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(54) **A HEATING DEVICE FOR PERFORMING INSTANT DOMESTIC HOT WATER SUPPLY AND SPACE HEATING SIMULTANEOUSLY AND A METHOD OF OPERATION THEREOF**

(57) The present invention is a heating device (1) capable of performing space heating and instant domestic hot water supply simultaneously.

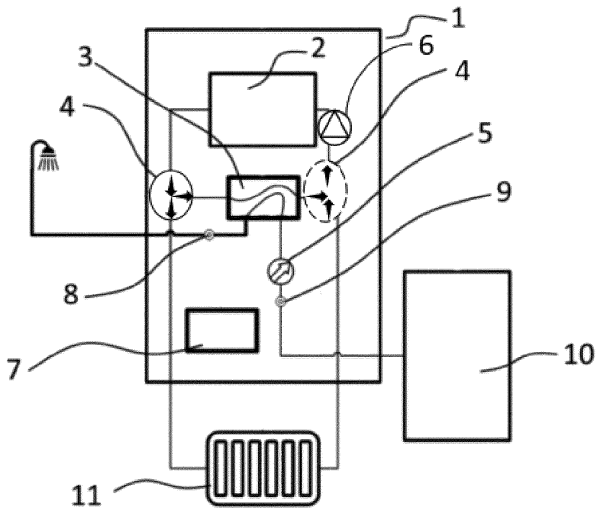

Figure 1

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Description

Field of The Invention

[0001] The present invention relates to a heating device capable of performing space heating and instant domestic hot water supply simultaneously.

[0002] The invention particularly relates to a heating device capable of simultaneously providing space heating and instant domestic hot water in the devices, which comprise switching mechanism and an additional exchanger for hot water providing space heating and instant domestic hot water heating.

Background Art

[0003] Producing, distributing and consuming the heat in the same independent section for providing heat and supplying hot water in houses is called individual heating. In the case of space heating systems, heat generation and distribution for the same purposes is centrally performed outside the independent sections, while the heat consumption takes place within the independent sections.

[0004] Examples of individual heating devices are combi boilers, room heaters, stoves, fireplaces, water heaters and thermo siphons. The combi boilers, which are known as the most commonly used heating devices, are used to provide space heating and hot water supply.

[0005] In the current technical applications, when the domestic hot water consumption is detected, the heating device regulator stops the space heating by turning the switching mechanism to the side of domestic water, regardless of the temperature of the water coming out of the device.

[0006] The heating device comprises a first heat exchanger, in which the heating takes place, a hot water second heat exchanger for heating the domestic water, and other components.

[0007] The domestic water is heated as follows; When the domestic water consumption occurs, i.e. when the hot water tap is turned on, the flow meter detects the flow and/or flow quantity and the switching mechanism directs the water heated in the first heat exchanger to the second heat exchanger. As the switching mechanism, a three-way valve or two on/off valves on each destination or one four-way valve with one pinched end piping can be used. On the other hand, the switching mechanism can be located to provide same function as optional before water circulation pump to gather heated water from second heat exchanger and space heating installation.

[0008] The domestic inlet water, which passes through the flow meter and reaches the hot water second heat exchanger, is encounter with the water heated in the first heat exchanger and heated, and exited from the device for the purpose of domestic water.

[0009] The water, which was heated in the first heat exchanger for heating the domestic inlet water, passes through the hot water second heat exchanger and is resent to the first heat exchanger by the water circulation pump and thereby the closed cycle is completed.

[0010] The space heating is provided by the way that the water heated in the first heat exchanger is sent to the space heating system by switching mechanism and the heat transfer is performed by radiator and similar heat distributors therein.

[0011] When the heating device is in the winter position, it cannot provide both space heating and domestic hot water at the same time.

[0012] The demand for domestic hot water always takes precedence during operation and when domestic hot water is demanded, the device heats the domestic water by stopping the space heating, namely it runs the switching mechanism, namely directs to the second heat exchanger.

[0013] The device determines, according to the water flow passing through the flow meter, whether domestic water has been demanded.

[0014] In such a case, both hot water supply and space heating cannot be provided at the same time.

[0015] Since space heating has to be stopped temporarily, temperature drop occurs in the space and more time is needed to reach the same temperature again. During this time, heating device has to run in high power to reach same temperature.

[0016] This causes discomfort for the user and heating device to run with less efficiency because efficiency degreases in higher operation power which results in more energy costs.

[0017] In the literature, Patent Application No: TR2018/01549 discloses: "The invention relates to an intelligent thermodynamic analysis, control and management system for calculating the minimum energy consumption for the spaces/building as a result of thermodynamic analyzes, evaluating the parameters such as type and power of heating/cooling/ventilation/air-conditioning devices, which affect the space heating balance, in an artificial intelligence software, providing the intelligent control of heating, cooling, ventilation and air conditioning devices by the activators of the artificial intelligence software as a result of the evaluation, learning the thermal characteristics of the space over time with its thermodynamic analysis, calculation and evaluations, making predictions with the artificial intelligence software by using the predictable parameters (estimated air temperature, humidity, pressure, etc.) and the thermal characteristics of the space, planning the energy management, measuring and monitoring the realized energy consumption, comparing the realized energy consumption with the calculated minimum energy consumption and gradually reducing the difference in-between."

[0018] Said application discloses an intelligent thermodynamic analysis, control and management system for the heating and cooling systems.

[0019] In the literature, Patent Application No: TR2017 08124 discloses: "A pipe system or a reservoir connected

to the heating system is placed in the boiler. The water, which is activated by the circulating pump in the small water tank in the installation system, heats up continuously through the boiler and heats the radiators in the system. The temperature in the closed area is controlled by the thermostat in the small water tank, which can be opened and closed via the switch-on/switch-off button in the system. The water supply to the heating system from the water inlet is also provided by the valve with pressure display connected to the water installation. The present invention is intended to heat the spaces and save energy by transferring the temperature inside the boiler to the heating radiators, which are used only for hot water supply, without the use of a combi boiler."

[0020] In said application, a system is used to transfer the hot water used for the hot water supply to the radiators in order to heat the spaces without using the boiler.

[0021] For the above-mentioned reasons, there has been a need for a device capable of simultaneously performing space heating and hot water supply.

Objects of the Invention

[0022] From this point of the art, the object of the invention is to provide a device capable of simultaneously providing space heating and instant domestic hot water supply, which eliminates the existing disadvantages.

[0023] Another object of the invention is to provide a structure that prevents the amount of heat in the space from falling while the users are using the hot water.

[0024] Another object of the invention is to provide a structure that allows users to spend much less fuel due to the fact that it is a structure whereby the heat loss is minimized.

[0025] Another object of the invention is to provide a structure where efficiency is at the highest level.

[0026] Another object of the invention is to provide a structure that prevents unnecessary blocking of space heating.

Brief Description of the Drawings

[0027]

Figure 1 is a block diagram as a representation of the heating device according to the invention.

Figure 2 is a flow chart showing the operation of the heating device according to the invention.

Figure 3 is a representation of the switching mechanism in the heating device for the space heating according to the invention.

Figure 4 is another representation of the switching mechanism in the heating device for the hot water supply according to the invention.

Brief Description of the Reference Numbers

[0028]

1. Heating Device
2. First Heat Exchanger
3. Second Heat Exchanger
4. Switching Mechanism
5. Flow Meter
6. Water Circulation Pump
7. Device Controller
8. Domestic Hot Water Temperature Sensor
9. Domestic Water Supply Temperature Sensor
10. Water Tank
11. Panel Radiator

100. Running the heating device.
110. Selecting the winter mode.
120. Running the operation mode.
200. Simultaneous operation.
300. Flow control by flow meter.
400. Heating domestic water only.
500. Flow control by flow meter.
600. Space heating only.
700. Waits for the designated waiting time
800. The difference between the domestic water set value and the designated first tolerance value (S) is smaller than the input water temperature
900. Heating domestic water only.
1000. The value regarding the sum of the domestic water set value and the designated second tolerance value (D) is smaller than the calculated value (Tcalc).
1100. Simultaneously supplying domestic hot water and space heating.
1200. The temperature of the input water is higher than or equal to the domestic water set value.

Detailed Description of the Invention

[0029] The invention is a device which is capable of performing space heating and instant domestic hot water supply simultaneously. It comprises a first heat exchanger (2) which transmits combustion energy of gas to water, a second heat exchanger (3) which heats cold water, coming from domestic inlet water supply, by meeting the cold water with the hot water which is heated in the first heat exchanger (2), used in domestic water heating, a switching mechanism (4) which enables the water heated in said first heat exchanger (2) to direct to the second heat exchanger (3) for domestic water heating or to space heating circuit for space heating. The heating device comprises an operating mechanism (a device controller (7)) which measures the temperature of the domestic inlet water which flow into said second heat exchanger (3) by means of the domestic water supply temperature sensor (9) during supplying the domestic hot water and thereby enables the direction of said switching mechanism (4) to be towards the space heating installation (11) for keeping it on performing the space heating if it is at sufficient

temperature.

[0030] Furthermore, the invention is an operating method for a heating device, which is capable of performing space heating and instant domestic hot water supply simultaneously. It comprises a first heat exchanger which transmits the combustion energy of the gas to the water, a second heat exchanger (3), which heats the cold water, coming from domestic inlet water supply, by meeting it with the hot water which is heated in the first heat exchanger (2), used in the domestic water heating, a switching mechanism (4) which enables the water heated in said first heat exchanger (2) to direct to the second heat exchanger (3) for domestic water heating or to space heating circuit for space heating. The method comprises the steps of running heating device (100), user's selecting winter mode (110), selecting simultaneous operation mode (200), sensing water flow by flow control (500) by flow meter (5), waits for a waiting time (700) so that the value of domestic water temperature coming from water tank (10) is sufficient, meaning that it is equal to the value measured by water supply temperature sensor (9) and checking the condition that the difference between domestic water set value and a designated first tolerance value (S) is smaller than input water temperature (800) is fulfilled, after the flow continues during the specified waiting period (700), checking the condition that the value regarding the sum of a domestic water set value and a designated second tolerance value (D) is smaller than the calculated value (Tcalc) (1000), keeping the switching mechanism (4) on operating in space heating position (600) as indicated in the case of domestic hot water supply (1100).

[0031] The heating device (1) according to the present invention comprises a first heat exchanger (2) transmitting gas combustion energy to water, a second heat exchanger (3), which heats the cold water, coming from domestic inlet water supply, by meeting it with the hot water which is heated in the first heat exchanger (2), used in the domestic water heating, a switching mechanism (4) which enables the water heated in said first heat exchanger (2) to be directed to the second heat exchanger (3) for domestic water heating or to space heating circuit for space heating, a flow meter (5) for measuring the flow rate of domestic water, a device controller (7) which stores the operating algorithm of said heating device (1) and is positioned as an electronic motherboard by which the user can adjust for operating the heating device (1), a water circulation pump (6) which provides the circulation of water in the heating device (1) with the data received from said device controller (7), a domestic hot water temperature sensor (8) which measures the temperature of the domestic water leaving the second heat exchanger (3), a domestic water supply temperature sensor (9) which measures the temperature of the domestic inlet water which will flow into said second heat exchanger (3) during supplying the domestic hot water and thereby enables the direction of said switching mechanism (4) to be towards the first heat exchanger (2) for its keeping on performing the space heating if it is at sufficient temperature, water tank (10) where the water heated by the preheating is stored, panel radiator (11) used for space heating (11).

[0032] The heating device (1), as shown in Figure 1, comprises the first heat exchanger (2) in which the heating takes place and the second heat exchanger (3) for heating the domestic water and other components.

[0033] Domestic water is heated as follows; when the domestic water consumption occurs, i.e. when the hot water tap is turned on, the flow meter (5) detects the flow and/or flow quantity and the switching mechanism (4) directs the heated water in the first heat exchanger (2) to the second heat exchanger (3) as indicated in Figure 4.

[0034] The domestic inlet water, which passes through the flow meter (5) and reaches the second heat exchanger (3), met with the water heated in the first heat exchanger (2) and heated, and exited from the device for the purpose of domestic water. The water, which was heated in the first heat exchanger (2) for heating the domestic inlet water, passes through the second heat exchanger (3) and is resent to the first heat exchanger (2) by the water circulation pump (6) and the closed cycle is thus completed.

[0035] The space heating is provided by sending the water heated in the first heat exchanger (2) to the space heating system by the operation of the switching mechanism (4) as in the position indicated in Figure 3 and by performing the space heat transfer by means of a panel radiator (11) therein.

[0036] The heating device (1) of the present invention decides according to the water flow passing through the flow meter (5) whether or not a domestic water demand has occurred. When the flow rate is reached above a predefined limit lower value in said implementation, it is assumed that there is a demand for domestic water.

[0037] Domestic water output temperature is measured by water temperature sensor (8) located at the outlet of the second heat exchanger (3) and the heating device (1) meets the demand of the domestic water by making the capacity modulation to provide domestic water at that temperature until domestic water temperature has reached the set temperature.

[0038] The heating device (1) according to the invention comprises a water tank (10) (for instance a solar tank or a water tank/reservoir) to feed the domestic water entry and a domestic water supply temperature sensor (9) to be connected to the domestic water inlet pipe.

[0039] The flow chart describing the working principle of the present invention is given in Figure 2.

[0040] After the heating device (1) is switched on (100) by a signal from the device controller (7) and if the "Winter Mode" (110) is selected by the user on the device controller (7) panel, "Simultaneous Operation Function" option (200) can be added in order to let the user as the sub-parameter to select it as customized. Also, this function can also be directly adapted to the winter mode operating system. If the winter mode is not selected, the

heating device (1) operates depending on the operating mode (120).

[0041] The operating algorithm shown in Figure 2 is shown in the structure allowing the selection as sub-parameter to the Winter Mode (110) option.

[0042] If the simultaneous operation (200) mode is not selected by the user, it is controlled whether there is any flow of domestic water by the flow control (300) made by flow meter according to the value detected via the flow meter (5). If flow is detected, the switching mechanism (4) permits the flow of water by operating only in domestic water heating (400) mode, as indicated in figure-3. This continues with this cycle until the simultaneous operation (200) mode is activated.

[0043] If the simultaneous operation (200) mode is selected by the user and if the flow meter (5) is detected water flow through the flow control (500), it is waited up to a designated waiting time (700), in that way the domestic water temperature value which comes from the water tank (10) and the value measured by the domestic inlet water temperature sensor (9) become equal.

[0044] The "Designated Waiting Time" is defined as the elapsed time for the water coming from the water tank (10) to reach the heating device (1). It can also be expressed as the transmission time (Delay Time) of the water coming from the water tank (10) to the heating device (1). As the water temperature in the tank (10) is not measured, "Designated Waiting Time" is adjustable and should be adjusted according to pipe length between water tank (10) and heating device (1) inlet. Therefore, it is a parametric value.

[0045] If the water flow is interrupted before the designated waiting time is over, the switching mechanism (4) continues to operate only in the space heating (600) position as indicated in Figure 3.

[0046] After the flow continues during the designated waiting time, it is controlled on a condition that the difference between the domestic water set value and the designated 'S' tolerance value is smaller than the input water temperature (800) is fulfilled.

[0047] In case of not fulfilling the condition that the difference between the domestic water set value and the designated'S' tolerance value is smaller than the input water temperature (800), the switching mechanism (4) directs the flow to the place where domestic water is, as indicated in Figure 4, and continues to meet the demand for domestic water heating (900) solely until the condition of "Input Water Temperature" is greater than or equal to "Domestic Water Set Value" (1200) is provided.

[0048] In case of not fulfilling the condition that the input water temperature is greater than or equal to the domestic water set value (1200), the demand for domestic water continues to be met with the cycle indicated in Figure 2 as from the Flow control by flow meter (500) if the flow of water through the flow meter (5) continues to be detected.

[0049] After fulfilling the condition that the difference between the domestic water set value and the designated first tolerance value (S) is smaller than the input water temperature (800), the condition that the value regarding the sum of the domestic water set value and the designated second tolerance value (D) is smaller than the calculated value (Tcalc) (1000) is controlled.

[0050] The value "Tcalc" is the calculated value of the domestic hot water output temperature when the device operates at minimum capacity. Mentioned tolerance values which specified with "S" and "D" can be set as same or different temperature values according to system designer decision.

[0051] In case of fulfilling the condition that the value regarding the sum of the domestic water set value and the designated second tolerance value (D) is smaller than the calculated value (Tcalc) (1000), the switching mechanism (4) continues to operate only in the space heating position (600) as indicated in Figure 3, in the case of simultaneously supplying domestic hot water and space heating (1100).

[0052] At this point, the demand for domestic water is met at the same time and the demand for domestic water continues to be met with the cycle indicated in Figure 2 as from the Flow control by flow meter (500) if the flow of water through the flow meter (5) continues to be detected.

[0053] In case of not fulfilling the condition that the value regarding the sum of the domestic water set value and the designated second tolerance value (D) is smaller than the calculated value (Tcalc) (1000), the switching mechanism (4) meets the demand for domestic water by directing the flow to the water side as indicated in Figure 4 in the case of heating domestic water only.

[0054] The heating device (1) is a combi boiler in the preferred embodiment of the invention.

Claims

1. A heating device, which is capable of performing space heating and instant domestic hot water supply simultaneously, comprising a first heat exchanger (2) which transmits heat to water, a second heat exchanger (3), which heats domestic water, coming from domestic inlet water supply, by meeting domestic water with hot water which is heated in said first heat exchanger (2), a switching mechanism (4) which enables hot water heated in said first heat exchanger (2) to directed to the second heat exchanger (3) for domestic water heating or to space heating circuit for space heating, **characterized in that** it comprises

   a water tank (10) to feed the domestic water entry and a domestic water supply temperature sensor (9) to be connected to the domestic water inlet pipe,
   and a device controller (7) which stores an operating algorithm of said heating device (1) and

configured to enable the direction of said switching mechanism (4) to be towards space heating for allowing said switching mechanism (4) to keep on performing the space heating if the domestic inlet water supply is at sufficient temperature.

2. The heating device (1) according to claim 1, **characterized in that** the device controller (7) is an electronic motherboard by which user can adjust for operating said heating device (1).

3. The heating device (1) according to any of the preceding claims, **characterized in that** said heating device (1) is a combi boiler.

4. A method of operation for a heating device (1), which is capable of performing space heating and instant domestic hot water supply simultaneously, comprising a first heat exchanger (2) which transmits heat to water, a second heat exchanger (3), which heats domestic water, coming from domestic inlet water supply, by meeting domestic water with hot water which is heated in the first heat exchanger (2), a switching mechanism (4) which enables hot water heated in said first heat exchanger (2) to be directed to the second heat exchanger (3) for domestic water heating or to space heating circuit for space heating, **characterized in that**

the method comprises the steps of running the heating device (100),
selecting simultaneous operation mode (200),
sensing water flow by the flow control (500) by a flow meter (5),
waiting for a designated waiting time (700) until the value of domestic water temperature coming from a water tank (10) is equal to the value measured by a domestic water supply temperature sensor (9),
checking the condition that the difference between a domestic water set value and a designated first tolerance value (S) is smaller than an input water temperature (800) reached after the flow continues during the specified waiting period,
checking the condition that the value regarding the sum of the domestic water set value and a designated second tolerance value (D) is smaller than a calculated value (Tcalc) (1000),
keeping the switching mechanism (4) on operating in space heating position (600) as indicated in the case of domestic hot water supply (1100).

5. The operating method for the heating device (1) according to claim 4, **characterized in that** the calculation value is the calculated value of the domestic water output temperature, which is measured by a domestic water temperature sensor (8) located in the outlet of the second heat exchanger (3), when the device (1) operates at minimum capacity.

6. The operating method for the heating device (1) according to claims 4 and 5, **characterized in that** the switching mechanism (4) continues to operate only in the space heating (600) position if the water flow is interrupted before the designated waiting time is over.

7. The operating method for the heating device (1) according to claims 4 to 6, **characterized in that** the switching mechanism (4) directs the flow to the place where domestic water is and continues to meet the demand for domestic water heating (900) solely until the condition of the input water temperature is greater than or equal to the domestic water set value (1200) is provided, in case of not fulfilling the condition that the difference between the domestic water set value and the designated first tolerance value (S) is smaller than the input water temperature (800).

8. The operating method for the heating device (1) according to claims 4 to 6, **characterized in that** the demand for domestic water continues to be met with the cycle as from the flow control by flow meter (500) if the flow of water through the flow meter (5) continues to be detected, in case of not fulfilling the condition that the input water temperature is greater than or equal to the domestic water set value (1200).

9. The operating method for the heating device (1) according to claims 4 to 8, **characterized in that** the switching mechanism (4) meets the demand for domestic water by directing the flow to the place where the water is in the case of heating domestic water only, in case of not fulfilling the condition that the value regarding the sum of the domestic water set value and the designated second tolerance value (D) is smaller than the calculation value (Tcalc) (1000).

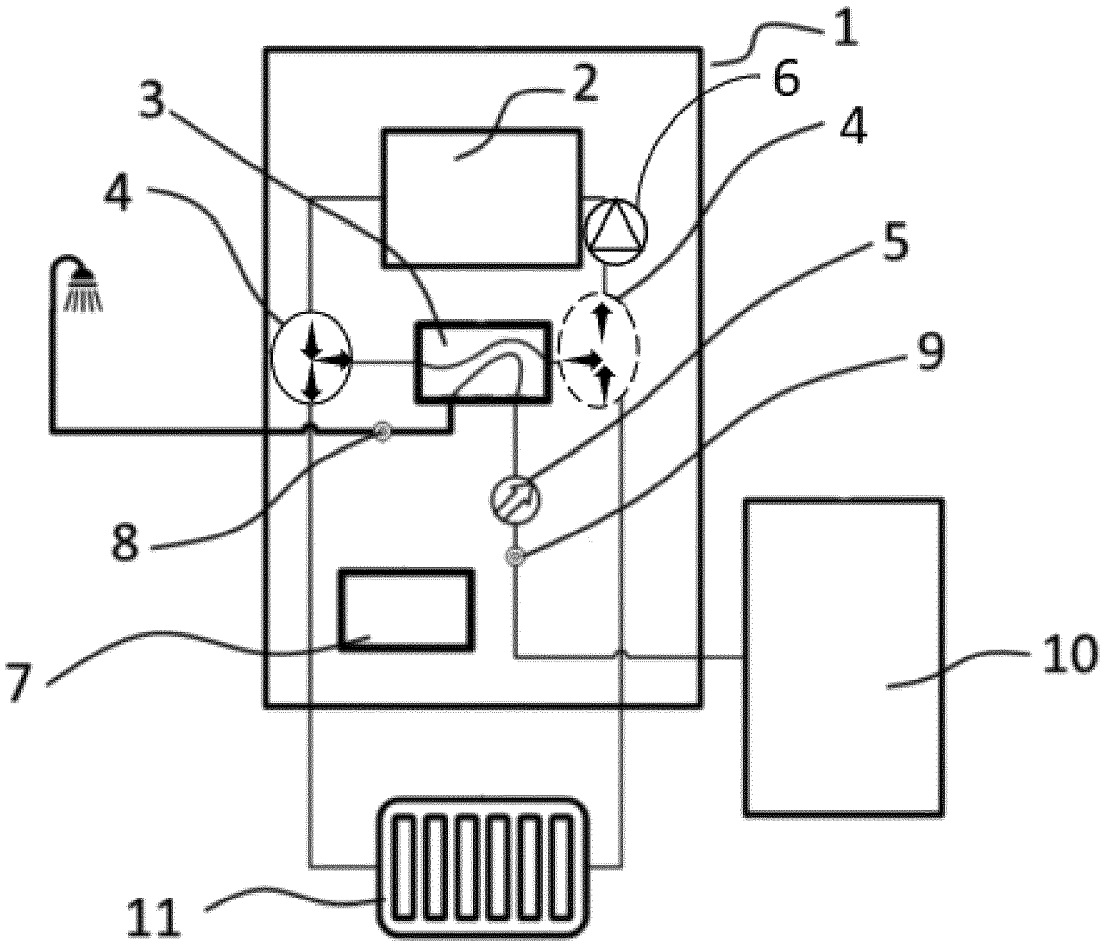

Figure 1

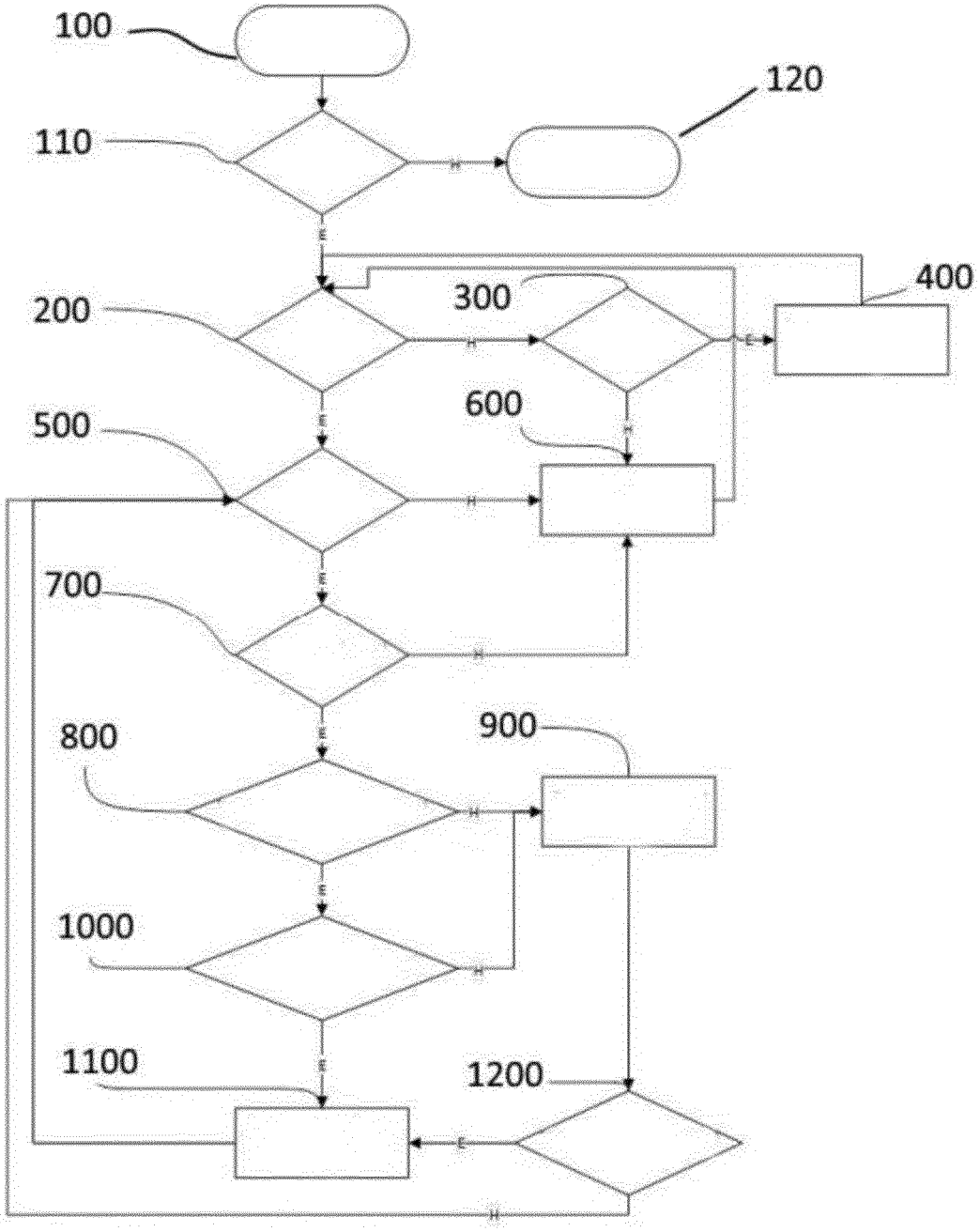

Figure 2

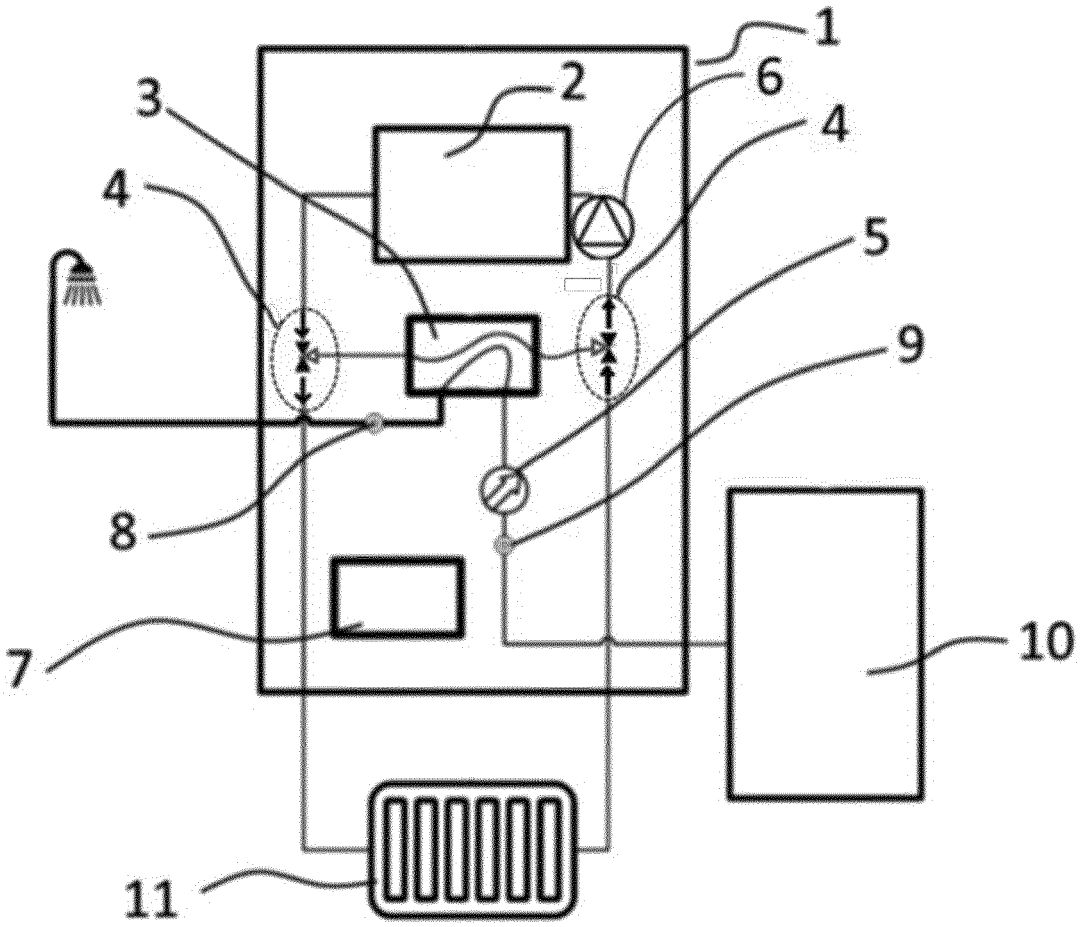

Figure 3

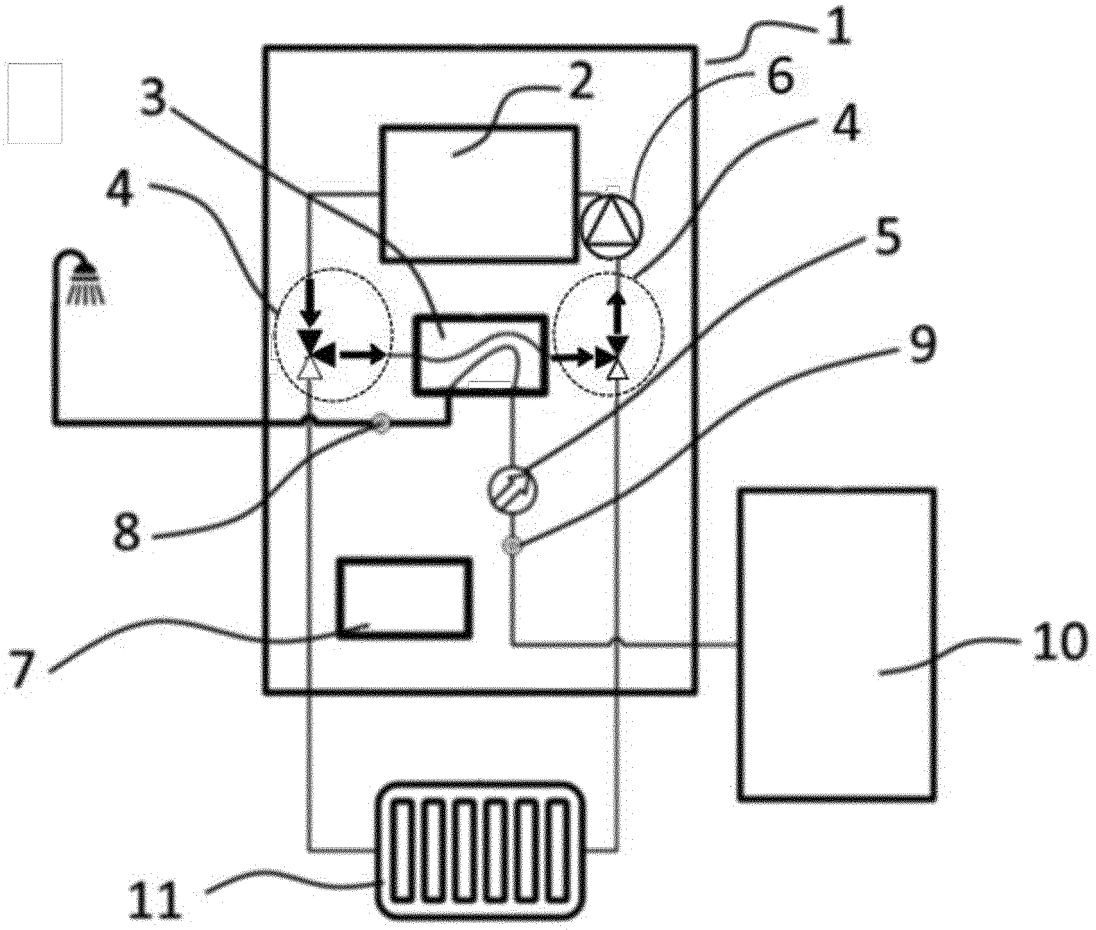

Figure 4

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EUROPEAN SEARCH REPORT

Application Number
EP 22 02 0316

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			F24D F24H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 November 2022	Schwaiger, Bernd

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 02 0316

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