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(54) Title: HEAT AND COLD SOURCES OF TEMPERATURE AND HUMIDITY INDEPENDENT CONTROL AIR CONDITIONING SYSTEM

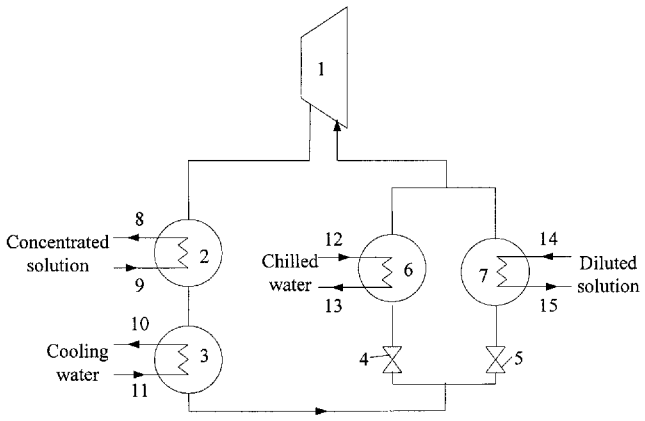


Fig. 2

(57) Abstract: Heat and cold sources of a temperature and humidity independent control air conditioning system comprise a compressor (1), a first condenser (2) and a second condenser (3), which are connected successively. A first expansion valve (4) and a second expansion valve (5) are respectively connected to the second condenser (3). A first evaporator (6) and a second evaporator (7) are respectively connected to the compressor (1). The first evaporator (6) is connected to the first expansion valve (4) to form a first cycle branch while the second evaporator (7) is connected to the second expansion valve (5) to form a second cycle branch. The first cycle branch and the second cycle branch are connected in parallel. The heat and cold sources of the temperature and humidity independent control air conditioning system have a relatively high refrigeration efficiency so as to significantly reduce energy consumption and protect environment.

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Heat and Cold Sources of Temperature and Humidity Independent Control Air Conditioning System

Technical Field

The present invention generally relates to refrigeration and air conditioning equipments technology fields, and more particularly, to heat and cold sources of Temperature and Humidity Independent Control (THIC) air conditioning system.

Background Art

The THIC air conditioning system is directed to an air conditioning system composed of an independent sensible heat processing system for indoor temperature control and an independent latent heat processing system for indoor humidity control. Due to its advantages on improving performance of conditioning system, reducing energy consumption, improving indoor air quality, and protecting atmosphere, the THIC air conditioning system is more and more widely applied in recent years. China patent CN1862123A provides high efficiency liquid desiccant fresh air handling units driven by heat pump. On one hand, the fresh air units cool the desiccant concentrated solution with an evaporator of a heat pump so as to improve the solution's capability of moisture absorption and remove the latent heat released during the moisture absorption process; on the other hand, the fresh air units heat the regenerated dilute solution with a condenser of the same heat pump, and the solution is concentrated into regenerated solution by performing a total heat exchange with the exhaust air of total heat recovery. The energy efficiency ratio (EER) of the heat pump driven liquid desiccant fresh air units provided by China patent CN1862123A is relatively high, thus the fresh air units has very good prospects for application. In the THIC air conditioning system mentioned below, the liquid desiccant fresh air units refers to the heat pump driven liquid desiccant fresh air units provided by China patent CN1862123A.

Fig. 1 is a schematic diagram illustrating the working principle of the THIC air conditioning system in the prior art. The indoor sensible heat is removed by high temperature(around 18℃) chilled water from refrigerator 1, and the indoor latent heat is removed by the dry and cool fresh air from the liquid desiccant fresh air units. In the liquid desiccant fresh air units, the cooling capacity required by the liquid dehumidifier and the heating capacity required by the liquid regenerator are provided by refrigerator 2. The refrigerator 1 and refrigerator 2 can be regarded as the heat and cold sources of the THIC air conditioning system. For the heat and cold sources of the THIC air conditioning system in the prior art, the refrigerator 1 is usually a centrifugal or screw refrigerator with a relatively large cooling capacity, and the refrigerator 2 is usually a vortex refrigerator with a relatively small cooling capacity. A centrifugal refrigerator is not used as the refrigerator 2, since the cooling capacity of a conventional centrifugal refrigerator is thousands of kilowatts and the cooling capacity required by the refrigerator 2 is usually below 200 kw according to the usual fresh air requirement (below 18000 m^3 per hour). However, the refrigeration efficiency of a vortex refrigerator is usually lower than that of a centrifugal refrigerator; the rated value of a vortex refrigerator is usually 3~4 while the refrigeration efficiency rated value of a centrifugal refrigerator may be 5~6. If a centrifugal refrigerator can be made small enough with the cooling capacity level of a vortex refrigerator, the original vortex refrigerator may be replaced by a centrifugal refrigerator.

To sum up, the refrigeration efficiency of the heat and cold sources of the prior THIC air conditioning system is relatively low, and it is disadvantaged to reduce energy consumption and protect atmospheric environment.

Contents of the Invention

(1) The technical problem to be solved

The technical problem to be solved according to the present invention is how

to provide heat and cold sources of the THIC air conditioning system with higher refrigeration efficiency in response to the above defects, so as to reduce energy consumption and protect atmospheric environment.

(2) The technical solution

To solve the above technical problem, the present invention provides heat and cold sources of the THIC air conditioning system, comprising: a compressor **1**, a first condenser **2** and a second condenser **3**, which are connected successively; a first expansion valve **4** and a second expansion valve **5** respectively connected to the second condenser **3**; a first evaporator **6** and a second evaporator **7** respectively connected to the compressor **1**; the first evaporator **6** is connected to the first expansion valve **4** to form a first cycle branch; the second evaporator **7** is connected to the second expansion valve **5** to form a second cycle branch; the first cycle branch and the second cycle branch which are connected in parallel connect the second condenser **3** and the compressor **1**.

Preferably, the compressor **1** is a centrifugal compressor.

Preferably, the first expansion valve **4** is further used for adjusting the temperature of the outlet chilled water of the first evaporator **6**.

Preferably, the second expansion valve **5** is further used for adjusting the temperature of the outlet diluted solution of the second evaporator **7**.

The present invention further provides heat and cold sources of the THIC air conditioning system, comprising: one or more refrigerators **a** and one or more refrigerators **b**, wherein,

The refrigerator **a** comprises: a first compressor **1a**, a first condenser **2a**, a first expansion valve **3a** and a first evaporator **4a**, which are connected together to form a ring;

The refrigerator **b** comprises: a second compressor **1b**, a second condenser **2b**, a second expansion valve **3b** and a second evaporator **4b**, which are connected together to form a ring.

Preferably, both the first compressor **1a** and the second compressor **1b** are centrifugal compressors.

Preferably, the one or more refrigerators **a** are independently controlled respectively; the one or more refrigerators **b** are independently controlled respectively.

(3) The advantageous effects

The present invention provides heat and cold sources of the THIC air conditioning system, in which a centrifugal refrigerator is used as a compressor for removing the indoor sensible heat and the indoor latent heat, so as to meet the heat and cold sources requirement of a small-scale THIC air conditioning system (the total cooling capacity is less than 250kW); the present invention further provides another heat and cold sources of the THIC air conditioning system, in which at least two centrifugal refrigerators are used as compressors for respectively removing the indoor sensible heat and the indoor latent heat independently, so as to meet the heat and cold sources requirement of a large-scale THIC air conditioning system (the total cooling capacity is greater than 500kW). Compared with the original vortex refrigerator, a centrifugal refrigerator has an obvious advantage on the refrigeration efficiency, thus the total refrigeration efficiency may be improved by taking a centrifugal refrigerator as heat and cold sources of the THIC air conditioning system. Therefore, it is possible to significantly reduce energy consumption and protect atmosphere environment.

Description of Figures

Fig. 1 is a schematic diagram illustrating the working principle of the THIC air conditioning system in the prior art;

Fig. 2 is a structure schematic diagram illustrating the heat and cold sources of the THIC air conditioning system according to embodiment 1 of the present invention;

Fig. 3 is a structure schematic diagram illustrating the heat and cold sources of the THIC air conditioning system according to embodiment 2 of the present invention.

Specific Mode for Carrying out the Invention

The specific mode for carrying out the invention is hereinafter described in detail with reference to the accompanying figures and embodiments. The following embodiments are provided by way of explanation of the invention, not limitation of the scope of the invention.

Embodiment 1

Fig. 2 is a structure schematic diagram illustrating the heat and cold sources of the THIC air conditioning system according to embodiment 1 of the present invention; as shown in fig. 2, the heat and cold sources of the THIC air conditioning system comprises: a compressor **1**, a first condenser **2** and a second condenser **3**, which are connected successively; a first expansion valve **4** and a second expansion valve **5** respectively connected to the second condenser **3**; a first evaporator **6** and a second evaporator **7** respectively connected to the compressor **1**; the first evaporator **6** is connected to the first expansion valve **4** to form a first cycle branch; the second evaporator **7** is connected to the second expansion valve **5** to form a second cycle branch; the first cycle branch and the second cycle branch which are connected in parallel connect the second condenser **3** and the compressor **1**.

The outlet refrigerant with higher temperature (greater than 45℃) from the compressor **1** firstly flows into the first condenser **2** to heat the concentrated solution which flows on the other side of the first condenser **2** in reverse direction from the refrigerant. Then, the outlet refrigerant from the first condenser **2** flows into the second condenser **3** and removes the extra condensing heat with the cooling water which flows on the other side of the second condenser **3** in reverse

direction from the refrigerant. The outlet refrigerant of the second condenser **3** is divided into two flows which are adjusted respectively by the first expansion valve **4** and the second expansion valve **5**; one of the two flows enters into the first cycle branch and passes through the first expansion valve **4** to flow into the first evaporator **6**, so as to cool the high temperature (18~21℃) chilled water which flows on the other side of the first evaporator **6** in reverse direction from the refrigerant; the other flow enters into the second cycle branch and passes through the second expansion valve **5** to flow into the second evaporator **7**, so as to cool the diluted solution which flows on the other side of the second evaporator **7** in reverse direction from the refrigerant. The outlet refrigerants of the first cycle branch and the second cycle branch, i.e. of the first evaporator 6 and the second evaporator **7** are mixed into a stream of refrigerant and return back to the compressor **1**, and then the refrigerant enters the next cycle after being processed.

In this embodiment, the compressor **1** of the heat and cold sources of the THIC air conditioning system is a centrifugal compressor, for example, a centrifugal compressor with the cooling capacity of 175kW (Wang Jia et al., Performance analysis on micro centrifugal chillers, Heating, Ventilating & Air Conditioning, 2009，39（5）：104~108).

In this embodiment, the concentrated solution entering the first condenser **2** through a concentrated solution inlet **9** is heated to around 45℃ by the refrigerant, and then it is sent to a regenerator through a concentrated solution outlet **8**.

The chilled water entering the first evaporator **6** through a chilled water inlet **12** is cooled to around 18℃ by the refrigerant, and then it is sent to an indoor sensible heat terminal through a chilled water outlet **13**.

The diluted solution entering the second evaporator **7** through a diluted solution inlet **14** is cooled to around 14℃ by the refrigerant, and then it is sent to the dehumidifier through a diluted solution outlet **15**.

In this embodiment, the outlet chilled water temperature of the first

evaporator **6** and the outlet diluted solution temperature of the second evaporator **7** are respectively adjusted by the first expansion valve **4** and the second expansion valve **5**, so that the cooling capacities of the first evaporator **6** and the second evaporator **7** respectively meet the requirements of themselves.

In this embodiment, the frequency or the guide vane angle of compressor **1** is adjusted according to the superheat degree of the outlet refrigerants of the first evaporator **6** and the second evaporator **7** to adjust the total refrigerant flow, so that the total cooling capacity of refrigerator meets the requirement of removing the sensible heat and the latent heat.

In this embodiment, the condensing temperature is adjusted by adjusting the temperature or flow of the cooling water entering the second condenser **3** through a cooling water inlet **11**, so that the outlet concentrated solution temperature of the first condenser **2** is adjusted to meet the requirement of the concentrated solution.

Embodiment 2

Fig. 3 is a structure schematic diagram illustrating the heat and cold sources of the THIC air conditioning system according to embodiment 2 of the present invention; as shown in fig. 3, the heat and cold sources of the THIC air conditioning system comprises one or more refrigerators **a** and one or more refrigerators **b**, wherein, the refrigerator **a** comprises: a first compressor **1a**, a first condenser **2a**, a first expansion valve **3a** and a first evaporator **4a**, which are connected together to form a ring; the refrigerator **b** comprises: a second compressor **1b**, a second condenser **2b**, a second expansion valve **3b** and a second evaporator **4b**, which are connected together to form a ring.

In the refrigerator **a**, the outlet refrigerant of the first compressor **1a** first flows into the first condenser **2a** to remove the condensing heat generated by the refrigerator **a** with the cooling water which flows on the other side of the first condenser **2a** in reverse direction from the refrigerant. The outlet refrigerant from the first condenser **2a** passes through the first expansion valve **3a** to flow into the

first evaporator **4a**, so as to cool the high temperature chilled water which flows on the other side of the first evaporator **4a** in reverse direction from the refrigerant; the outlet refrigerant of the first evaporator **4a** flows into the first compressor **1a**, and then enters the next cycle after being processed.

In the refrigerator **b**, the outlet refrigerant of the second compressor **1b** first flows into the second condenser **2b** to heat the concentrated solution which flows on the other side of the second condenser **2b** in reverse direction from the refrigerant by the higher temperature of the refrigerant. The outlet refrigerant of the second condenser **2b** passes through the second expansion valve **3b** to flow into the second evaporator **4b**, so as to cool the diluted solution which flows on the other side of the second evaporator **4b** in reverse direction from the refrigerant. The outlet refrigerant of the second evaporator **4b** flows into the second compressor **1b**, and then enters the next cycle after being processed.

In this embodiment, both the first compressor **1a** and the second compressor **1b** are centrifugal compressors, for example, a centrifugal compressor with the cooling capacity of 175kW (Wang Jia et al., Performance analysis on micro centrifugal chillers, Heating, Ventilating & Air Conditioning, 2009, 39 (5): 104~108).

In this embodiment, the high temperature chilled water entering the first evaporator **4a** through a chilled water inlet **7** is cooled to around 18℃ by the refrigerant, and then it is sent to an indoor sensible heat terminal through a chilled water outlet **8**.

In this embodiment, the concentrated solution entering the second condenser **2b** through a concentrated solution inlet **10** is heated to around 45℃ by the refrigerant, and then it is sent to a regenerator through a concentrated solution outlet **9**.

In this embodiment, the diluted solution entering the second evaporator **4b** through a diluted solution inlet **11** is cooled to around 14℃ by the refrigerant, and

then it is sent to the dehumidifier through a diluted solution outlet **12**.

In this embodiment, the one or more refrigerators **a** are independently controlled respectively.

In this embodiment, the one or more refrigerators **b** are independently controlled respectively.

The above embodiments are only used for explaining the present invention, but not for limiting its protection scope. Those skilled in the art may conduct various changes and variations without departing from the spirit and scope of the present invention. Therefore, all equivalent technical solutions shall fall into the protection scope of the present invention which is defined by the attached claims.

INDUSTRIAL APPLICABILITY

To sum up, the present invention provides heat and cold sources of the THIC air conditioning system, in which a centrifugal refrigerator is used as a compressor for removing both the indoor sensible heat and the indoor latent heat so as to meet the requirement of heat and cold sources of a small-scale THIC air conditioning system (the total cooling capacity is less than 250kW); the present invention further provides another heat and cold sources of the THIC air conditioning system, in which at least two centrifugal refrigerators are used as compressors for respectively removing the indoor sensible heat and the indoor latent heat independently so as to meet the requirement of heat and cold sources of a large-scale THIC air conditioning system (the total cooling capacity is greater than 500kW). Compared with the original vortex refrigerator, a centrifugal refrigerator has an obvious advantage on the refrigeration efficiency, thus the total refrigeration efficiency may be improved by taking a centrifugal refrigerator as a heat and cold sources of the THIC air conditioning system. Therefore, it is possible to significantly reduce energy consumption and protect atmosphere environment.

Claims

1. Heat and cold sources of the temperature and humidity independent control air conditioning system, comprising: a compressor (1), a first condenser (2) and a second condenser (3), which are connected successively; a first expansion valve (4) and a second expansion valve (5) respectively connected to the second condenser (3); a first evaporator (6) and a second evaporator (7) respectively connected to the compressor (1); the first evaporator (6) is connected to the first expansion valve (4) to form a first cycle branch; the second evaporator (7) is connected to the second expansion valve (5) to form a second cycle branch; the first cycle branch and the second cycle branch which are connected in parallel connect the second condenser (3) and the compressor (1).

2. The heat and cold sources of claim 1, wherein the compressor (1) is a centrifugal compressor.

3. The heat and cold sources of claim 1, wherein, the first expansion valve (4) is further used for adjusting the temperature of the outlet chilled water of the first evaporator (6).

4. The heat and cold sources of claim 1, wherein, the second expansion valve (5) is further used for adjusting the temperature of the outlet diluted solution of the second evaporator (7).

5. Heat and cold sources of the temperature and humidity independent control air conditioning system, comprising: one or more refrigerators (a) and one or more refrigerators (b), wherein

the refrigerator (a) comprises: a first compressor (1a), a first condenser (2a), a first expansion valve (3a) and a first evaporator (4a), which are connected together to form a ring;

the refrigerator (b) comprises: a second compressor (1b), a second condenser (2b), a second expansion valve (3b) and a second evaporator (4b), which are

connected together to form a ring.

6. The heat and cold sources of claim 5, wherein both the first compressor (1a) and the second compressor (1b) are centrifugal compressors.

7. The heat and cold sources of claim 5, wherein,

the one or more refrigerators (a) are independently controlled respectively;

the one or more refrigerators (b) are independently controlled respectively.

Figures Attached to Description

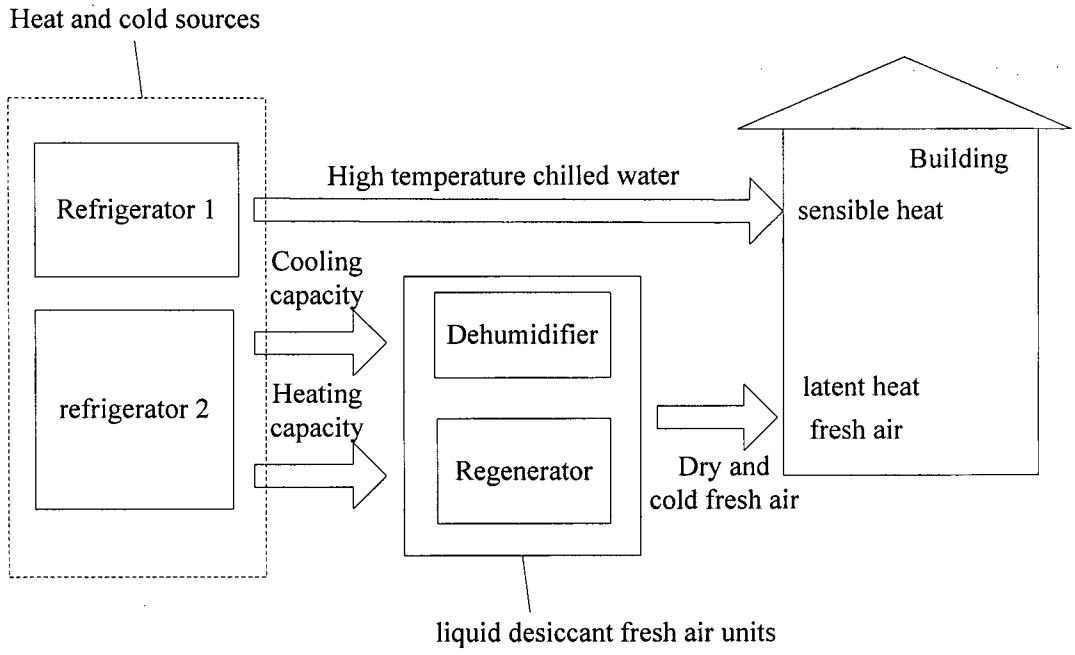


Fig. 1

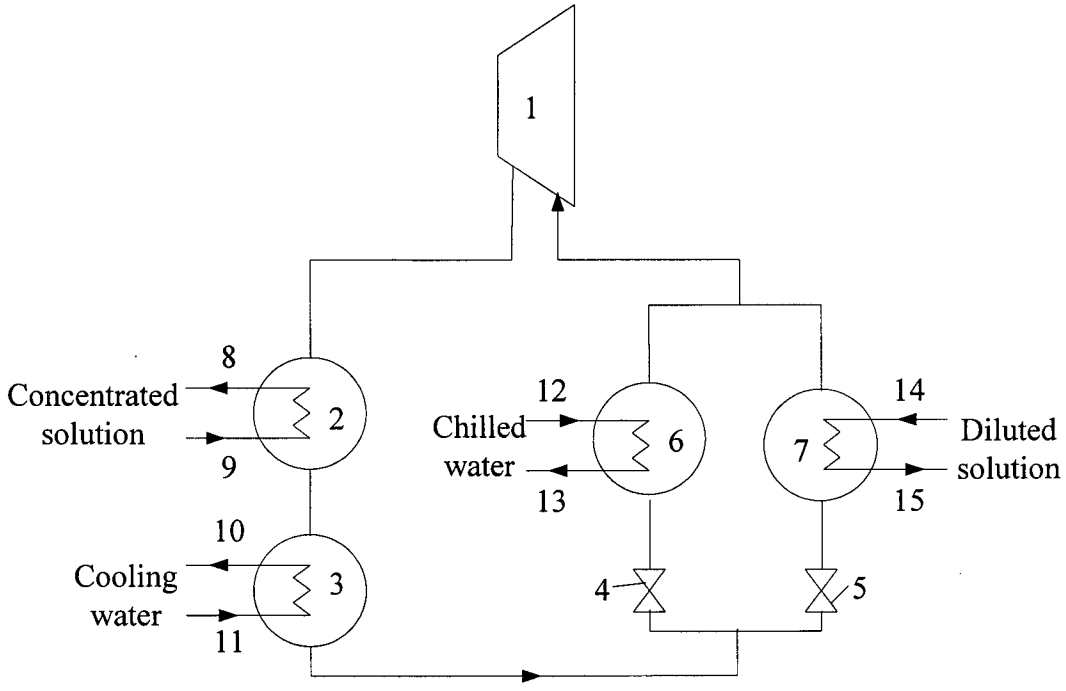


Fig. 2

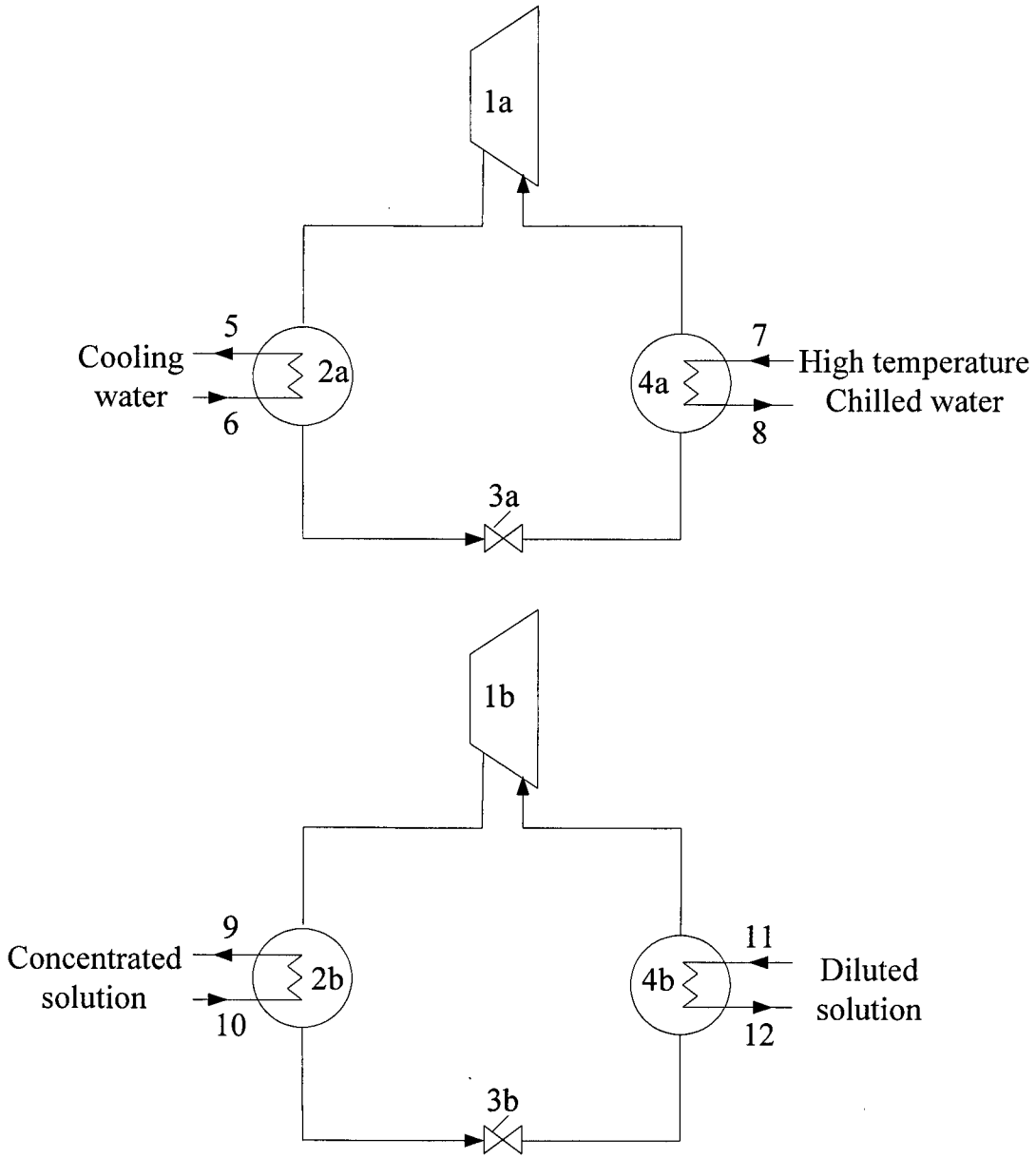

1a
5
Cooling
water
6
2a
7
High temperature
Chilled water
8
4a
3a
1b
9
Concentrated
solution
10
2b
11
Diluted
solution
12
4b
3b

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/000642

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC: F25B6/04; F25B5/02;F25B6/00;F25B5/00;F25B49/02;F25B49/00;F24F3/14

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 practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC, temperature, humidity, independent, control+, air w condition+, THIC, compressor, first, second, double, evaporate+, condens+, chilled, cold, cooling, water

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN1570501A (TAIWAN SINKO KOGYO CO., LTD.) 26 Jan. 2005 (26.01.2005) line 17, page 4 to line 11, page 6 of description, figures 1,5	1-4
X	WO2009/141282A2 (BSH BOSCH UND SIEMENS HAUSGERÄTE GMBH) 26 Nov. 2009 (26.11.2009) lines 13-21, page 2 of description, figure 3	5-7
A	LIU, Xiaohua et al., Temperature and Humidity Independent Control Air-conditioning System, China Architecture and Building Press, 31 Jan. 2006 (31.01.2006) pages 210-227	1-7
A	CN1862121A (TSINGHUA UNIVERSITY et al.) 15 Nov. 2006 (15.11.2006) the whole document	1-7
A	US4941324 (PETERSON John L. et al.) 17 July 1990 (17.07.1990) the whole document	1-7
A	US2011/0036113A1 (JOHNSON CONTROLS TECHNOLOGY COMPANY) 17 Feb. 2011 (17.02.2011) the whole document	1-7

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
15 Dec. 2011 (15.12.2011)	**19 Jan. 2012 (19.01.2012)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer ZHANG,Yi Telephone No. (86-10)62414357

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2011/000642

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN1570501A	26.01.2005	CN100362286C	16.01.2008
WO2009/141282A2	26.11.2009	CN102037294A	27.04.2011
		DE102008024325 A1	26.11.2009
		EP2297531 A2	23.03.2011
CN1862121A	15.11.2006	NONE	
US4941324	17.07.1990	NONE	
US2011/0036113A1	17.02.2011	WO2011022290 A1	24.02.2011

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/000642

Continuous of: Box A in second sheet

CLASSIFICATION OF SUBJECT MATTER:

F25B5/02(2006.01) i
F25B6/04(2006.01) i
F25B49/02(2006.01) i
F24F3/14(2006.01) i