(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 602 559 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.06.2013 Bulletin 2013/24

(51) Int Cl.:
F24D 17/00 *(2006.01)* ***F24D 19/10*** *(2006.01)*

(21) Application number: **12185517.5**

(22) Date of filing: **21.09.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **05.12.2011 PL 39724811**

(71) Applicant: **Kurzawski, Pawel**
63-700 Krotoszyn (PL)

(72) Inventor: **Kurzawski, Pawel**
63-700 Krotoszyn (PL)

(74) Representative: **Kiciak, Krzysztof Boleslaw**
Przedsiebiorstwo Rzecznikow Patentowych Patpol sp. z o.o.
Ul. Nowoursynowska 162 J
02-776 Warszawa (PL)

(54) **A method for improving thermal efficiency of a central hot medium buffered supply installation equipped with a storage heater wherein the heat source is a low-temperature boiler heater, and the central hot medium buffered supply installation**

(57) The method outlined in the invention relates to lowering the temperature of the working medium in addition to the working medium return **(b)**, in a controlled manner and dependent on the maximum temperature difference between working medium supply (**a**) and working medium return **(b)** going back to heat source **(B),** going back to the heat source **(B),** cooling thereof with a cooler medium flow going through an additional external heat exchanger **(2),** pumped by a cold medium circulation pump **(4** or **4a)** from the bottom of storage heater **(1),** filled with hot buffered medium, or from a supply connection (**1b**^{1}) feeding the storage heater tank **(1)** with buffered medium. To reduce the working medium temperature in the working medium return **(b)** going to the heat source **(B)** is controlled by a controller **(6).** The controller input signals being signals from first **(6a),** second **(6b)** and third **(6c)** temperature sensor, used to collect data from the first hydraulic circuit **(2a)** of the additional external heat exchanger **(2)** connected in parallel to the working medium return **(b)** going from storage heater **(1)** heat exchanger **(1a)** to the heat source **(B),** the second hydraulic circuit **(2b)** of additional external heat exchanger **(2),** and from the working medium supply **(a)** to the heat exchanger **(1a)** of storage heater **(1),** respectively. Quantity flow control is used for the flow of the cold medium in the process of cooling the returning working medium.

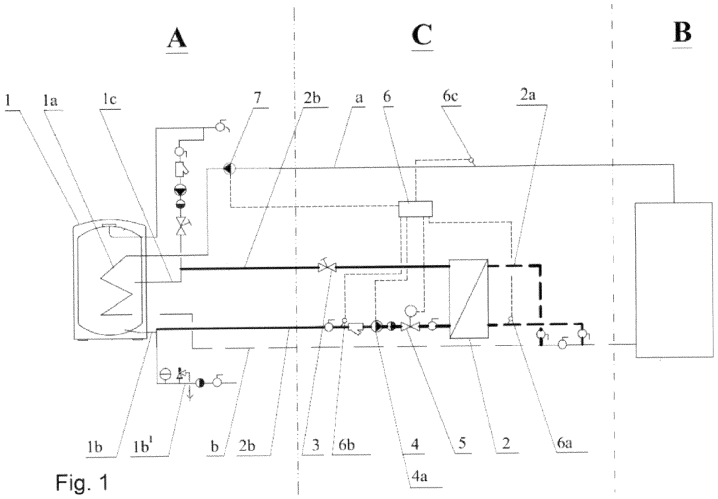

Fig. 1

EP 2 602 559 A2

Description

[0001] A method for improving thermal efficiency of a central hot medium buffered supply installation equipped with a storage heater, wherein the heat source is a low-temperature boiler heater, and the central hot medium buffered supply installation

The invention relates to a method for improving thermal efficiency of a central hot medium buffered supply installation equipped with a storage heater, wherein the heat source is a low-temperature boiler heater, and the central hot medium buffered supply installation.

Central hot medium supply installations are known, wherein the process system for hot buffered medium preparation and distribution is in fluid connection with a heat source. A process system for hot buffered medium preparation and distribution comprises a heat exchanger of a storage heater, supplied with a working medium leaving the low-temperature heating boiler. The storage heater is fed with a cold medium, e.g. water, from a water supply installation via a system of valves, pressure reducer and manometer. Leaving the storage heater outlet, the hot medium is fed to the receivers via a system of valves.

Central hot medium supply installations are also known, wherein the process system for a hot buffered medium (e.g. hot utility water) preparation and distribution is in fluid connection with a heat source. The process system for hot buffered medium preparation and distribution comprises a heat exchanger of a storage heater supplied with a working medium leaving the low-temperature heating boiler. The storage heater is fed with a cold medium, e.g. cold water, from a water supply installation via a system of valves, pressure reducer and manometer. Leaving the storage heater outlet, a hot medium is fed to the receivers via a system of valves. The working medium for space heating is supplied directly from a boiler, while the temperature of a hot medium (e.g. hot water) used for other purposes, is increased by separate burners dedicated for this purpose and installed as part of heaters for heating the buffered hot medium (e.g. hot utility water).

The purpose of the invention is to provide a solution which improves the thermal efficiency of a hot buffered medium production process (e.g. hot utility water).

A method for improving thermal efficiency of a central hot medium buffered supply installation equipped with a storage heater, wherein the source of heat is a low-temperature boiler heater, **characterizes in that** the medium is cooled in an additional external heat exchanger by a cooler medium flow, performed in a controlled manner and dependent on the maximum temperature difference between the working medium supply and working medium return going back to the heat source, admissible for a given heat source. The cooler medium, e.g. cold water, is supplied by a cooler medium circulation pump from the bottom of a storage heater tank filled with a hot medium, or from a supply connection line feeding this storage tank with a cold medium. According to further preferable embodiment of the invention, a controller is installed in the working medium return (wherein medium temperature is reduced), going to the heat source, the controller receives signals from the first, second and third temperature sensors, used to collect data from the first hydraulic circuit of the additional external heat exchanger which is connected in parallel to the working medium return leading from the storage heater heat exchanger to the heat source, the second hydraulic circuit of the additional external heat exchanger, and third sensor, from the working medium supply going to the heat exchanger of the hot buffered medium storage heater, respectively. According to further preferable embodiment of the invention a flow quantity control is used for the flow of cold medium in the process of return working medium cooling, which control is realized by a communication of the controller with a cold medium flow control device, wherein signals for controller switch-on and switch-off are switch-on and switch-off commands controlling the working medium feeding pump of the storage heater heat exchanger. According to another preferable embodiment of the invention a flow control device for cold medium flow control is a cold medium pump and a control valve with an actuator. According to another preferable embodiment of the invention, the cold medium pump used for cold medium flow control has a variable and adjustable output.

A central hot medium supply buffered installation, wherein the process system for buffered hot medium preparation and distribution is in fluid communication with a heat source, wherein the storage heater heat exchanger being a part of the hot buffered medium preparation and distribution system is in fluid communication with a working medium supply coming from a heating boiler, is **characterized in that** a process recirculation system is installed in the working medium return, being a component of storage heater, to the heat source from heat exchanger. The process recirculation system comprises a combination of at least the additional external heat exchanger, cold medium flow limiter valve, cold medium flow control device and the controller, wherein the controller being connected to the first temperature sensor, second temperature sensor and third temperature sensor and the pump feeding the working medium leaving the heat source and going to the storage heater heat exchanger. According to further preferable embodiment of the invention, the cold medium pump for cold medium flow control has a variable and adjustable output. According to yet further preferable embodiment of the invention, the first hydraulic circuit of the additional external heat exchanger is connected in parallel to the working medium return going from the storage heater heat exchanger to the heat source, whereas the second hydraulic circuit of the additional external heat exchanger is connected to the bottom of the storage heater tank, filled with the buffered hot medium of relatively lower temperature, and to the circulation outlet of the storage heater. Moreover, the first temperature sensor is installed in the first hydraulic circuit, while the second temperature sensor is installed in

the second hydraulic circuit and the third temperature sensor is installed in the hydraulic working medium supply coming from the heat source and supplying the storage heater heat exchanger. According to further preferable embodiment of the invention, the line connecting to the bottom of storage heater tank, filled with buffered hot medium of relatively lower temperature, is a part of a cold medium line feeding the cold medium to the heater storage tank from the medium source.

The method according to the invention will be now described in more detail using examples of hot utility water central supply installations. The examples of embodiments of the hot utility water central supply installations according to the invention will be described in more detail with reference to drawings, wherein Fig.1, Fig.2 and Fig, 3 show flowcharts of their exemplary connections.

Example 1

[0002] According to one of many possible embodiments of the invention, as shown in Fig. 1 (but applying also to Fig.2 and Fig.3), the central hot utility water installation comprises a process system **A** for hot utility water preparation and distribution is in fluid communication with a heat source **B**. The process system **A** for hot utility water preparation and distribution comprises a heat exchanger **1a** of a storage heater **1,** which is in a fluid connection with a working medium supply **a** coming from heat source **B**, which is a low-temperature heating boiler. A recirculation process system **C** is installed in the working medium return **b** from the heat exchanger **1a** to the heat source **B**. The process recirculation system **C** is a combination of an additional external heat exchanger **2**, cold water flow limiter valve **3**, cold water circulation pump **4**, control valve with actuator **5** and controller **6**. The controller **6** is connected to a first **6a**, second **6b** and third **6c** temperature sensor and a pump **7** feeding the working medium leaving the heat source **B**, and going to the storage heater **1** heat exchanger **1a**. The first hydraulic circuit **2a** of an additional external heat exchanger **2a** is connected in parallel to the working medium return **b** going from the storage heater **1** heat exchanger **1a** to the heat source **B**. The second hydraulic circuit **2b** of the additional external heat exchanger **2** is in fluid connection with the bottom of storage heater tank **1,** filled with hot utility water **1b,** and to the outlet **1c** of the storage heater **1.** The first temperature sensor **6a** is installed in the first hydraulic circuit **2a**, whereas the second temperature sensor **6b** is installed in the second hydraulic circuit **2b** and the third temperature sensor **6c** is installed in the working medium hydraulic connection **a** at the outlet from heat source **B**, supplying the storage heater **1** heat exchanger **1a**. The connection to the bottom of the storage heater **1** tank, filled with the buffered hot medium **1b** of relatively lower temperature, is made by a part of a cold medium **1b[1]** feeding the cold water from the water supply line to the storage heater **1.** The outlet 1c of the storage heater **1** is the hot utility water circulation line. The signal switching the installation on and off according to the embodiment of the invention is a signal switching on and off the working medium supply pump **7,** feeding the working medium to the heat exchanger **1a** of the storage heater **1.** The controller **6** controls the return heating water flowing back to heat source **B**, by cooling it in the additional external heat exchanger **2** using the cooler cold water flow supplied by cold water circulation pump **4** from the bottom of storage heater **1** tank of hot utility water or from water supply line. The degree of cooling heating water return is controlled by the controller **6** and temperature sensors **6a, 6b** and **6c.** The effect of cooling the return water, which is preferable and safe for the heat source **B**, is achieved also by controlling the cold water quantity flow, being a result of a flow control valve with actuator **5**, following the command signal from controller **6**.

The above example of a solution of the hot utility water preparation installation, fed with the working medium coming from low-temperature gas-fired condensation boiler, allows to achieve boiler efficiency exceeding 100% with regard to the calorific value of a gas fuel. The result of the above is then a reduction of a quantity of the fuel necessary to prepare an analogous amount of hot utility water.

Example 2

[0003] According to one of many possible embodiments of the invention, as shown now in Fig. 1 (but applying also to Fig. 2 and Fig. 3), the central hot utility water installation comprises a process system **A** for hot utility water preparation and distribution, in fluid connection with the heat source **B**. The process system **A** for hot utility water preparation and distribution comprises a heat exchanger **1a** of the storage heater **1,** being in a fluid connection with a working medium supply **a** coming from the heat source **B** which is a low-temperature heating boiler. A recirculation process system **C** is installed in the working medium return **b** coming from heat exchanger **1a** to the heat source **B**. The process recirculation system **C** is a combination of additional external heat exchanger **2**, cold water flow limiter valve **3**, cold water circulation pump **4a** having a variable and adjustable output controlled by the controller **6**. The controller **6** is connected to the first **6a,** second **6b** and third **6c** temperature sensor and a pump **7** feeding the working medium leaving the heat source and going to the storage heater **1** heat exchanger **1a.** The first hydraulic circuit **2a** of the additional external heat exchanger is connected in parallel to the working medium return **b** going from the storage heater **1** heat exchanger **1a** to the heat source **B.** The second hydraulic circuit **2b** of the additional external heat exchanger **2** is in fluid connection with the bottom part of the storage heater tank **1,** filled with hot utility water **1b** of relatively low temperature, and to the outlet **1c** of storage heater **1.** The first temperature sensor **6a** is installed in the first hydraulic circuit **2a**, whereas the second temperature sensor **6b** is installed in the second hydraulic

circuit **2b** and the third temperature sensor **6c** is installed in fluid connection working medium supply **a** in the outlet from heat source **B,** supplying the storage heater heat exchanger **1.** The connection to the bottom **1b** of the storage heater tank **1,** filled with hot utility water of relatively low temperature, is a part of a cold medium line **1b1** feeding the cold water to the storage heater tank **1** from e.g. water supply line. The outlet **1c** of storage heater **1** is the hot utility water circulation line. The signal switching on and off the process recirculation installation **C** in this embodiment of the invention, is a signal switching on and off the working medium supply pump **7** feeding the working medium **a** to the storage heater **1** heat exchanger **1a.** The controller **6** controls the heating water return **b** flowing back to heat source **B,** cooling it in the additional external heat exchanger **2** using the cooler cold water flow supplied by cold water circulation pump **4a** having an adjustable output controlled by the controller **6,** coming from the bottom of the storage heater tank **1** of hot utility water, or from water supply line. The degree of cooling the return working medium **b** is controlled by the controller **6** and temperature sensors **6a, 6b** and **6c.** The effect of cooling the return working medium **b,** which is preferable and safe for the heat source **B,** is achieved also by controlling the cold water quantity flow, which is resulted by operation of the cold water circulation pump **4a** having variable and adjustable output following the command signal from controller **6.** Use of the cold water circulation pump **4a** with a variable and adjustable output allows eliminating the control valve with an actuator **5**, what however does not apply to the situation shown in Fig. 3.

The above example of a solution of the hot utility water preparation installation according to the invention, fed with the working medium coming from low-temperature heating boiler, wherein the heat source is a gas-fired condensation boiler, allows the attainment of the boiler efficiency exceeding 100% with regard to the calorific value of the gas fuel. The result is then a reduction of a fuel quantity necessary to prepare an analogous amount of hot utility water.

Example 3

[0004] The method for improving thermal efficiency of a central hot utility water supply installation, wherein the heat source is a low-temperature boiler heater, according to one of many possible embodiments of the invention, here shown in Fig. 1, even though it also applies to examples as shown in Fig. 2 and Fig. 3, comprises cooling the working medium **b** in an additional external heat exchanger **2** by a cooler cold water flow, in a controlled manner taking and dependent on the maximum temperature difference between the working medium supply line and working medium return going to heat source **B**, admissible for a given heat source. Cold water is supplied by cold water circulation pump **4** from the bottom of storage heater tank **1** filled with hot utility water, or from a water supply line. A controller **6** is used for the reduction of working medium temperature in the connection of working medium **b** going to the heat source **B.** The controller input signals are signals from the first **6a,** second **6b** and third **6c** temperature sensors, used for collect data from the first hydraulic circuit **2a** of the additional external heat exchanger **2** connected in parallel to the working medium return **b** leading from the storage heater **1** heat exchanger **1a** to the heat source **B,** the second hydraulic circuit **2b** of the additional external heat exchanger **2,** and from the working medium **a** supply line connecting the heat exchanger **1a** of storage heater **1,** respectively. Quantity control is used for the flow of cold water in the second hydraulic circuit **2b** in the process of cooling the returning working medium **b,** what is realized by cooperation of the controller **6** with the flow control device with an actuator **5,** the signals for controller **6** switch-on and switch-off being switch-on and switch-off commands controlling the working medium supply pump **7** feeding the storage heater **1** heat exchanger **1a.**

Example 4

[0005] The method for improving thermal efficiency of a central hot utility water supply installation, wherein the heat source is a low-temperature boiler heater, according to one of many possible embodiments of the invention, here shown in Fig. 1, comprises decreasing the temperature of the working medium with the returning working medium **b** to the heat source **B** in a controlled manner and dependent on the maximum temperature difference between working medium supply line **a** and working medium return **b,** cooling it in the additional external heat exchanger **2** with a cooler cold water flow supplied by cold water circulation pump **4a** having a variable and adjustable output, controlled by the controller **6,** from the bottom of storage heater tank **1,** filled with hot utility water, or from a water supply line. The controller **6** is used for the reduction of the working medium temperature in the working medium return **b** leading to the heat source **B.** The controller input signals are signals from the first **6a,** second **6b** and third **6c** temperature sensor, used to collect data from the first hydraulic circuit **2a** of the additional external heat exchanger **2** connected in parallel to the working medium return **b** coming from the storage heater heat exchanger **1a** to the heat source **B,** the second hydraulic circuit of the additional external heat exchanger **2,** and from the working medium supply line **a** going to the heat exchanger **1a** of the storage heater **1,** respectively. Quantity control is used for the flow of cold water in the second hydraulic circuit **2b** in the process of cooling the returning working medium **b,** what is realized by a cooperation of the controller **6** with the cold water circulation pump **4a** having a variable and adjustable output, wherein the signals for controller **(6)** switch-on and switch-off being switch-on and switch-off commands controlling the working medium supply pump **7** feeding the storage heater **1** heat exchanger **1a.** Use of the cold

water circulation pump **4a** with a variable and adjustable output allows eliminating the control valve with an actuator **5**, which however does not apply to the situation presented in Fig. 3.

[0006] The embodiments according to the invention may be used in vide variety of heating systems, wherein the conditions of exchange between heat receivers system and a heat source can be improved, and wherein there is a sufficiently cold medium available on the secondary side of the heat reception system as well as a capability to its recirculation. The embodiments according to the invention may also support many of the existing central supply installations distributing hot utility water or other buffered hot media, as long as it is possible to use the invention without interference in their basic process solutions or the design of component devices. In case of newly built heating systems, the invention may also allow reducing capital costs.

In multi-function heating systems, providing also the function of hot utility water (or other hot media) preparation in storage heaters, there is no requirement to use complex heaters equipped with a separate burner provided to realize this function only. Added heating power of the additional external heat exchanger, according to the solution in the invention, allows for better utilization of installed heat source boilers heating capacity, in particular during the period out of heating season when the heat source is sometimes underloaded.

Further process-related advantage gained thanks to the use of the invention and resulting from the extra heating power provided by the additional external heat exchanger, is time shortening of charging the hot buffered medium tank. In multi-function heating systems, this allows a quicker deployment of heating power and a required temperature of the heat source working medium to meet the heating demand caused by simultaneous execution of the rest system functions during the same periods, e.g. heating circulation of central heating systems.

Claims

1. A method for improving the thermal efficiency of a hot buffered medium preparation installation equipped with a low-temperature heating boiler as a heat source, **characterized in that** the temperature of the working medium is lowered in the combination of the working medium return (**b**) going back to the heat source (**B**) cooling with a cooler medium flow going through an additional external heat exchanger (**2**), pumped by a cold medium circulation pump (**4** or **4a**) from the bottom (**1b**) of storage heater (**1**), filled with the hot buffered medium, or from a supply line (**1b**[1]) feeding the storage heater tank (**1**) with buffered medium, performed in a controlled manner and dependent on the maximum temperature difference between the working medium supply (**a**) and working medium return **b** going back to the heat source (**B**), admissible for said heat source (**B**).

2. A method for improving the thermal efficiency according to claim 1, **characterized in that** the lowering the working medium temperature in the working medium return (**b**) going back to the heat source (**B**) is controlled by a controller (**6**), the controller input signals being signals from first (**6a**), second (**6b**) and third (**6c**) temperature sensor, used to collect data from the first hydraulic circuit (**2a**) of the additional external heat exchanger (**2**) connected in parallel to the working medium return (b) going from storage heater (**1**) heat exchanger (**1a**) to the heat source (**B**), the second hydraulic circuit (**2b**) of the additional external heat exchanger (**2**), and from the working medium supply (**a**) going to the heat exchanger (**1a**) of storage heater (**1**) from heat source (**B**), respectively.

3. A method for improving the thermal efficiency according to claim 1 or 2, **characterized in that** a cold medium flow quantity control is used in the process of cooling the working medium return (**b**), which is realized by a cooperation of the controller (**6**) with a cold medium flow control device, wherein the signals for controller (**6**) switch-on and switch-off being switch-on and switch-off commands controlling the working medium supply pump (**7**) ,feeding the storage heater (**1**) heat exchanger (**1a**).

4. A method for improving the thermal efficiency according to claims 2 or 3, **characterized in that** the cold medium pump (**4**) and the a control valve with an actuator (**5**) are used as the cold medium flow control device.

5. A method for improving the thermal efficiency according to claims 2 or 3, **characterized in that** the cold medium pump (**4a**) of a variable and adjustable output is used as the cold medium flow control device.

6. A central hot medium supply buffered installation, wherein the process system for buffered hot medium preparation and distribution (**A**) in fluid connection with a heat source (**B**), wherein a storage heater heat exchanger being a part of the hot buffered medium preparation and distribution system (**A**) in fluid communication with the working medium supply (**a**) coming from a heating boiler, **characterized in that** a process recirculation system (**C**) is installed in the working medium return (**b**) from the heat exchanger (**1a**) to the heat source (**B**), and the recirculation system (**C**) comprises a combination of at least the additional external heat exchanger (**2**), cold medium flow limiter valve (3), cold medium flow control device and controller (**6**), wherein the regulator (**6**) being connected to the first temperature sensor (6a), sec-

ond temperature sensor (**6b**) and third temperature sensor (**6c**) and the pump (**7**) feeding the working medium leaving the heat source (**B**) and going to storage heater (**1**) heat exchanger (**1a**).

7. A central hot medium supply buffered installation according to claim 6, **characterized in that** the flow control valve with an actuator (**5**) throttling the flow output of cold medium pump (**4**) is used as the cold medium flow control device.

8. A central hot medium supply buffered installation according to claim 6, **characterized in that** the cold medium pump (**4a**) of a variable and adjustable output is used as the cold medium flow control device.

9. The central hot medium supply buffered installation according to claim 6, **characterized in that** the first hydraulic circuit (**2a**) of the additional external heat exchanger (**2**) is connected in parallel to the working medium return (**b**) coming from the storage heater (**1**) heat exchanger (**1a**) and going back to the heat source (**B**), whereas the second hydraulic circuit (**2b**) of the additional external heat exchanger (**2**) is connected to the bottom (**1b**) of storage heater (**1**), filled with hot buffered medium of relatively low temperature, and to the storage heater outlet (**1c**), wherein the first temperature sensor (**6a**) being installed in the first hydraulic circuit (**2a**), the second temperature sensor (**6b**) being installed in the second hydraulic circuit (**2b**), and the third temperature sensor (**6c**) being installed in the working medium supply (**a**) leaving the heat source (**B**) and feeding the storage heater (**1**) heat exchanger (**1a**).

10. A central hot medium supply buffered installation according to claim 6, **characterized in that** the line connecting to the bottom (**1b**) of storage heater (**1**) tank, filled with the hot buffered medium of relatively low temperature, is a part of the cold medium supply (**1b^1**), feeding the storage heater (**1**) tank.

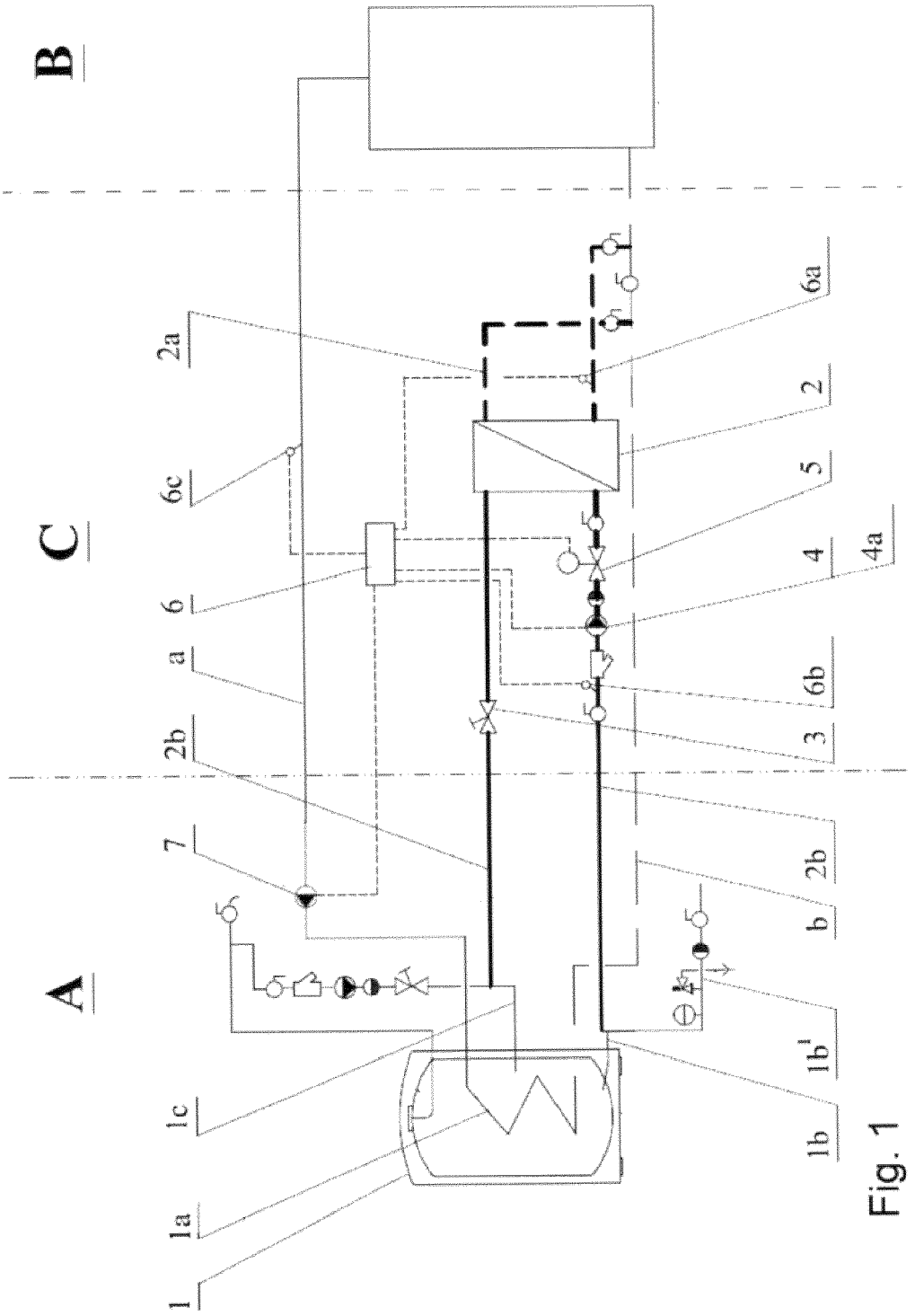

Fig. 1

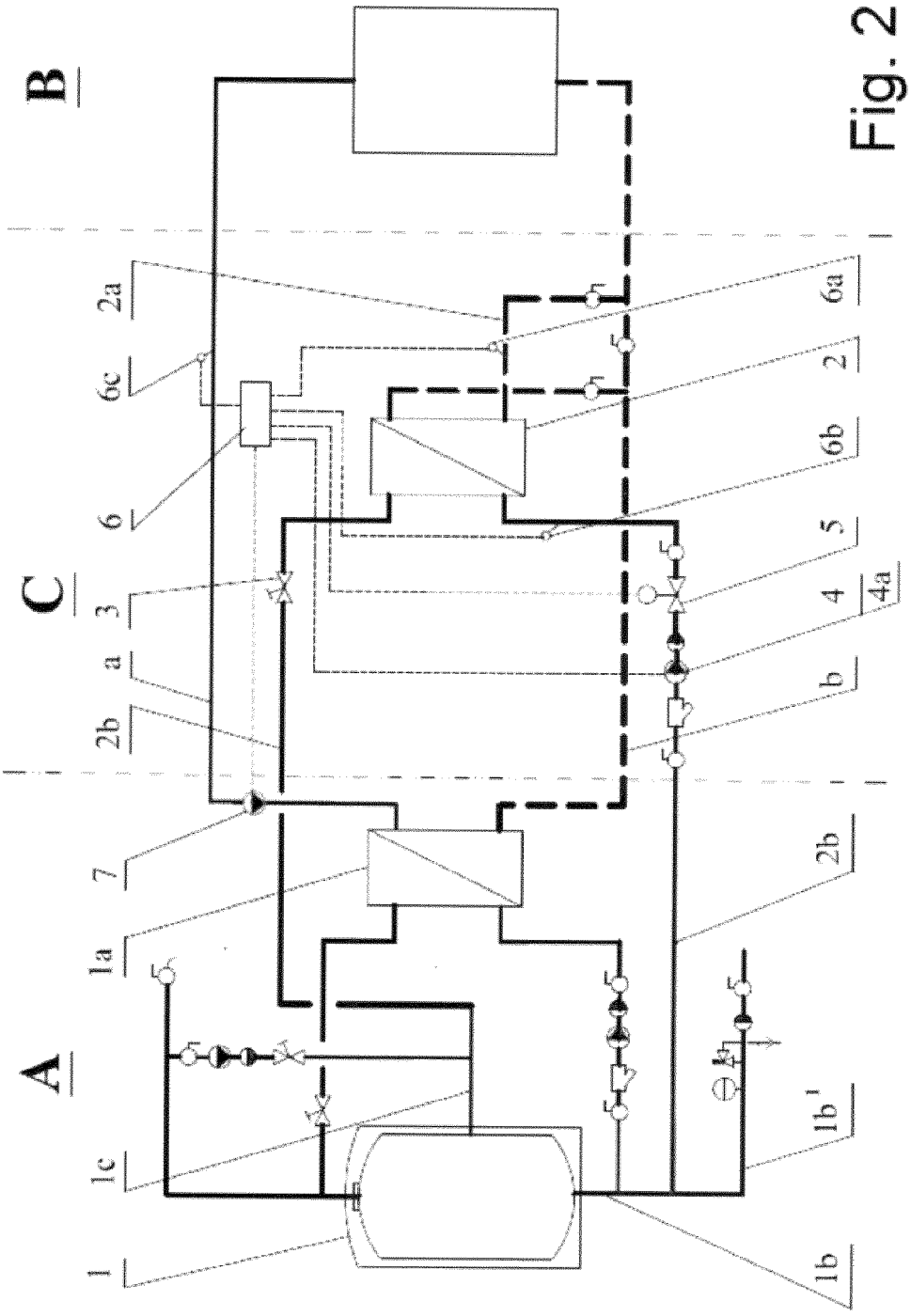

Fig. 2

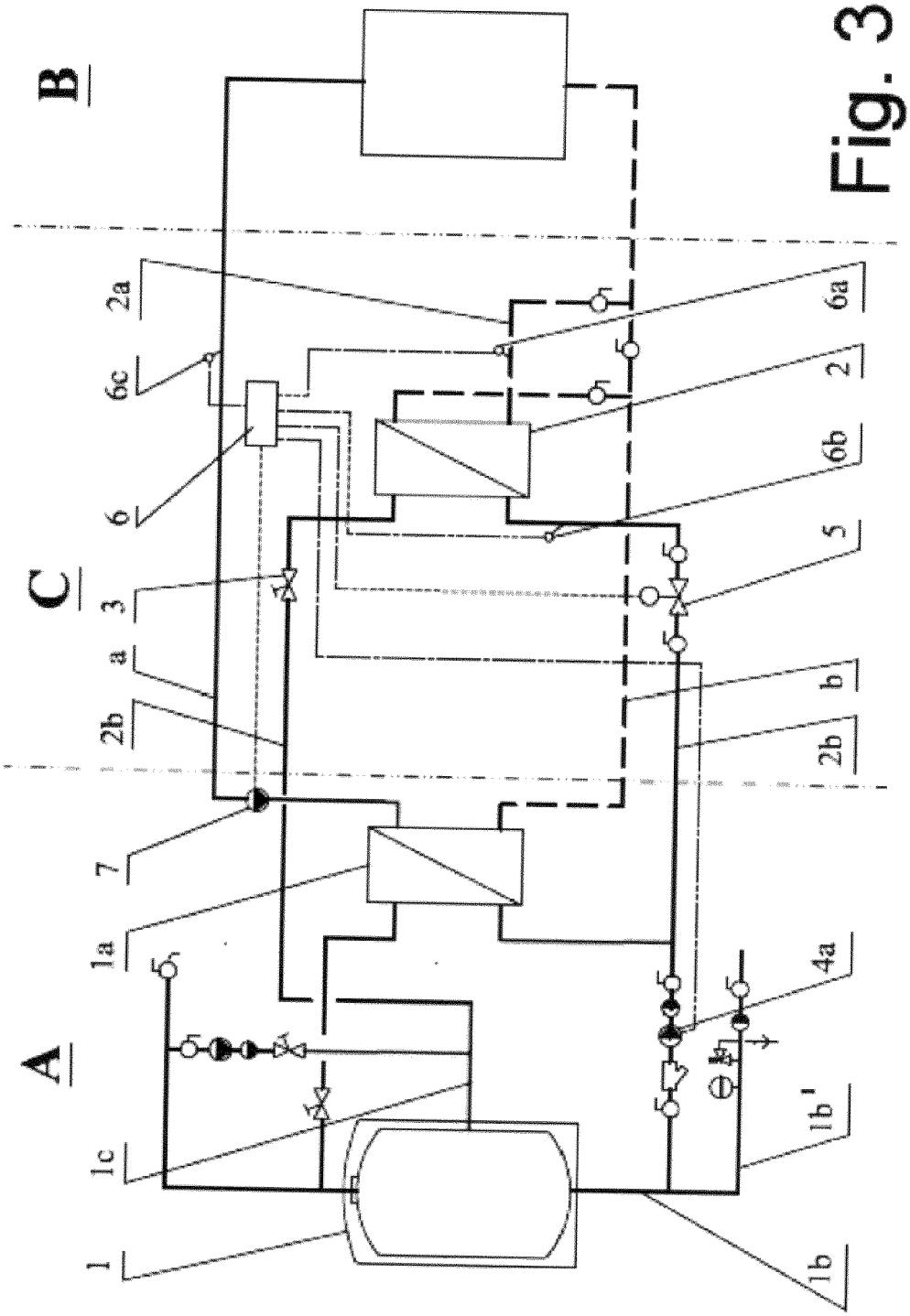

Fig. 3