 through piping 88. As such, heat from the steam is transferred to hot water 30 and the steam condenses on the outside of tubes 86 to form a liquid condensate. Generally speaking, when steam from generator 16 is entering the shell side of heat exchanger 26 and hot water 30 is passing through the tube side, an outlet temperature $T_{HE\ OUT}$ of hot water 30b at outlet 90 is greater than an inlet temperature $T_{HE\ IN}$ of hot water 30a at inlet 84.

[0021] Valve 72 (CV2) is configured to regulate an amount of heat transferable to hot water 30. If CV2 is open, the liquid condensate (which was steam from generator 16) is directed to flow out of heat exchanger 26 and back to generator 16 through piping 92. Conversely, if CV2 is closed, the liquid condensate builds up inside heat exchanger 26. A heating capacity of heat exchanger 26 is a function of an amount of condensate inside heat exchanger 26. As condensate accumulates inside heat exchanger 26, less steam is entering heat exchanger 26; consequently, there is less heat transfer to hot water 30. If CV2 remains closed over a period of time, the condensate eventually may occupy all of the space inside heat exchanger 26 such that heat exchanger 26 is not capable of providing any heating to hot water 30. In summary, the heating capacity of heat exchanger 26 is a function, in part, of the position or state of CV2.

[0022] CV2 controls the outlet temperature $T_{HE\ OUT}$ of hot water 30b by controlling an amount of condensate inside heat exchanger 26, based on a set point temperature $T_{SET\ PT}$ for hot water 30. For example, during a heating demand, the set point temperature $T_{SET\ PT}$ may be equal to 175°F. Therefore, CV2 is positioned and adjusted as necessary so that $T_{HE\ OUT}$ remains essentially equal to 175°F. Because system 10 is a simultaneous heating and cooling absorption chiller, system 10 may be operating in some cases when there is a cooling demand, but no heating demand. (This includes those scenarios in which the heating and cooling demands on system 10 are frequently fluctuating.) Under those conditions, hot water 30 may continue to be pumped through heat exchanger 26, even though the building is not requesting any heating.

[0023] The set point temperature $T_{\text{SET PT}}$ for the hot water outlet is adjusted to reflect changes in the heating demand. When there is no heating demand, controller 112 of system 10 (described below in reference to FIG. 5) may decrease $T_{\text{set pt}}$ and adjust diverter valve 70 (CV1) to supply less heat to generator 16. Less heat results in a generation of less steam and less heat transfer to hot water 30. The controller may also close CV2 in order to decrease the heating capacity of heat exchanger 26 by accumulating liquid condensate inside heat exchanger 26. Despite these adjustments, as a pump continues to circulate hot water 30 through heat exchanger 26, residual energy from the pump, as well as friction heat, may cause outlet temperature $T_{\text{HE OUT}}$ to increase above the set point temperature $T_{\text{SET PT}}$. If this hot water energy is not consumed by a building heating load, the outlet temperature $T_{\text{HE OUT}}$ may eventually reach an undesirably high temperature.

[0024] Bypass loop 80 may be used to reject (i.e. transfer) heat from hot water 30 when outlet temperature $T_{\text{HE OUT}}$ rises above a predetermined level. Bypass loop 80 includes first flow passage 96, second flow passage 98 and heat rejection radiator 100 (see FIG. 4). As shown in FIGS. 1 and 2, bypass loop 80 is configured in parallel with heat exchanger 26 and is configured to receive a portion of hot water 30a entering inlet 84 of heat exchanger 26. As shown in FIG. 2, first flow passage 96 is connected to inlet 84 of heat exchanger 26 and second flow passage 98 is connected to outlet 90. (This is further described in FIGS. 3 and 4.)

[0025] FIG. 3 is a schematic diagram of heat exchanger 26, a portion of bypass loop 80, and valve 82. First flow passage 96 delivers hot water 30 from heat exchanger inlet 84 to heat rejection radiator 100 (see FIG. 4); second flow passage 98 delivers hot water 30 from heat rejection radiator 100 to heat exchanger outlet 90. In the exemplary embodiment shown in FIG. 3, first flow passage 96 includes two sections of piping - first piping section 96a and second piping section 96b. Second flow passage 98 is similarly formed from at least one section of piping.

[0026] Valve 82 is located between first and second sections of piping 96a and 96b, and is configured to regulate a flow of hot water 30 through bypass loop 80. In one embodiment, valve 82 is a solenoid valve. It is recognized that other types of flow valves or similar flow regulating devices may be used. As described above, passage 96 is configured to receive a portion of hot water 30 passing through inlet 84. When solenoid valve 82 is actuated, water 30 is permitted to flow through valve 82 to radiator 100. When valve 82 is closed, all of hot water 30 flows through tubes 86 of heat exchanger 26.

[0027] FIG. 4 is a schematic diagram of a portion of absorber 14, condenser 20, cooling water loop 32, and bypass loop 80, all of which are also shown in FIG. 1. As described above in reference to FIG. 1, cooling water loop 32 is configured to circulate water from a cooling tower through absorber 14 and condenser 20. Cooling water loop 32 includes cross-over piping 32a between absorber 14 and condenser 20. As shown in FIG. 4, bypass loop 80 includes first flow passage 96 (specifically second section 96b), second flow passage 98, and heat rejection radiator 100 located between passages 96 and 98.

[0028] Heat rejection radiator 100 is designed to be located inside cross-over piping 32a and includes radiator inlet 102 and radiator outlet 104. Hot water 30 from heat exchanger inlet 84 passes from first fluid passage 96 through heat rejection radiator 100, and then to heat exchanger outlet 90 through second fluid passage 98. During operation of system 10, cooling water is circulating through cross-over piping 32a. As hot water 30 flows through radiator 100, heat is transferred from hot water 30 to cooling water in cross-over piping 32a. As such, a temperature of hot water 30 at outlet 104 of radiator 100 is less than a temperature of hot water 30 at inlet 102.

[0029] In the embodiment shown in FIG. 4, heat rejection radiator 100 is a piece of U-shaped piping, wherein a diameter of the piping is significantly less than a diameter of cross-over piping 32a. A benefit of the embodiment of FIG. 4 is that a standard piece of piping may be bent to form the U-shape or hairpin shape. In other embodiments, the piping may be bent in various ways so long as the piping is configured to be located inside cross-over piping 32a.

[0030] By containing heat rejection radiator 100 within cross-over piping 32a, system 10 does not require an additional heat exchanger configured for rejecting heat from hot water 30. Instead, chiller system 10 uses an existing cooling source (i.e. cooling water loop 32) for heat rejection under those conditions in which the hot water outlet temperature $T_{HE\ OUT}$ rises above a predetermined level. Moreover, because heat rejection radiator 100 is contained within cross-over piping 32a, bypass loop 80 does not increase a footprint of chiller system 10.

[0031] In preferred embodiments, radiator 100 is configured to maximize a length L of radiator 100 inside cross-over piping 32a in order to maximize an amount of heat transferred from radiator 100 to cooling water inside cross-over piping 32a. In some embodiments, radiator 100 may reside only in cross-over piping 32a; in alternative embodiments, a portion of radiator 100 may extend into a water box of absorber 14 and/or condenser 20.

[0032] FIG. 5 is a schematic diagram of control system 110 for controlling operation of chiller system 10, including bypass loop 80. System 110 includes controller 112, inputs 114 to controller 112 and outputs 116. It is recognized that control system 110 includes additional inputs and outputs that are not included in FIG. 5 for clarity.

5 [0033] Inputs 114 include cooling demand 118, heating demand 120, $T_{HE\ OUT}$, $T_{HE\ SET\ PT}$, $T_{ABS\ OUT}$, $T_{G2\ OUT}$, and $T_{G2\ SET\ PT}$. Because chiller system 10 is configured for simultaneous heating and cooling, system 10 may have a cooling demand and a heating demand at the same time. At other times, system 10 may be operating under either a cooling demand or a heating demand. Moreover, system 10 may experience frequent fluctuations in
10 the cooling and/or the heating demand. Based on cooling demand 118 and heating demand 120, controller 112 controls a position of valve 70 (CV1), which supplies heat (i.e. waste gas) to generator 16. So long as the total demand (heating plus cooling) does not exceed a maximum value, controller 112 may not be required to designate a heating priority or a cooling priority. However, if the total demand is greater than the maximum value, controller
15 12 may operate as a function, at least in part, of whether system 10 has a heating priority or a cooling priority. In either case, when the total demand is at or above a maximum value, control valve 70 (CV1) is fully open and controller 112 adjusts valves 72 and 74 to provide the required heating and/or cooling.

[0034] Because valve 72 (CV2) is configured to regulate a flow of condensate exiting
20 heat exchanger 26, valve 72 controls an ability of heat exchanger 26 to transfer heat to hot water 30 passing through heat exchanger 26. A position of valve 72 (CV2) is controlled, in part, as a function of the temperature $T_{HE\ OUT}$ of hot water 30b at outlet 90. Temperature $T_{HE\ OUT}$ is compared to a set point temperature $T_{HE\ SET\ PT}$ for the hot water, which may be, for example, commonly set at 175°F. Thus, as shown in FIG. 5, $T_{HE\ OUT}$ and $T_{HE\ SET\ PT}$ are both
25 inputs to controller 112.

[0035] As described above and illustrated in FIGS. 2 through 4, bypass loop 80 is configured to redirect at least a portion of hot water 30 from heat exchanger 26 to heat rejection radiator 100 if the temperature $T_{HE\ OUT}$ of hot water 30 at outlet 90 of heat exchanger 26 is too high. As described above, controller 112 adjusts CV2 to control
30 temperature $T_{HE\ OUT}$, based on the set point temperature $T_{HE\ SET\ PT}$. Therefore, heat rejection radiator 100 is usually not used until temperature $T_{HE\ OUT}$ is above a predetermined value that is greater than the set point temperature $T_{HE\ SET\ PT}$. Valve 82 controls a flow of hot water 30 to radiator 100, and is controlled by controller 112. When $T_{HE\ OUT}$ rises above the predetermined value, controller 112 opens valve 82 so that water 30 is able to flow through

radiator 100. The predetermined value is equal to a sum of the set point temperature $T_{SET\ PT}$ and a marginal value. For example, if $T_{HE\ SET\ PT}$ is equal to 175°F and the marginal value is equal to ten degrees, controller 112 opens valve 82 if $T_{HE\ OUT}$ is greater than 185°F. Valve 82 may then be closed when $T_{HE\ OUT}$ decreases to a temperature that is less than or equal to the predetermined value. Control system 110 includes at least one temperature sensor located around outlet 90 of heat exchanger 26 for measuring $T_{HE\ OUT}$.

[0036] As shown in FIG. 5, inputs 114 also include $T_{G2\ OUT}$, which is a temperature of liquid condensate exiting a tube side of generator 18, and $T_{ABS\ OUT}$, which is a temperature of absorbent solution (i.e. lithium bromide) exiting absorber 14. $T_{G2\ OUT}$ and $T_{ABS\ OUT}$ may be monitored, along with $T_{HE\ OUT}$, by controller 112 to determine a position of valve 74 (CV3). As described above, valve 72 (CV2) is used to control the outlet temperature $T_{HE\ OUT}$ of hot water 30, and consequently control an amount of heating provided by heat exchanger 26. However, in some scenarios (for example – a low outside ambient air temperature), even if valve 72 (CV2) is fully open (i.e. to maximize heating capacity of heat exchanger 26), the outlet temperature $T_{HE\ OUT}$ of hot water 30 may be less than the set point temperature $T_{HE\ SET\ PT}$. In that case, adjustments may be made to valve 74 (CV3), based on $T_{G2\ OUT}$, $T_{ABS\ OUT}$, and $T_{HE\ OUT}$, to increase the outlet temperature $T_{HE\ OUT}$ and bring it closer to $T_{HE\ SET\ PT}$. As also shown in FIG. 5, inputs 114 may also include a set point temperature for liquid condensate exiting low stage generator 18 (referred to as $T_{G2\ SET\ PT}$), which may be a function of $T_{ABS\ OUT}$ and $T_{HE\ OUT}$. The condensate set point temperature $T_{G2\ SET\ PT}$ is calculated by controller 112 as a function of inputs 114 to controller 112, and thus $T_{G2\ SET\ PT}$ varies depending on conditions inside system 10. Controller 112 compares $T_{G2\ OUT}$ to $T_{G2\ SET\ PT}$ to determine how to adjust valve 74. Control system 110 includes at least one temperature sensor at an outlet of absorber 14 for measuring the temperature of the absorbent solution $T_{ABS\ OUT}$, and at least one sensor at an outlet of generator 18 for measuring the temperature of the steam condensate, $T_{G2\ OUT}$.

[0037] As described herein and shown in FIGS. 1-4, bypass loop 80, which includes radiator 100, may be used in chiller system 10 to reject or transfer heat from hot water 30 when the building does not have a heating demand and an outlet temperature of hot water 30 becomes undesirably high. Bypass loop 80 is designed such that existing piping 32a of cooling water loop 32 in system 10 may be used for rejecting heat from hot water 30 to cooling water passing through piping 32a. As such, bypass loop 80 does not increase a footprint of absorption chiller system 10. Moreover, by utilizing an existing cooling water

loop, bypass loop 80 does not require an additional heat exchanger dedicated to removing heat from hot water 30.

[0038] In the exemplary embodiment shown and described above, heat rejection radiator 100 is a single piece of piping having a U-shape, and located in cross-over piping 32a. It is recognized that additional designs for radiator 100 may be used in system 10. For example, in alternative embodiments, heat rejection radiator 100 may be located inside the piping of cooling water loop 32 at a different location within system 10. Bypass loop 80 may be added to existing chiller systems or it may be included in the design of new chillers.

[0039] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

CLAIMS:

1. A system for use in a simultaneous heating and cooling absorption chiller having an absorber, a generator, a heat exchanger, a condenser, an evaporator, and a cooling water loop
5 passing through the absorber and the condenser, the system comprising:
a bypass loop in parallel with the heat exchanger and connected to an inlet and an outlet of the heat exchanger, and configured to receive at least a portion of hot water flowing to the heat exchanger, the bypass loop comprising:
a radiator positioned inside a portion of the cooling water loop and configured
10 to transfer heat from the hot water to cooling water in the cooling water loop; and
a valve for controlling a flow of hot water through the bypass loop.
2. The system of claim 1 wherein the valve is a solenoid valve.
3. The system of claim 2 wherein the solenoid valve is actuated if a temperature of the
15 hot water at the outlet of the heat exchanger is above a predetermined temperature.
4. The system of claim 1 wherein the valve operates as a function of a difference between a temperature of the hot water at the outlet of the heat exchanger and a predetermined temperature.
5. The system of claim 1 wherein the radiator is a heat exchanger contained within the
20 cooling water loop.
6. The system of claim 5 wherein the heat exchanger is insertable within the cooling water loop.
7. The system of claim 1 wherein the bypass loop further comprises:
a first flow passage connected to the inlet of the heat exchanger and configured to
25 deliver the hot water to an inlet of the radiator; and
a second flow passage connected to the outlet of the heat exchanger and configured to deliver the hot water from an outlet of the radiator to the outlet of the heat exchanger.
8. The system of claim 7 wherein the valve is located within the first flow passage.
- 30 9. The system of claim 1 further comprising:
a sensor for measuring a temperature of the hot water at the outlet of the heat exchanger.
10. A system for controlling a temperature of a hot water source in a simultaneous heating and cooling absorption chiller, the system comprising:

an absorption chiller comprising:

an evaporator configured to receive a refrigerant in liquid form and vaporize a portion of the refrigerant;

an absorber configured to contain an absorbent solution and receive the refrigerant in vaporized form from the evaporator so that the absorbent solution absorbs the refrigerant to form a diluted absorbent solution;

a generator configured to receive the diluted absorbent solution and a heat source such that the refrigerant is vaporized from the diluted absorbent solution;

a heat exchanger configured to receive at least a portion of the vaporized refrigerant from the generator, wherein the heat exchanger is configured to use the vaporized refrigerant to increase a temperature of hot water passing through the heat exchanger;

a condenser configured to receive refrigerant in vaporized form and form a condensate that is recycled back to the evaporator; and

a cooling water loop passing through the absorber and the condenser; and

a heat rejection loop configured in parallel with the heat exchanger and comprising:

a radiator positioned inside the cooling water loop and configured to lower the temperature of the hot water delivered to the heat exchanger in an absence of a heating demand;

a first flow passage connected to an inlet of the heat exchanger and configured for directing a portion of the hot water to the radiator; and

a second flow passage connected to an outlet of the heat exchanger and configured for directing the hot water from the radiator to an outlet of the heat exchanger;

a sensor for measuring a temperature of the hot water at the outlet of the heat exchanger; and

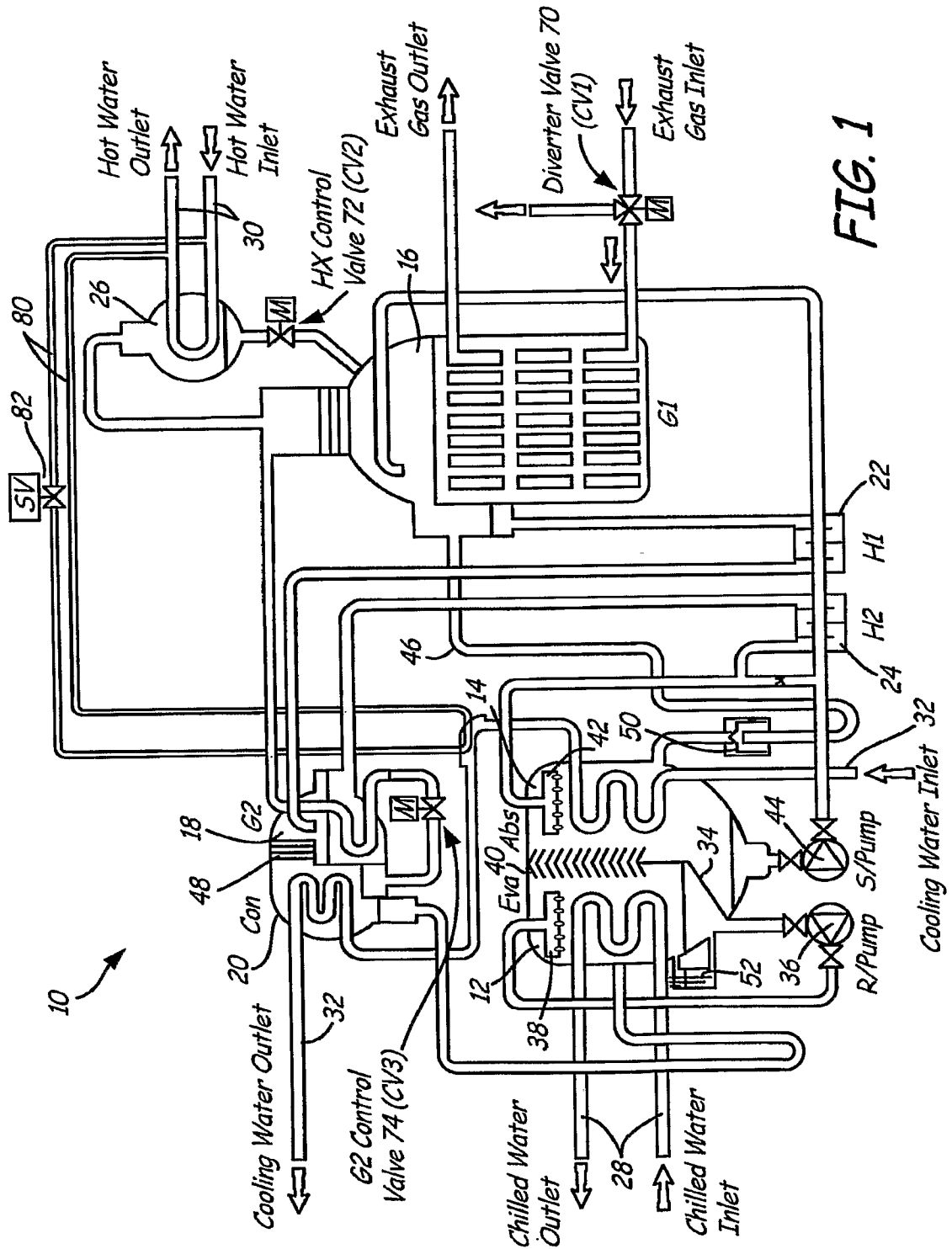
a valve for regulating a flow of the hot water through the heat rejection loop.

11. The system of claim 10 wherein a position of the valve is a function of a difference in the temperature of the hot water source at the outlet of the heat exchanger and a predetermined temperature.

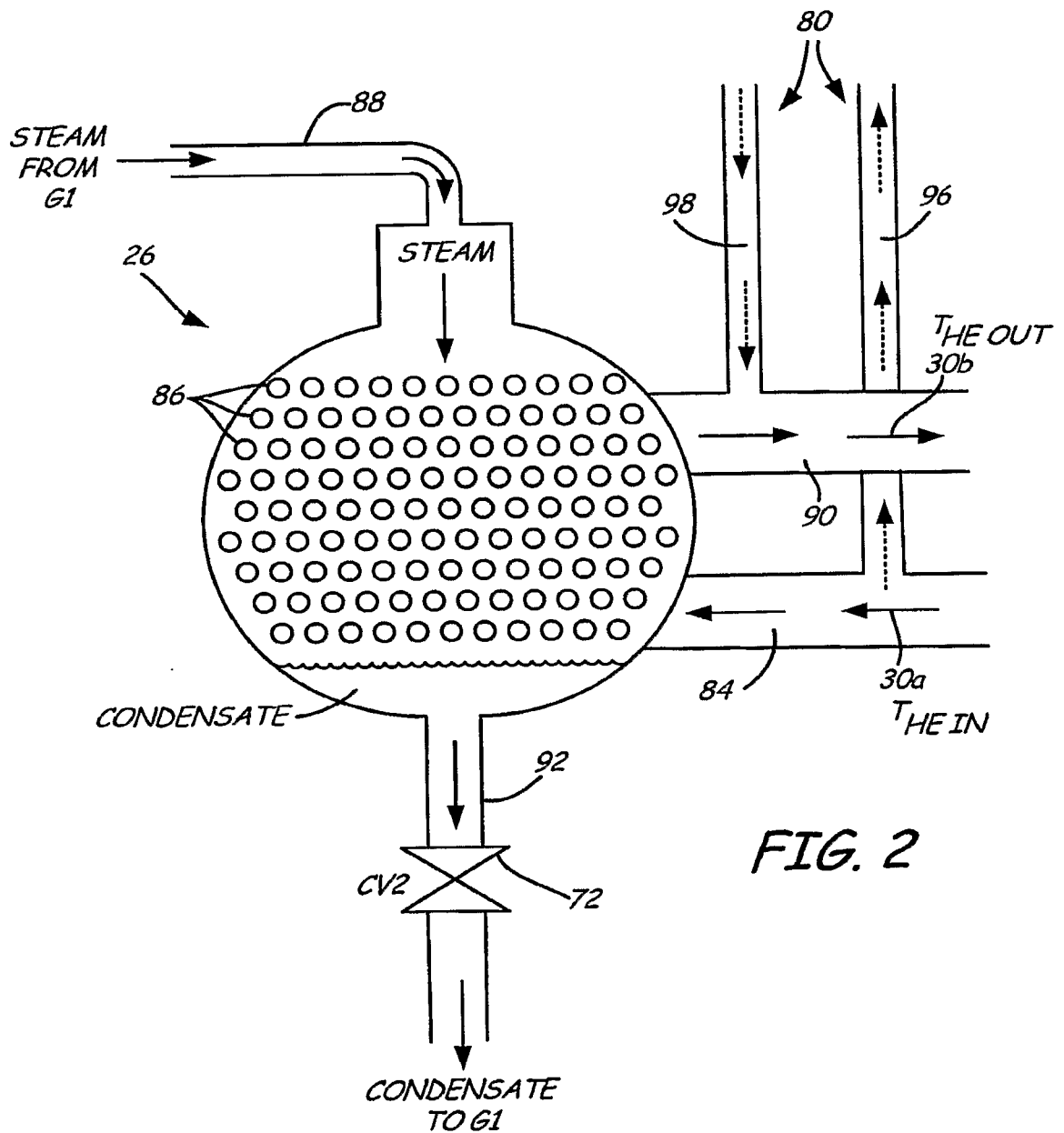
12. The system of claim 11 wherein the predetermined temperature is a sum of the set point of an outlet temperature of the hot water source and a marginal value.

13. The system of claim 10 wherein the valve is a solenoid valve.
14. The system of claim 10 further comprising:
a controller configured to receive signals from the sensor and control the valve as a
function of the temperature of the hot water source at the outlet of the heat
exchanger.
15. The system of claim 10 wherein the cooling water loop includes cross-over piping
between the absorber and the condenser, and the radiator is a section of piping having a
diameter that is less than a diameter of the cross-over piping.
16. The system of claim 15 wherein the radiator is U-shaped.
17. A method of rejecting heat from a hot water source capable of being used for heating
in a simultaneous heating and cooling absorption chiller, the method comprising:
removing a portion of hot water from an inlet of the auxiliary heat exchanger;
flowing the hot water through a heat rejection radiator, wherein the heat rejection
radiator is located inside cross-over piping between the absorber and the
condenser, and the cross-over piping is configured to carry cooling water such
that hot water exiting the heat rejection radiator is at a lower temperature
compared to hot water entering the heat rejection radiator;
directing the hot water from the heat rejection radiator to an outlet of the auxiliary
heat exchanger; and
controlling a flow of water through the heat rejection radiator as a function of an
outlet temperature of water exiting the outlet of the auxiliary heat exchanger.
18. The method of claim 17 wherein controlling a flow of water through the heat rejection
radiator includes a solenoid valve.
19. The method of claim 17 wherein controlling a flow of water through the heat rejection
radiator includes preventing water from flowing through the heat rejection radiator so long as
the outlet temperature of the water is below a predetermined value.
20. The method of claim 17 wherein controlling a flow of water through the heat rejection
radiator includes flowing water through the heat rejection radiator so long as the outlet
temperature of the water is above a predetermined value.
21. The method of claim 17 further comprises:
sensing a temperature of the hot water exiting the outlet of the auxiliary heat
exchanger.
22. The method of claim 17 wherein the heat rejection radiator is piping having a U-
shape.

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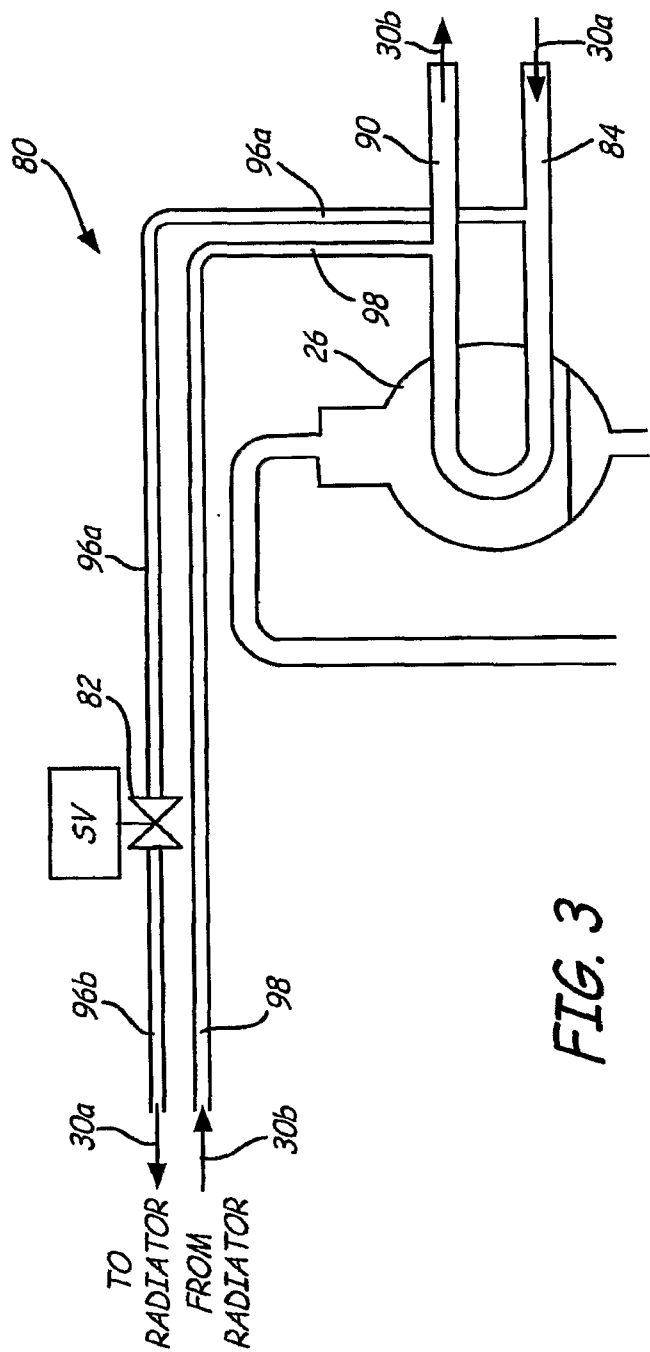


FIG. 3

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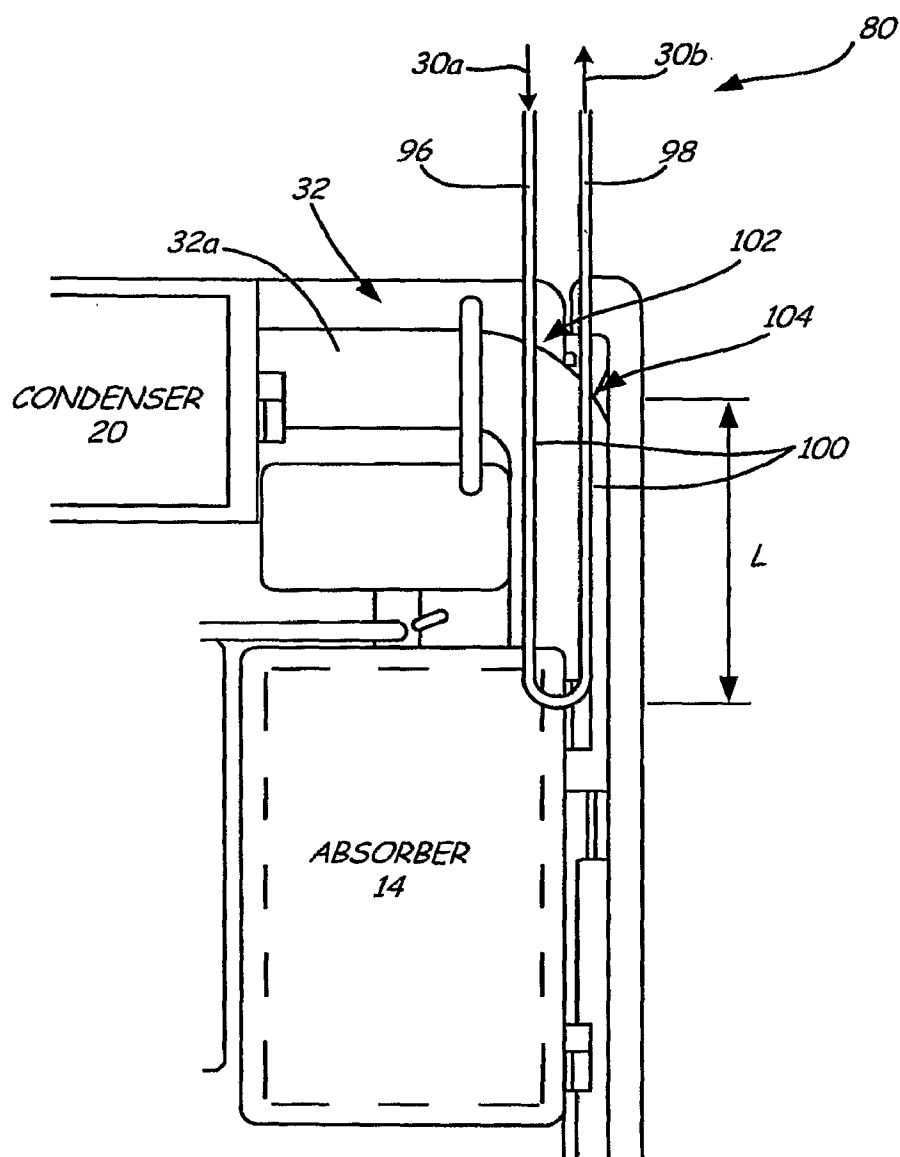


FIG. 4

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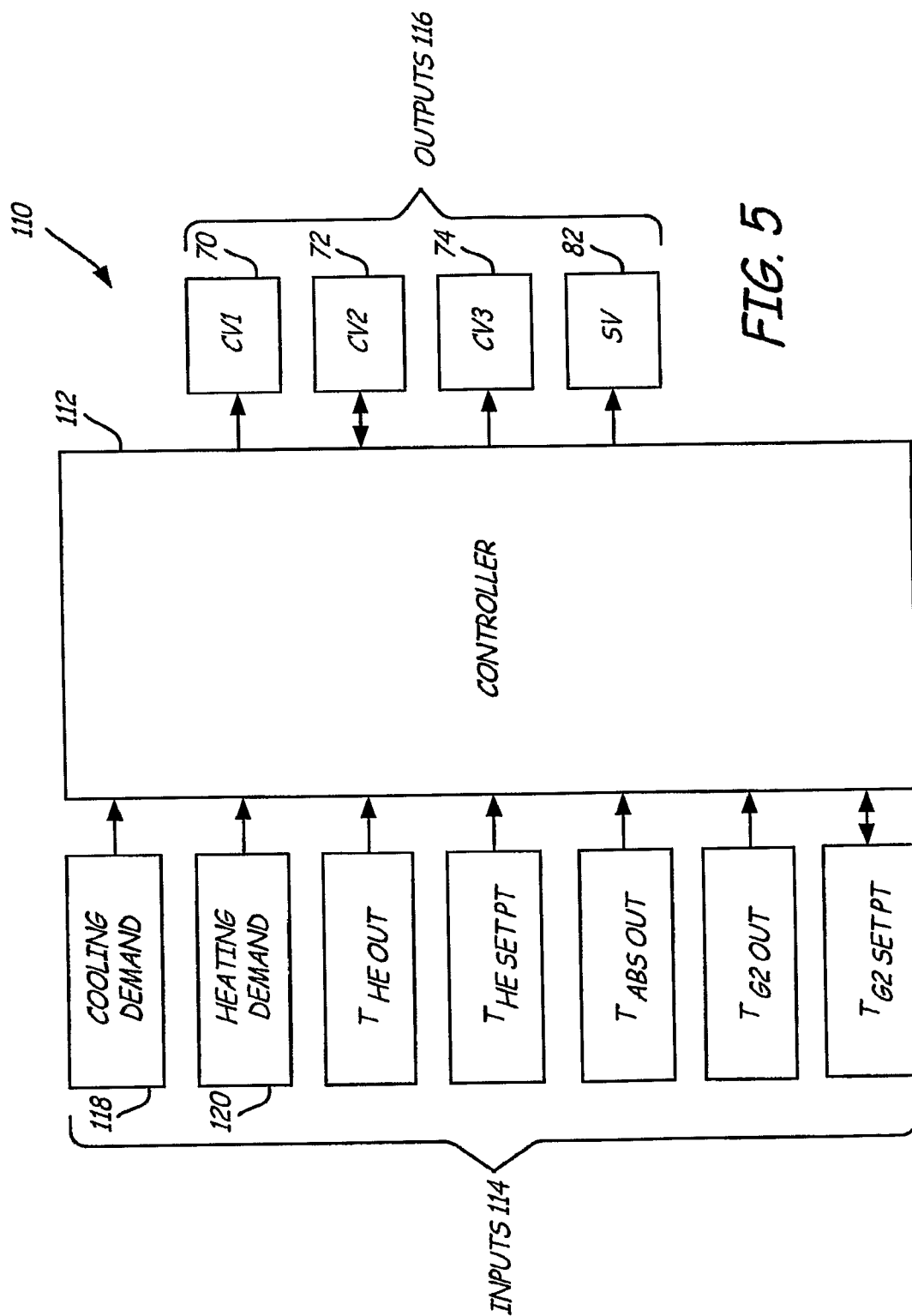


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2007/009033

A. CLASSIFICATION OF SUBJECT MATTER

INV. F25B29/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2007 003122 A (SANYO ELECTRIC CO) 11 January 2007 (2007-01-11) the whole document	1-22
X	US 5 749 244 A (MURAYAMA TOMOYUKI [JP] ET AL) 12 May 1998 (1998-05-12) the whole document	1-22
A	US 6 116 047 A (INOUE NAOUYUKI [JP] ET AL) 12 September 2000 (2000-09-12)	
A	JP 10 122692 A (EBARA CORP) 15 May 1998 (1998-05-15)	
A	JP 07 218016 A (HITACHI LTD) 18 August 1995 (1995-08-18)	



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

22 February 2008

Date of mailing of the international search report

28/02/2008

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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