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(54) **SYSTEM FOR TRANSPORTING AND CONTROLLING LIQUID FLOW IN A HEATING SYSTEM**

(57) The invention relates to a system for transporting and controlling liquid flow in a heating system, said heating system comprising a container for containing a liquid therein, wherein said system comprises:
- a liquid transporting system comprising:
- at least one heat source heat exchanger;
- at least one heat use heat exchanger;
- a plurality of conduits;
- a plurality of pumps for pumping and thereby transporting liquid in the liquid transporting system;
and wherein the system further comprises:
- a control system for controlling the transport of the liquid in the liquid transporting system by controlling the plurality of pumps, said control system comprising a control means arranged to control the plurality of pumps based on:
- a central heating and/or hot tap water demand, and
- a temperature of the liquid within the container.

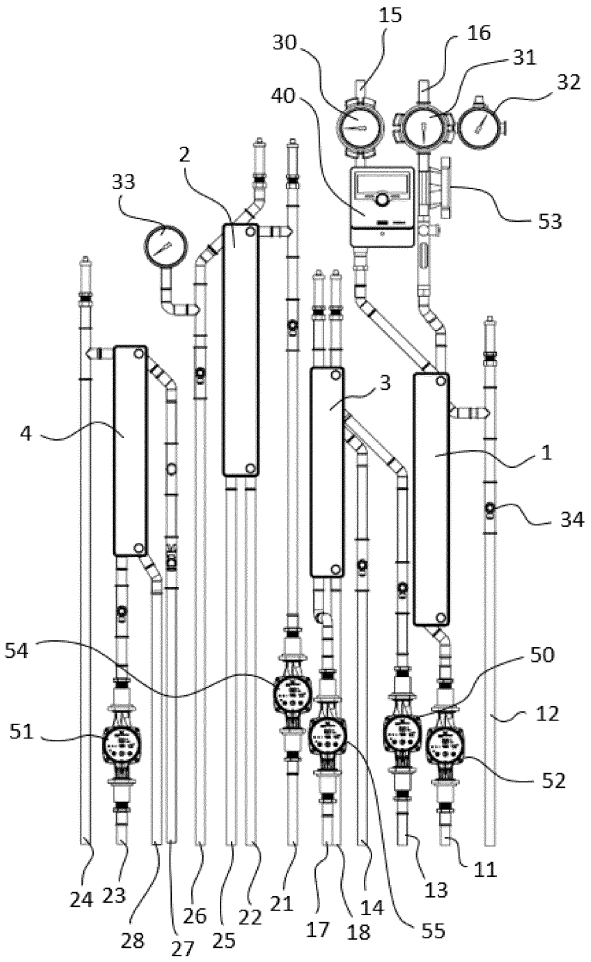

Fig. 1

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Description

[0001] The invention relates to a system for transporting and controlling liquid flow in a heating system, wherein said heating system comprises a container for containing a liquid therein. Said container may in particular be a heat buffer container in which relatively hot liquid may be stored or buffered, such that the relatively hot liquid can be used at any suitable time for heating tap water and/or central heating water. Such a container may also be referred to as a thermal battery and may be embodied in any suitable way.

[0002] Such a system is known per se. It is an object of the invention to provide an improved system for transporting and controlling liquid flow in a heating system, wherein said heating system comprises a container for containing a liquid therein.

[0003] This object is achieved by providing a system according to the preamble, wherein said system comprises:

- a liquid transporting system comprising:
    - at least one heat source heat exchanger;
    - at least one heat use heat exchanger,
    - a plurality of conduits, wherein:
        - a first conduit fluidly connects the container to the at least one heat source heat exchanger to transport liquid discharged from the container to the at least one heat source heat exchanger;
        - a second conduit fluidly connects the at least one heat source heat exchanger to the container to transport liquid discharged from the at least one heat source heat exchanger to the container;
        - a third conduit fluidly connects the container to the at least one heat use heat exchanger to transport liquid discharged from the container to the at least one heat use heat exchanger;
        - a fourth conduit fluidly connects the at least one heat use heat exchanger to the container to transport liquid discharged from the at least one heat use heat exchanger to the container;
        - a fifth conduit fluidly connects a heat source to the at least one heat source heat exchanger to transport liquid discharged from the heat source to the at least one heat source heat exchanger;
        - a sixth conduit fluidly connects the at least one heat source heat exchanger to the heat source to transport liquid discharged from the at least one heat source heat exchanger to the heat source;
        - a seventh conduit fluidly connects a liquid supply to the at least one heat use heat exchanger to transport liquid to the at least one heat use heat exchanger, said liquid supply being part of a central heating system or connecting to a tap water distribution network, and
        - an eight conduit fluidly connects the at least one heat use heat exchanger to the central heating system or a tap water supply element, respectively, for transporting liquid discharged from the at least one heat use heat exchanger to the central heating system or the tap water supply element, respectively,
    - a plurality of pumps for pumping and thereby transporting liquid in the liquid transporting system;

and wherein the system further comprises:

- a control system for controlling the transport of liquid in the liquid transporting system by controlling the plurality of pumps, said control system being arranged to control the plurality of pumps based on:
    - a central heating and/or hot tap water demand, and
    - a temperature of the liquid within the container.

[0004] An advantage of the system according to the invention is that liquid flow in the liquid transporting system can be easily and/or efficiently controlled by the control system and in particular by the control means thereof, in particular by controlling the plurality of pumps based on the central heating and/or hot tap water demand and based on a temperature of the liquid within the container. For example, if there is a central heating and/or hot tap water demand any suitable pump of the plurality of pumps may be controlled to pump and thereby transport relatively hot liquid from the container to the at least one heat use heat exchanger and then back to the container. In the heat use heat exchanger heat is transferred from the relatively hot container liquid to the central heating liquid and/or tap water. As an alternative or additional example, if the temperature of the liquid within the container appears to be too low, i.e. below a certain threshold, any other suitable pump of the plurality of pumps may be controlled to pump and thereby transport relatively cold liquid from the container to the at least one heat source heat exchanger and then back to the container. In the heat source heat exchanger the container liquid will absorb heat from relatively hot liquid originating from the heat source, such that the container liquid that is returned to the container has a higher temperature than the container liquid discharged from the container, such that the average temperature of the liquid within the container will increase. It will be clear for the skilled person that any other suitable pump from the plurality of pumps can be

employed in the above described examples, such as for example a pump for pumping and thereby transporting liquid from the heat source to the heat source heat exchanger and back to the heat source and/or another pump for pumping and thereby transporting liquid from the central heating system to the heat use heat exchanger and back to the central heating system. It is noted that in particular for tap water no pump may be required because the pressure of the tap water as provided by the water distribution network may be sufficient to transport the tap water to the heat use heat exchanger for heating up and then to the tap water supply element.

[0005] The liquid may in particular be water. Preferably a number of distinct liquid flows are present in the system. The liquid within the container that may be transported to any of the heat exchangers for being heated or for transferring heat to another liquid and then transported back to the container may be referred to as the container liquid. The liquid(s) circulating in the heat source circuit(s) that circulate(s) between the heat source(s) and heat source heat exchanger(s) may be referred to as the heat source liquid(s) or more in particular for example the explicit name of the heat source followed by liquid. The liquid circulating in the central heating system and heat use heat exchanger may be referred to as central heating liquid. The liquid from the tap water system that is transported to the tap water element after being heated in the or another heat use heat exchanger may be referred to as tap water.

[0006] The at least one heat source heat exchanger and/or heat use heat exchanger may be any suitable type of heat exchanger, such as for example a plate heat exchanger and/or a counterflow heat exchanger.

[0007] The plurality of conduits may be any suitable type of conduits and may alternatively be referred to as pipes, ducts, etc. The conduits may in particular be pipes suitable for transporting hot and cold water.

[0008] It is noted that any number of heat sources and/or any suitable type of heat source may be provided. For example, but not limited thereto, the heat source may be any type of solar thermal collector, such as a heat pipe, or any other type of heat source, such as a heat pump, a (pellet) stove, a boiler.

[0009] Preferably there is a heat source heat exchanger for each heat source that is part of the heating system.

[0010] Preferably there are two heat use heat exchangers. A first heat use heat exchanger for heating central heating water and a second heat use heat exchanger for heating tap water.

[0011] The number of conduits is preferably adapted to the number of heat source heat exchangers and heat use heat exchangers. If there is one heat source heat exchanger there is one set of first and second conduits and one set of fifth and sixth conduits. If there is one heat use heat exchanger there is one set of third and fourth conduits and one set of seventh and eight conduits. In case there are multiple heat source heat exchanger and/or heat use heat exchangers, there is a corresponding number of respective described sets of conduits. For example, if there are two heat source heat exchangers, there are therefore two sets of first and second conduits and two sets of fifth and sixth conduits. The conduits of the second set may be referred to as the second first conduit, second second conduit, etc. It is noted that the conduits are referred to as first to eight conduits only to be able to easily distinguish between the different conduits.

[0012] Said control means may be any suitable control means or controller, such as for example a (micro)processor.

[0013] The pumps may be any suitable type of pump for pumping liquid.

[0014] The tap water supply element may be any suitable type of tap water supply element, such as for example a faucet or a showerhead.

[0015] The central heating system may be any suitable type of central heating system and may for example comprise floor heating or radiator(s) and conduits connecting thereto.

[0016] As described, the first, second, third and fourth conduits connect to the container. Relatively hot liquid present in the container may be discharged from the container to heat tap water or central heating liquid in the at least one heat use heat exchanger and may then return to the container. Relatively cold liquid present the container may be discharged from the container to be heated in the at least heat source heat exchanger and may then return to the container. Preferably the conduits connect to the container at a suitable height, i.e. at a higher height for discharging and feeding relatively hot liquid and at a lower height for discharging and feeding relatively cold liquid. The first, second, third and fourth conduits and container together define a closed system for the container liquid.

[0017] It is noted that if "a" or "an" is used, this is to be interpreted as at least one.

[0018] In an embodiment of the system according to the invention said system comprises or connects to at least one hot water demand sensor for sensing a central heating and/or hot tap water demand, wherein said hot water demand sensor provides a hot water demand signal when a central heating and/or hot tap water demand is sensed, wherein the control means is operatively connected to the hot water demand sensor for receiving the hot water demand signal and is arranged to control a first pump of the plurality of pumps to transport liquid from the container to the heat use heat exchanger and back to the container via the third conduit and fourth conduit respectively based on the hot water demand signal.

[0019] In such an embodiment the control means is arranged to control the first pump to transport hot container liquid from the container to the at least one heat use heat exchanger to heat the tap water and/or central heating liquid when it receives the hot water demand signal or when the hot water demand signal indicates the hot water demand.

[0020] Preferably the system may comprise or connect to two hot water demand sensors, wherein a first hot water demand sensor is arranged to sense a hot tap water demand and a second hot water demand sensor is arranged to sense a central heating demand.

[0021] The hot water demand sensor arranged to sense a hot tap water demand may for example be a flow sensor or flow switch. Such a flow sensor may be arranged at any suitable location in or at the hot tap water supply system in order to be able to detect a flow of the water in the hot tap water supply system, which flow occurs when a tap water supply element is activated, for example by a user, and when such flow is detected by the flow sensor the flow sensor may provide a signal that is transmitted to the control means. Upon receiving the signal from the flow sensor the control means controls said first pump to pump the liquid as described above, such that the relatively hot liquid from the container is transported to the heat use heat exchanger. The tap water that flows in the hot tap water supply system is also transported to the heat use heat exchanger via the seventh conduit and is thus heated by the relatively hot liquid from the container and then supplied via the eighth conduit as hot tap water at the tap water supply element that was activated.

[0022] The hot water demand sensor arranged to sense a central heating demand may for example be a thermostat of the central heating system. Such a thermostat may be arranged at any suitable location in or at a building and may for example control the central heating system based on a measured and set temperature. If it is determined by the thermostat that central heating is required, a signal may be transmitted to the control means. Upon receiving the signal from the thermostat the control means controls said first pump or a second first pump to pump the liquid as described above, such that the relatively hot liquid from the container is transported to the heat use heat exchanger or a second heat use heat exchanger. The central heating liquid that flows in the central heating system is also transported to that heat use heat exchanger via the seventh conduit or a second seventh conduit and is thus heated by the relatively hot liquid from the container and then returned to the central heating system via the eighth conduit or a second eight conduit to heat up (part of) the building. The pump for pumping the central heating liquid may for example be an external pump that is external to the system according to the invention, but alternatively the central heating system may not have it's own pump and the system according to the invention may have a pump to circulate the central heating liquid through (part of) the central heating system. Such a pump of the system may be controlled by said control means to start pumping if there is a central heating demand. Such an external pump may either be controlled by the control means or by a control means of the central heating system itself.

[0023] In the above described examples the so-called (second) seventh and (second) eight conduits may be part of or connect to the tap water system and central heating system. Such tap water system and central heating system may comprise further conduits that may connect to the seventh and/or eight conduits of the system according to the invention.

[0024] In an embodiment of the system according to the invention said system comprises or connects to a container temperature sensor for sensing a temperature of the liquid in the container, wherein said container temperature sensor provides a container temperature signal indicative of the temperature of the liquid in the container, wherein the control means is operatively connected to the container temperature sensor for receiving the container temperature signal and is arranged to control a second pump of the plurality of pumps to transport the liquid from the container to the heat source heat exchanger and back to the container via the first conduit and second conduit respectively based on the container temperature signal.

[0025] The control means may in particular be arranged to control the second pump to pump the liquid when the container temperature signal indicates that the liquid in the container needs heating, i.e. when the temperature is below a certain threshold, or when the temperature of the liquid in the container is such with respect to a temperature of any of the heat sources that said heat source is able to further heat, i.e. increase the temperature of, the liquid in the container.

[0026] Practically the control means may be further arranged to control a third pump of the plurality of pumps or a pump external to the system to transport liquid from the at least one heat source to the at least one heat source heat exchanger and back to the at least one heat source via the fifth conduit and sixth conduit respectively based on the container temperature signal.

[0027] The liquid from the heat source is thereby able to heat the container liquid.

[0028] In this embodiment the heat source may for example be a heat pump or pellet stove, which is arranged to heat the container liquid if the temperature thereof is too low, which is indicated by the container temperature signal as described above. Because a heat pump or pellet stove is independent of an available renewable energy source, such a heat source may be used to heat the container liquid based on the container temperature signal only and may be used to heat the container liquid at any time when the container liquid temperature is too low, i.e. is below said certain threshold.

[0029] In an embodiment of the system according to the invention said system comprises or connects to a solar thermal collector temperature sensor for sensing a temperature of the liquid in a solar thermal collector element, wherein said solar thermal collector temperature sensor provides a solar thermal collector temperature signal indicative of the temperature of the liquid in the solar thermal collector, wherein the control means is operatively connected to the solar thermal collector temperature sensor for receiving the solar thermal collector

temperature signal and is arranged to control the third pump or the pump external to the system to transport the liquid from the solar thermal collector to the at least one heat source heat exchanger and back to the solar thermal collector via the fifth conduit and sixth conduit respectively based on both the container temperature signal and the solar thermal collector temperature signal.

[0030] If the solar thermal collector temperature signal and the container temperature signal together indicate that the thermal solar collector is able to heat the container liquid, the control system may be arranged to control the third pump or a second third pump to pump the liquid from the solar thermal collector to the heat source heat exchanger and back. This way the container liquid is heated by solar energy.

[0031] In such an embodiment the control system takes into account both temperature signals and may for example be arranged to initiate heating of the liquid in the container by the solar thermal collector when the container temperature signal indicates that the temperature of the container liquid is too low, i.e. is below said threshold, and when the solar thermal collector temperature signal indicates that it is possible to heat the container liquid by the solar thermal collector. Alternatively or additionally the control system may be arranged to initiate heating of the liquid in the container by the solar thermal collector when the two temperature signals indicate that heating of the container liquid by the solar thermal collector is possible even when the container liquid has a temperature above the certain threshold, because this will add thermal energy to the container liquid when solar energy is available and therefore reduces or avoids a waste of this solar energy.

[0032] The solar thermal collector may for example comprise at least one heat pipe.

[0033] Practically the control means is arranged to control the third pump or pump external to the system to transport the liquid from the solar thermal collector to the at least one heat source heat exchanger and back to the solar thermal collector via the fifth conduit and sixth conduit respectively if the difference between the solar thermal collector signal and the container temperature signal exceeds a chosen threshold.

[0034] Such a difference, in particular a positive difference, indicates that the solar thermal collector is able to heat the liquid in the container. The difference in temperature may be any suitable difference, for example a few degrees Celsius.

[0035] As described above, any suitable type and number of heat sources and thereby heat source heat exchangers may be applied in the system. Preferably there is at least one heat source making use of renewable energy sources, such as the above described solar thermal collector, and at least one heat source that is not dependent on the availability of renewable energy and in particular not dependent on the sun shining, such as the above described heat pump or pellet stove. In such an embodiment the control means are arranged to control a second third pump or pump external to the system to transport the liquid from a second heat source to a second heat source heat exchanger and back to the second heat source via a second fifth conduit and second sixth conduit respectively based on the container temperature signal and the solar thermal collector signal, and wherein the control means is arranged to control the second heat source to activate the second heat source.

[0036] If the container temperature signal and the solar thermal collector signal indicate that the container liquid cannot be (efficiently) heated by the solar thermal collector, the control means is arranged to heat the container liquid by the second heat source and thus activates the second heat source. The second heat source may for example be the above described heat pump or pellet stove or any other type of heat source that is not dependent on solar energy. Activating the second heat source may mean that that the second heat source is activated to heat the heat source liquid. The heat source liquid may heat the container liquid in the heat source heat exchanger as explained before.

[0037] In an embodiment of the system according to the invention controlling the plurality of pumps comprises controlling at least one pump of the plurality of pumps to pump liquid or not.

[0038] Alternatively or additionally, controlling the plurality of pumps comprises controlling at least one pump of the plurality of pumps to pump liquid at an adjustable flow rate.

[0039] An advantage of controlling the flow rate is that this may influence the amount of heat transferred between the liquids in the heat exchangers and for example thereby the temperature of the requested tap water and/or central heating water.

[0040] In an embodiment of the system according to the invention the control means is arranged to control the third pump or pump external to the system to transport the liquid from the solar thermal collector to the at least one heat source heat exchanger and back to the solar thermal collector via the fifth conduit and sixth conduit respectively at a set flow rate based on the difference between the solar thermal collector temperature signal and the container temperature signal, wherein said set flow rate increases with increasing positive difference.

[0041] A high positive difference indicates that there is a relatively large difference between the container liquid temperature and solar thermal collector liquid temperature, i.e. large delta T, such that the energy transfer from the solar thermal collector liquid to the container liquid may be relatively high and as such the flow rate may be set at a relatively high setpoint. At lower temperature differences the flow rate is set at a relatively low set point. For example, there may be a linear relation or any other suitable relation between the difference in temperature and the set flow rate. The setpoint of the flowrate may substantially continually be adjusted by the control means.

[0042] In an embodiment said system comprises or

connects to a second heat source temperature sensor for sensing a temperature of liquid in the second heat source, wherein said second heat source temperature sensor provides a second heat source temperature signal indicative of the temperature of the liquid in the second heat source, wherein the control means is operatively connected to the second heat source temperature sensor for receiving the second heat source temperature signal and is arranged to control the second third pump to transport the liquid from the second heat source to the second heat source heat exchanger and back to the second heat source via the second fifth conduit and second sixth conduit respectively based on both the container temperature signal and the second heat source temperature signal.

[0043] As described above, the second heat source may be any suitable heat source, for example a heat pump or pellet stove. A heat pump or pellet stove may have a modulating control resulting in a varying temperature of the liquid thereof and/or the temperature of the liquid thereof may gradually increase after starting the heat pump or pellet stove, such that also for such heat sources, i.e. not dependent on renewable sources, it may be advantageous to sense the temperature of the liquid thereof to control the second third pump or external pump.

[0044] In an embodiment of the system according to the invention the control means is arranged to control the second third pump or the pump external to the system to transport the liquid from the second heat source to the second heat source heat exchanger and back to the second heat source via the second fifth conduit and second sixth conduit respectively at a set flow rate based on the difference between the second heat source temperature signal and the container temperature signal, wherein said set flow rate increases with increasing positive difference.

[0045] A high positive difference indicates that there is a relatively large difference between the container liquid temperature and the second heat source liquid temperature, i.e. large delta T, such that the energy transfer from the second heat source to the container liquid may be relatively high and as such the flow rate may be set at a relatively high setpoint. At lower temperature differences the flow rate is set at a relatively low set point. For example, there may be a linear relation or any other suitable relation between the difference in temperature and the set flow rate. The setpoint of the flowrate may substantially continually be adjusted by the control means.

[0046] Generally said, the control means may be arranged to control the respective third pump or the pump external to the system to transport the liquid from a respective heat source to the respective heat source heat exchanger and back to the respective heat source via the respective fifth conduit and respective sixth conduit respectively at a set flow rate based on the difference between the respective heat source temperature signal and the container temperature signal, wherein said set flow rate increases with increasing positive difference.

[0047] In an embodiment of the system according to the invention the control means is arranged to control the first pump to transport the liquid from the container to the heat use heat exchanger and back to the container via the third conduit and fourth conduit respectively at a set flow rate based on the hot water demand signal.

[0048] Dependent on the requested temperature of the hot tap water and/or central heating water, which information may be contained in the hot water demand signal, the flow rate of the first pump may be set by the control means. For example, if relatively low temperature tap water or central heating liquid is demanded the flow rate of the first pump may be set at a relatively low setpoint such that a relatively low amount of thermal energy is transferred to the tap water and/or central heating liquid. For example, if relatively high temperature tap water or central heating liquid is demanded the flow rate of the first pump may be set at a relatively high setpoint such that a relatively high amount of thermal energy is transferred to the tap water and/or central heating liquid. The setpoint of the flowrate may substantially continually be adjusted by the control means, for example in dependence on the heat demand.

[0049] In an embodiment of the system according to the invention said system comprises a housing, and wherein at least the at least one heat source heat exchanger, at least the at least one heat use heat exchanger, at least a part of all conduits, and the control means are accommodated in the housing.

[0050] An advantage of such a housing is that the system according to the invention may be easily be transported and/or installed, by installing the housing and connecting the conduits to the various components of the system. Another or alternative advantage of the housing is that all system components are grouped together, thereby providing easy access and/or maintenance of the system.

[0051] Practically the housing comprises a plurality of through holes or at least one common though hole for allowing the conduits to pass in and out of the housing.

[0052] The system according to the invention may comprise any other suitable elements, which may also be arranged in the housing.

[0053] For example, said system may comprise at least one pressure gauge or sensor for measuring and/or displaying the pressure of any of the liquids at any suitable location, for example of the container liquid and/or of the central heating liquid and/or heat source liquid.

[0054] For example, said system may comprise at least one thermometer for measuring and/or displaying the temperature of any of the liquids at any suitable location, for example of the liquid discharged from the solar thermal collector.

[0055] For example, the system may comprise at least one air vent, for discharging air from the system.

[0056] For example, the system may comprise at least one faucet for feeding or discharging liquid to the system.

[0057] The invention may also relate to the use of a system according to the invention.

[0058] The invention will be further elucidated with reference to the attached figures, in which:

Figure 1 is a front view of the system according to an embodiment;
Figures 2 - 5 are perspective views of different parts or columns of the system of figure 1; and
Figure 6 is a perspective view of a housing accommodating the system of figure 1.

[0059] In the figures the same elements are denoted by same reference numerals.

[0060] Figure 1 shows the system according to a first embodiment of the invention. The system comprises a plurality of heat exchangers, conduits, pumps and other components and is arranged for transporting and controlling a liquid flow in a heating system, wherein said heating system comprises a container for containing a liquid therein (not shown). The various components of the system of claim 1 will be described below with reference to figures 1 - 5.

[0061] The system according to this embodiment comprises a first heat source heat exchanger 1 and a second heat source heat exchanger 2.

[0062] The system further comprises a first heat use heat exchanger 3 and a second heat source heat exchanger 4.

[0063] The system further comprises a plurality of conduits. A first conduit 11 fluidly connects the container to the first heat source heat exchanger 1 to transport liquid discharged from the container to the first heat source heat exchanger 1. A second conduit 12 fluidly connects the first heat source heat exchanger 1 to the container to transport liquid discharged from the first heat source heat exchanger 1 to the container. A third conduit 13 fluidly connects the container to the first heat use heat exchanger 3 to transport liquid discharged from the container to the first heat use heat exchanger 3. A fourth conduit 14 fluidly connects the first heat use heat exchanger 3 to the container to transport liquid discharged from the first heat use heat exchanger to the container. A fifth conduit 15 fluidly connects a first heat source (not shown) to the first heat source heat exchanger 1 to transport liquid discharged from the first heat source to the first heat source heat exchanger 1. A sixth conduit 16 fluidly connects the first heat source heat exchanger 1 to the first heat source to transport liquid discharged from the first heat source heat exchanger 1 to the first heat source. A seventh conduit 17 fluidly connects a first liquid supply to the first heat use heat exchanger 3 to transport liquid to the first heat use heat exchanger 3, wherein said first liquid supply is a part of a central heating system (not shown). An eight conduit 18 fluidly connects the first heat use heat exchanger 3 to the central heating system for transporting liquid discharged from the first heat use heat exchanger 3 to the central heating system. A second first conduit 21 fluidly connects the container to the second heat source heat exchanger 2 to transport liquid discharged from the container to the second heat source heat exchanger 2. A second second conduit 22 fluidly connects the second heat source heat exchanger 2 to the container to transport liquid discharged from the second heat source heat exchanger 2 to the container. A second third conduit 23 fluidly connects the container to the second heat use heat exchanger 4 to transport liquid discharged from the container to the second heat use heat exchanger 4. A second fourth conduit 24 fluidly connects the second heat use heat exchanger 4 to the container to transport liquid discharged from the second heat use heat exchanger 4 to the container. A second fifth conduit 25 fluidly connects a second heat source (not shown) to the second heat source heat exchanger 2 to transport liquid discharged from the second heat source to the second heat source heat exchanger 2. A second sixth conduit 26 fluidly connects the second heat source heat exchanger 2 to the second heat source to transport liquid discharged from the second heat source heat exchanger 2 to the second heat source. A second seventh conduit 27 fluidly connects a second liquid supply to the second heat use heat exchanger 4 to transport liquid to the second heat use heat exchanger 4, wherein said second liquid supply is a part of a tap water distribution network (not shown). A second eight conduit 28 fluidly connects the second heat use heat exchanger 4 to a tap water supply element (not shown) for transporting liquid discharged from the second heat use heat exchanger 4 to the tap water element.

[0064] The system further comprises a plurality of pumps 50 - 55 for transporting the liquid in the liquid transporting system, such that the liquid will flow through some of the various conduits, heat exchangers, and container on the one hand. This liquid may also be referred to as the container liquid. Other liquids will flow will flow through others of the various conduits, heat exchangers, the tap water system, central heating system, and heat sources.

[0065] The system further comprises a control system for controlling the transport of the liquid in the liquid transporting system by controlling the plurality of pumps 50 - 55, said control system comprising a control means 40 arranged to control the plurality of pumps 50 - 55 based on a central heating and/or hot tap water demand, and a temperature of the liquid within the container.

[0066] A first pump 50 is arranged to transport the liquid from the container to the first heat use heat exchanger 3 and back to the container via the third conduit 13 and fourth conduit 14 respectively. In this embodiment the system comprises a hot water demand sensor (not shown) for sensing a central heating demand, which sensor may be a thermostat. If for example the temperature of a room or building where the thermostat is present is below a setpoint, the thermostat will transmit a central heating hot water demand signal which is received by the control means 40. Upon receiving this signal the control means 40 activates the first pump 50 to pump said

liquid as described above. Simultaneously a fourth pump 55 is activated to pump the central heating liquid to the first heat use heat exchanger 3 and back to the central heating system via the seventh conduit 17 and eight conduit 18 respectively. The central heating liquid is heated up by the container liquid in the first heat use heat exchanger.

[0067] A second first pump 51 is arranged to transport the liquid from the container to the second first heat use heat exchanger 4 and back to the container via the second third conduit 23 and fourth conduit 24 respectively. In this embodiment the system comprises a second hot water demand sensor (not shown) for sensing a hot tap water demand, which sensor may be a flow sensor. If a tap water supply element is activated, for example by a user, the tap water will start flowing in the tap water system and the flow sensor will sense this flow. The flow sensor will transmit a hot tap water demand signal which is received by the control means 40. Upon receiving this signal the control means 40 activates the second first pump 51 to pump said liquid as described above. The tap water that flows through the second first heat use exchanger 4 is heated up by the container liquid in the second first heat use heat exchanger 4 and then further transported to the tap water element that was activated via the second eight conduit 28. No pump is needed for transporting the tap water, because the tap water pressure is sufficient for transporting the tap water.

[0068] A second pump 52 is arranged to transport the liquid from the container to the first heat source heat exchanger 1 and back to the container via the first conduit 11 and second conduit 12 respectively. In this embodiment the system comprises a container temperature sensor (not shown) for sensing a temperature of the liquid in the container, wherein said container temperature sensor provides a container temperature signal indicative of the temperature of the liquid in the container. The container temperature sensor substantially continually transmits a signal to the control means 40, such that the temperature of the container liquid can be monitored substantially continuously. In this example, as soon as the container temperature is below a certain threshold or if it is determined that the container liquid may be heated by the first heat source which is in this embodiment a solar thermal collector such as a heat pipe, the control means 40 is arranged to activate the second pump 52 to transport the liquid as described above. Simultaneously the control means 40 activates a third pump 53, which third pump 53 transports a first heat source liquid from the first heat source to the first heat source heat exchanger 1 and back to the first heat source. The first heat source comprises a solar thermal collector temperature sensor (not shown) for sensing a temperature of the liquid in the solar thermal collector element, which transmits a solar thermal collector temperature signal indicative of the temperature of the liquid in the solar thermal collector that is received by the control means 40. Based on the difference between the temperature of the container liquid and the temperature of the liquid in the solar thermal collector, the control means 40 may activate the second pump 52 and third pump 53, such that the relatively hot liquid discharged from the solar thermal collector 1 heats the container liquid in the first heat source heat exchanger 1.

[0069] A second second pump 54 is arranged to transport the liquid from the container to the second heat source heat exchanger 2 and back to the container via the second first conduit 21 and second second conduit 22 respectively. If it is determined that the solar thermal collector is not able to heat the container liquid and the control means 40 receives the above described container temperature signal that heating of the container liquid is required because it is below said certain threshold, the second second pump 54 is activated to transport the liquid as described above. Simultaneously the control means 40 activates a second heat source and for example also a pump of the second heat source, which second heat source is for example a heat pump or any other heat source not relying on solar energy, which pump of the heat pump transports a second heat source liquid from the heat pump to the second heat source heat exchanger 2 and back to the heat pump via the second first conduit 25 and second sixth conduit 26 respectively. The relatively hot liquid discharged from the heat pump heats the container liquid in the second heat source heat exchanger, such that relatively hot container liquid is returned to the container via the second second conduit 22.

[0070] Said pumps 50 - 55 may for example be on-off pumps, meaning that these can be activated to pump or not. Preferably however, at least some of the pumps 50 - 55 are adjustable, such that the flow rate of the pumped liquid can be set at any suitable set point. The third pump 53 for pumping the solar thermal collector liquid is for example such an adjustable pump, such that the flow rate of the pumped solar thermal collector liquid may be set in accordance with the above described temperature difference between the solar thermal collector liquid and the container liquid as measured by the solar thermal collector temperature sensor and container temperature sensor and as determined by the control means 40. The first pump 50 and second first pump 50 for transporting the container liquid to the first heat use heat exchanger 3 and second heat use heat exchanger 4 respectively are preferably also adjustable, such that these can be set in accordance with a desired temperature of the central heating liquid and/or tap water, respectively.

[0071] As shown in figure 1 the system of this embodiment further comprises a thermometer 30 connecting to the fifth conduit 15 for displaying a temperature of the solar thermal collector liquid discharged from the solar thermal collector and a second thermometer 31 connecting to the sixth conduit 16 for displaying a temperature of the solar thermal collector liquid that is returned to the solar thermal collector after having passed the first heat source heat exchanger 1. The system also comprises a first pressure gauge 32 and second pressure 33 for displaying a pressure of the solar thermal collector liquid in

the sixth conduit 16 and of the heat pump liquid in the second sixth conduit 26, respectively. A faucet 34 is provided for feeding or discharging container liquid to the system, which faucet 34 is connected to the second conduit 12.

[0072] Figure 6 shows a housing 60 for accommodating the above-described system of the invention. The housing is in this embodiment a sort of cupboard, that may be installed at any suitable installation location where it is desired to install the system. The housing comprises a door 61 for closing and opening the housing, such that the system is accessible when needed. The housing further comprises two common through holes 62 at the bottom of the housing and one common though hole 62 at the top of the housing, said common through holes 62 for allowing the conduits 11 - 18 and 21 - 28 to pass in and out of the housing 60. A common through hole is defined is as allowing multiple conduits to pass in and out of the housing. In stead of common through holes a through hole for each conduit may be provided.

[0073] Although the invention is elucidated above on the basis of a number of specific examples and embodiments, the invention is not limited thereto. Consequently, the scope of the invention is defined by the following claims.

Claims

1. System for transporting and controlling liquid flow in a heating system, said heating system comprising a container for containing a liquid therein, wherein said system comprises:

- a liquid transporting system comprising:
  - at least one heat source heat exchanger;
  - at least one heat use heat exchanger,
  - a plurality of conduits, wherein:
    - a first conduit fluidly connects the container to the at least one heat source heat exchanger to transport liquid discharged from the container to the at least one heat source heat exchanger;
    - a second conduit fluidly connects the at least one heat source heat exchanger to the container to transport liquid discharged from the at least one heat source heat exchanger to the container;
    - a third conduit fluidly connects the container to the at least one heat use heat exchanger to transport liquid discharged from the container to the at least one heat use heat exchanger;
    - a fourth conduit fluidly connects the at least one heat use heat exchanger to the container to transport liquid discharged from the at least one heat use heat exchanger to the container;
    - a fifth conduit fluidly connects a heat source to the at least one heat source heat exchanger to transport liquid discharged from the heat source to the at least one heat source heat exchanger;
    - a sixth conduit fluidly connects the at least one heat source heat exchanger to the heat source to transport liquid discharged from the at least one heat source heat exchanger to the heat source;
    - a seventh conduit fluidly connects a liquid supply to the at least one heat use heat exchanger to transport liquid to the at least one heat use heat exchanger, said liquid supply being part of a central heating system or connecting to a tap water distribution network;
    - an eight conduit fluidly connects the at least one heat use heat exchanger to the central heating system or a tap water supply element, respectively, for transporting liquid discharged from the at least one heat use heat exchanger to the central heating system or the tap water supply element, respectively,
  - a plurality of pumps for pumping and thereby transporting liquid in the liquid transporting system;

and wherein the system further comprises:

- a control system for controlling the transport of the liquid in the liquid transporting system by controlling the plurality of pumps, said control system comprising a control means arranged to control the plurality of pumps based on:
  - a central heating and/or hot tap water demand, and
  - a temperature of the liquid within the container.

2. System according to claim 1, said system comprising or connecting to at least one hot water demand sensor for sensing a central heating and/or hot tap water demand, wherein said hot water demand sensor provides a hot water demand signal when a central heating and/or hot tap water demand is sensed, wherein the control means is operatively connected to the hot water demand sensor for receiving the hot water demand signal and is arranged to control a first pump of the plurality of pumps to transport liquid from the container to the heat use heat exchanger and back

to the container via the third conduit and fourth conduit respectively based on the hot water demand signal.

3. System according to claim 2, wherein the hot water demand sensor is a flow sensor arranged for sensing a flow of tap water.

4. System according to claim 2 or 3, wherein the hot water demand sensor or a second hot water demand sensor is a thermostat of the central heating system.

5. System according to any of the preceding claims, said system comprising or connecting to a container temperature sensor for sensing a temperature of the liquid in the container, wherein said container temperature sensor provides a container temperature signal indicative of the temperature of the liquid in the container, wherein the control means is operatively connected to the container temperature sensor for receiving the container temperature signal and is arranged to control a second pump of the plurality of pumps to transport the liquid from the container to the heat source heat exchanger and back to the container via the first conduit and second conduit respectively based on the container temperature signal.

6. System according to claim 5, wherein the control means is further arranged to control a third pump of the plurality of pumps or a pump external to the system to transport liquid from the at least one heat source to the at least one heat source heat exchanger and back to the at least one heat source via the fifth conduit and sixth conduit respectively based on the container temperature signal.

7. System according to claim 6, said system comprising or connecting to a solar thermal collector temperature sensor for sensing a temperature of liquid in a solar thermal collector element, wherein said solar thermal collector temperature sensor provides a solar thermal collector temperature signal indicative of the temperature of the liquid in the solar thermal collector, wherein the control means is operatively connected to the solar thermal collector temperature sensor for receiving the solar thermal collector temperature signal and is arranged to control the third pump or the pump external to the system to transport the liquid from the solar thermal collector to the at least one heat source heat exchanger and back to the solar thermal collector via the fifth conduit and sixth conduit respectively based on both the container temperature signal and the solar thermal collector temperature signal.

8. System according to claim 7, wherein the control means is arranged to control the third pump to transport the liquid from the solar thermal collector to the at least one heat source heat exchanger and back to the solar thermal collector via the fifth conduit and sixth conduit respectively if the difference between the solar thermal collector temperature signal and the container temperature signal exceeds a chosen threshold.

9. System according to any of claims 7 and 8, wherein the control means is arranged to control a second third pump or pump external to the system to transport the liquid from a second heat source to a second heat source heat exchanger and back to the second heat source via a second fifth conduit and second sixth conduit respectively based on the container temperature signal and the solar thermal collector temperature signal, and wherein the control means is arranged to control the second heat source to activate the second heat source.

10. System according to any of the preceding claims, wherein controlling the plurality of pumps comprises controlling at least one pump of the plurality of pumps to pump liquid or not.

11. System according to any of the preceding claims, wherein controlling the plurality of pumps comprises controlling at least one pump of the plurality of pumps to pump liquid at an adjustable flow rate.

12. System according to claim 11 and at least one of claims 7 and 8, wherein the control means is arranged to control the third pump or pump external to the system to transport the liquid from the solar thermal collector to the at least one heat source heat exchanger and back to the solar thermal collector via the fifth conduit and sixth conduit respectively at a set flow rate based on the difference between the solar thermal collector temperature signal and the container temperature signal, wherein said set flow rate increases with increasing positive difference.

13. System according to claim 11 and at least one of claims 2-4, wherein the control means is arranged to control the first pump to transport the liquid from the container to the heat use heat exchanger and back to the container via the third conduit and fourth conduit respectively at a set flow rate based on the hot water demand signal.

14. System according to any of the preceding claims, comprising a housing, and wherein at least the at least one heat source heat exchanger, at least the at least one heat use heat exchanger, at least a part of all conduits, and the control means are accommodated in the housing.

15. System according to claim 14, wherein the housing

comprises a plurality of through holes or at least one common though hole for allowing the conduits to pass in and out of the housing.

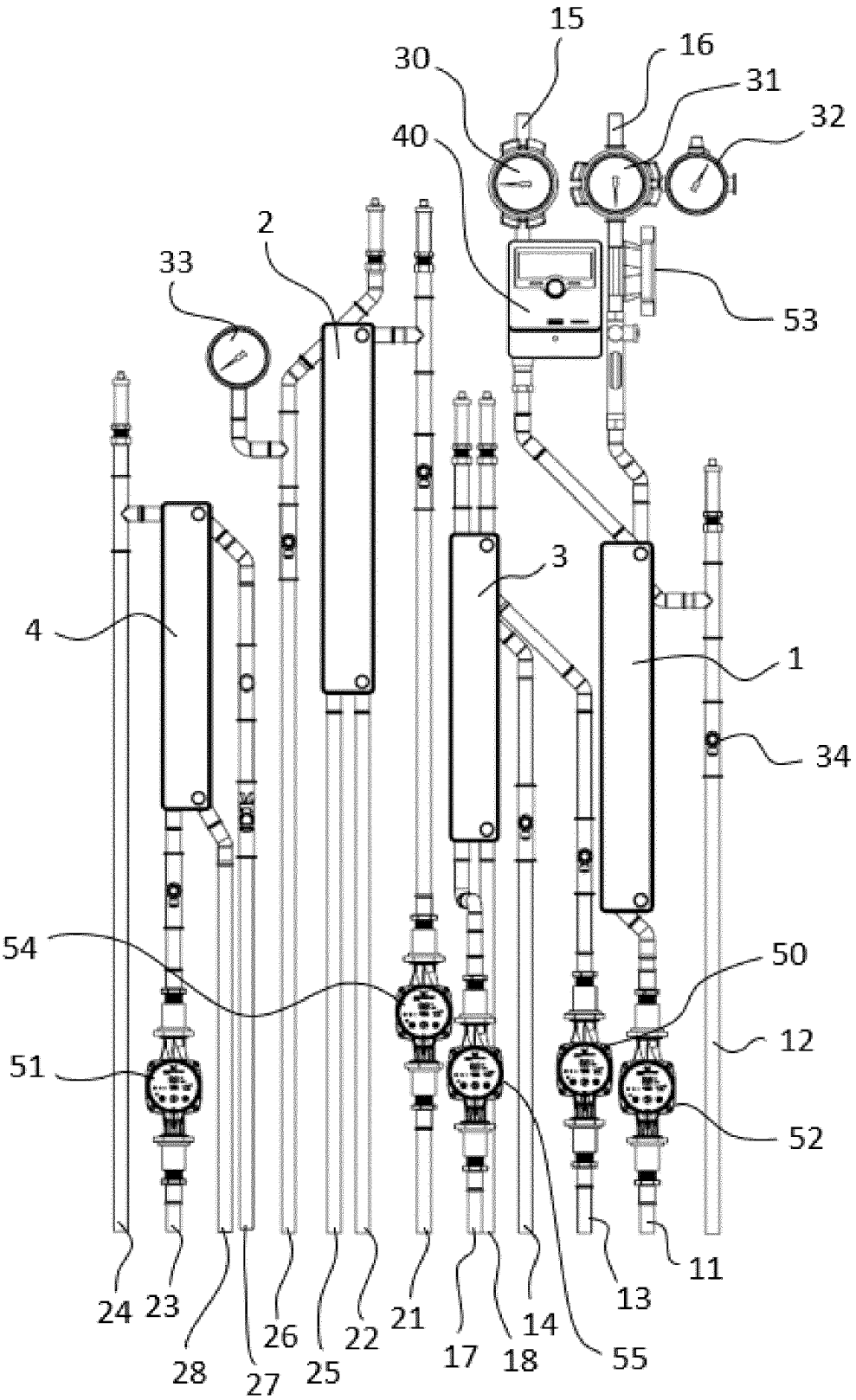
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Fig. 1

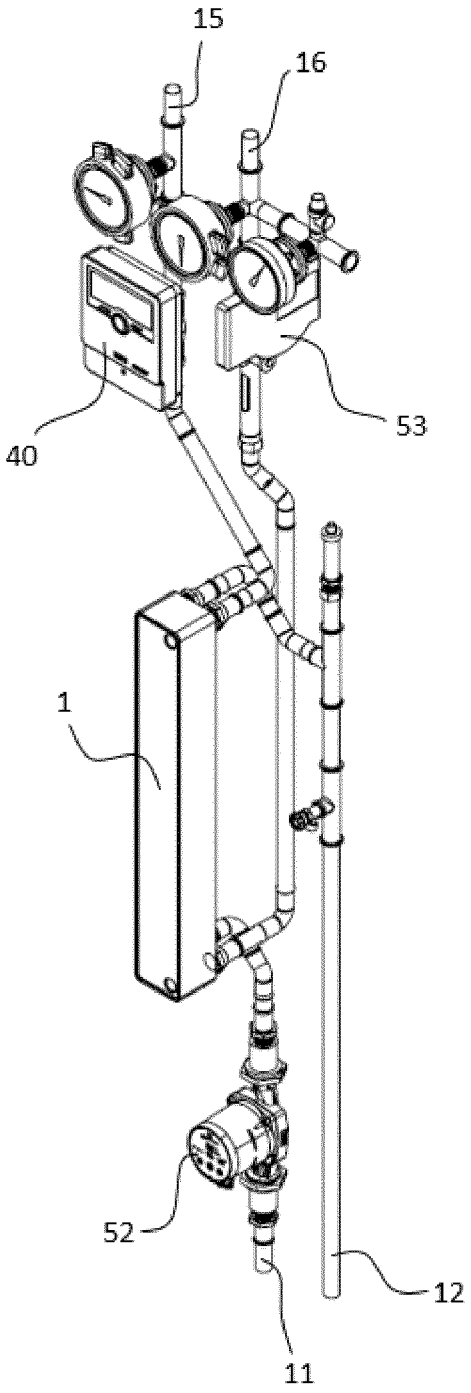

Fig. 2

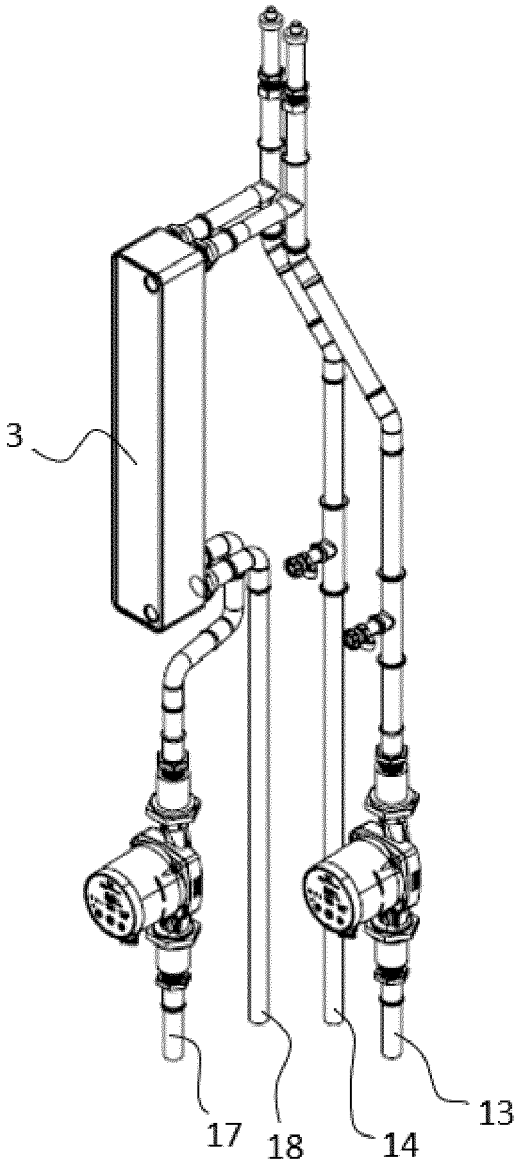

Fig. 3

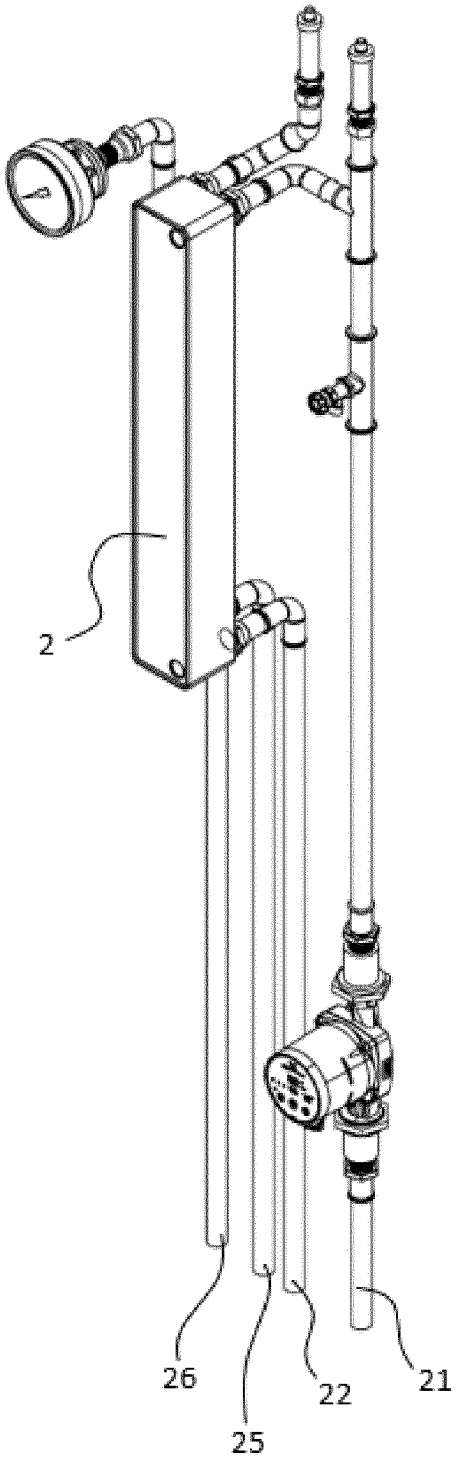

Fig. 4

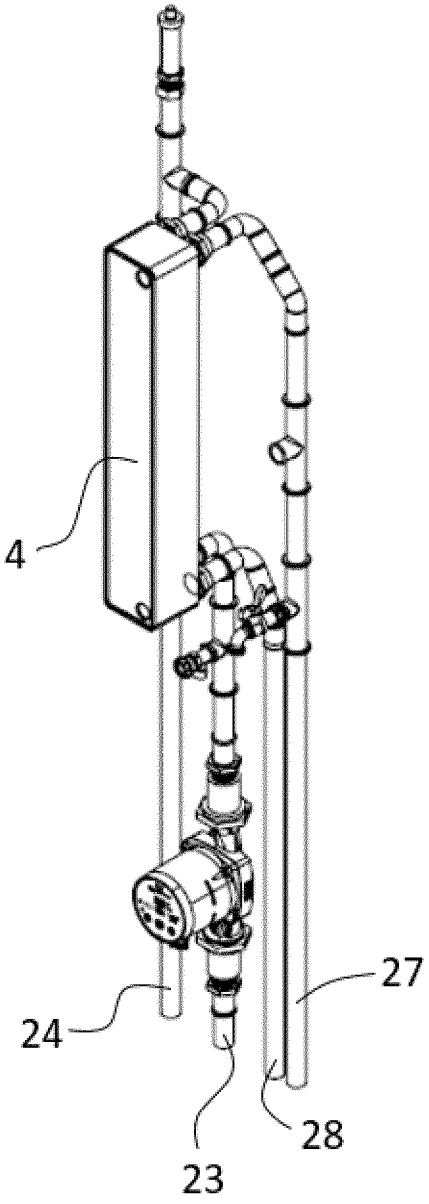

Fig. 5

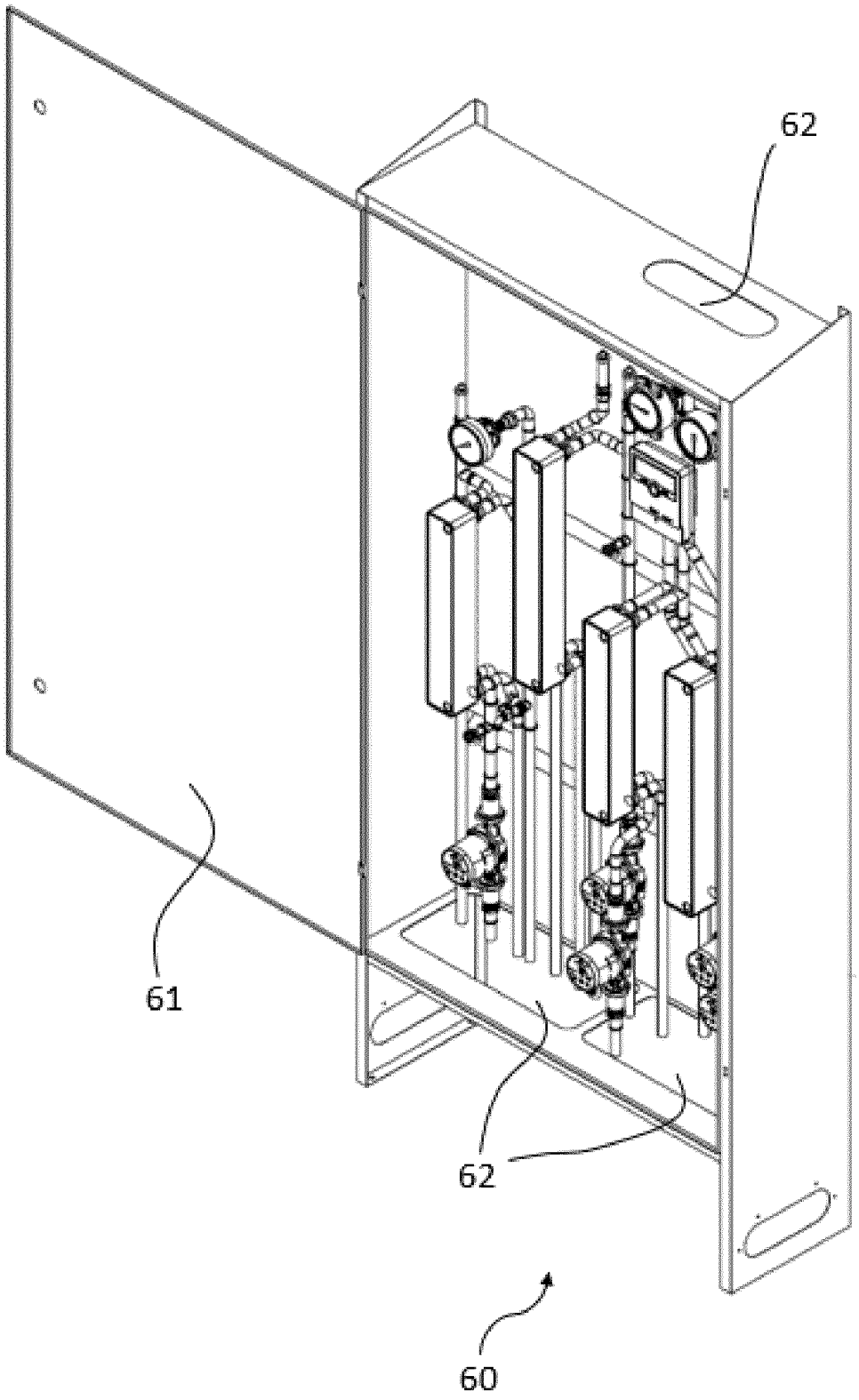

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 9254

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 March 2024	Riesen, Jörg

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