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(54) **Distribution Module for Heating or Cooling Circuit**

Verteilerarmatur für Heiz- oder Kühlkreislauf

Module de distribution pour un circuit de chauffage ou refroidissement

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(56) References cited:
EP-A- 0 309 440
EP-A- 0 806 612
EP-A- 0 957 319
EP-A- 1 039 249
DE-A- 3 404 849
DE-A- 19 644 773
FR-A- 2 733 822
US-A- 5 284 204

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Description

[0001] The present invention relates to a distribution module particularly suitable to be used to distribute water for heating or cooling.

[0002] Currently, a building or a portion of a building are usually heated or cooled by means of water, brought respectively to a high or low temperature by passing through a heat source, such as a boiler, or a cooling unit.

[0003] Such water is circulated in a distribution circuit toward one or more heat exchangers of the water-air type, such as radiators, radiating panels or a fan coil system.

[0004] Currently, water distribution to heat exchangers is usually controlled by means of electronic devices suitable to affect the adjustment of the boiler and the water circuits on the basis of measurements performed for example by room thermostats.

[0005] Accordingly, in modern building technology there is the drawback of providing technical sections reserved for placing the electronic devices and most of all the adjustment and control elements operated by such devices (for example pumps, calibration valves, mixing and/or distribution valves).

[0006] The main drawback is particularly that it is necessary to determine the technical section in each instance, according to each specific building structure, since every building has a specific heat demand, preset areas at different temperatures (for example, a home usually requires a daytime area, a night area and optionally a guest area) and other specific characteristics that require dedicated technical choices.

[0007] Accordingly, the installer of the system must have great experience and availability of time and resources, which affects the overall cost of the system.

[0008] In any case, the important problem of not having uniform technical solutions between two separate heating systems and of not having high efficiency or assurance of results between the systems remains evident; this is worsened by the fact that the presence of specialist workers of various kinds is often required, since the installer of the hydraulic components often does not have a specialization that is sufficient to install the electrical section as well.

[0009] As a consequence of all the above-mentioned problems and drawbacks, sometimes heating systems are installed which operate incorrectly, with high consumption and a high risk of abnormal operation and breakdowns, with obvious dissatisfaction of the user.

[0010] The situation is even worse when a mixed thermal system, providing both high temperatures by means of radiators and low temperatures by means of floor- or wall-mounted radiating panels, is required.

[0011] FR-A-2733822 discloses a distribution module for installation in a heating central with one radiating panel and radiators, in which water flowing out from a boiler is divided into two parallel paths which respectively feed a high-temperature circuit and a low-temperature circuit.

[0012] EP-A-0806612 discloses a heating installation having a mixing point in which hot water from a boiler mixes with the return of a low-temperature circuits so as to feed a running water store.

[0013] The aim of the present invention is to solve the noted problems, eliminating the drawbacks of the cited prior art and thus providing an invention that allows to install simply and rapidly a heating system in a building or in a portion of a building.

[0014] Within this aim, a further object is to provide an invention that allows even non-specialized personnel to perform the installation, often requiring a single installer for the entire system.

[0015] Another object is to provide an invention that allows unified and simultaneous management of a plurality of high-temperature circuits (for example radiators) together with a plurality of low-temperature circuits (such as floor- or wall-mounted radiating panels), and allows to use the same system for summer cooling.

[0016] Another object is to minimize not only the installation costs of the system but also its management costs.

[0017] Another object of the invention is to optimize temperature control, ensuring that comfortable conditions for the user are maintained automatically.

[0018] Another object is to have an installation that is compact, reliable over time and aesthetically pleasant.

[0019] Another object is to provide an installation that is structurally simple and has low manufacturing costs.

[0020] This aim and these and other objects that will become better apparent hereinafter are achieved by a distribution module according to claim 1.

[0021] Further characteristics and advantages of the present invention will become apparent from the following detailed description of a particular embodiment thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic view of the circuit according to the invention;

Figure 2 is a schematic view of the circuit of the invention applied to a heating system provided with one high-temperature circuit and one low-temperature circuit;

Figure 3 is a schematic view of the circuit of the invention applied to a heating system provided with two high-temperature circuits and two low-temperature circuits;

Figure 4 is a schematic view of the circuit of the invention applied to a heating system provided with three high-temperature circuits and three low-temperature circuits;

Figure 5 is a schematic view of the circuit of the invention applied to a heating and cooling system provided with one high-temperature circuit and one low-temperature circuit;

Figure 6 is a schematic view of the circuit of the invention according to an operating mode for feeding

only the high-temperature circuit;

Figure 7 is a schematic view of the circuit of the invention according to an operating mode for feeding only the low-temperature circuit;

Figure 8 is a schematic view of the circuit of the invention according to an operating mode for feeding both the high-temperature circuit and the low-temperature circuit.

[0022] With reference to Figure 1, the reference numeral 1 designates a distribution module, particularly suitable for distributing heating or cooling water in a building or in a portion thereof.

[0023] The distribution module 1 comprises a compartment, designated by the reference numeral 2, for containing a plurality of ducts suitable to allow to adjust the flow-rate and temperature of the water to be sent to heating bodies, such as for example radiators, radiating panels and/or fan coils.

[0024] A cabinet or enclosure, either recessed or arranged against a wall, is used for example as a compartment 2.

[0025] The compartment 2 is provided with a first duct 3a, suitable for the inflow of hot water arriving from a heat source, such as for example a boiler, designated by the reference numeral 4 in Figures 2 to 5.

[0026] Proximate to the first duct 3a there is advantageously a second duct, designated by the reference numeral 3b, which is designed to return to the boiler 4 an identical flow-rate of water, cooled beforehand in said heating bodies.

[0027] Inside compartment 2, the first and second ducts 3a and 3b are conveniently controlled by a first flow control valve 5a and a second flow control valve 5b, for example of the ball type.

[0028] Downstream of the first flow control valve 5a, the first duct is affected by a third duct, designated by the reference numeral 6, for connection to an adjustment or mixing valve, such as a three-way valve, designated by the reference numeral 7.

[0029] A calibration valve 8, such as for example a micrometric lockshield valve, is arranged along said third duct 6 and is suitable to adjust the flow-rate of hot water circulating in a first high-temperature circuit, designated by the reference numeral 9 in Figure 6, for supplying heating bodies, such as radiators, which operate in optimum conditions with water at a temperature of 70 to 80°C.

[0030] The water is returned from the radiators by means of a fourth duct, designated by the reference numeral 10 in Figure 6, which is connected to the third duct 6 downstream of the calibration valve or micrometric lockshield valve 8.

[0031] Circulation of the water in the first circuit is usually ensured by the first pump, designated by the reference numeral 11 in Figures 2 to 5, which is integrated in the boiler 4.

[0032] If a very high flow-rate, higher than the one that can be produced by the first pump 11, is required in the first circuit, it is possible to replace a portion or segment, designated by the reference numeral 12, of the first duct 3a with a second pump 50.

[0033] In order to ensure clockwise circulation in the first circuit 9, a first one-way valve 13 of Figure 1 is inserted along the fourth duct 10, specifically upstream of a first tee, designated by the reference numeral 14, where the fourth duct 10 and the third duct 6 merge.

[0034] Moreover, a third flow control valve 15a and a fourth flow control valve 15b are also preferably employed and are located respectively proximate to the outlet of the first duct 3a and the inlet of the fourth duct 10.

[0035] As the micrometric lockshield valve 8 opens, the flow-rate of water diverted toward the mixing valve 7 increases; when the lockshield valve is completely open, the flow-rate along the first duct 3a is approximately nil, since the first circuit has much higher load losses than those generated by the first lockshield valve 8.

[0036] The water arriving at the mixing valve 7 is diverted, by means of a fifth duct 16, into a first end 17a of a first manifold, designated by the reference numeral 18, which is arranged approximately horizontally.

[0037] The second duct 3b for the return of the water toward the boiler 4 is connected to a second end 17b of the manifold 18.

[0038] Figure 6 clearly shows that the flow-rate through the mixing valve 7 and the manifold 18 is equal to the entire flow-rate processed by the first boiler pump 11, since the flow-rate diverted to the radiators merges again in the third duct 6, after partial cooling, at the first tee 14.

[0039] Figure 7 illustrates the operation of the invention exclusively for low-temperature heating by circulating water in a second low-temperature circuit, designated by the reference numeral 19.

[0040] Such second circuit 19 comprises heating bodies which are suitable to operate in optimum conditions with water at a temperature between 35 and 50 °C, such as for example radiating panels.

[0041] In order to achieve this use, the lockshield valve 8 is placed in the fully open position; likewise, the mixing valve 7 is adjusted so as to allow an at least partial inflow of water from a sixth duct, designated by the reference numeral 20, for return from said radiating panels.

[0042] A second one-way valve 21 is conveniently arranged along the sixth duct 20 and is suitable to allow circulation of the water in the second circuit 19 only clockwise.

[0043] A seventh duct, designated by the reference numeral 22 and termed bypass duct, is connected downstream of the second one-way valve 21 and is suitable to make a fraction of the water flow-rate merge toward an eighth duct 23 for supplying the radiating panels. This eighth duct is a feed duct.

[0044] The eighth duct 23 connects the third duct 6, downstream of the first tee 14, to the second tee, designated by the reference numeral 24, with the bypass duct 22, then to a third pump 25, and from there to the outlet toward the radiating panels.

[0045] The third pump circulates water between the sixth, seventh and eighth ducts 20, 22 and 23 and the radiating panels.

[0046] The inflow of water from the third duct 6 into the eighth duct 23 is regulated by the mixing valve 7; the smaller the flow-rate entering the mixing valve 7 through the third duct 6, the higher the flow-rate circulating in the sixth and eighth ducts 20 and 23.

[0047] The flow-rate along the bypass duct 22 accordingly adapts to the flow-rate that arrives from the eighth duct 23, in order to keep the flow-rate in the second circuit 19 approximately constant.

[0048] It can be noted that the mixing valve 7, by adjusting the flows of hot water that arrives from the boiler 4 (by means of the third duct 6) and of cooled water that arrives from the radiating panels, determines the temperature of the water that leaves the eighth duct 23 and thus also determines the amount of heat transferred to the room to be heated.

[0049] Conveniently, a fifth flow control valve 26a and a sixth flow control valve 26b are provided at said outlet of the eighth duct 23, and likewise at the inlet of the sixth duct 20.

[0050] Figure 8 illustrates a module 1 that distributes and controls water in the first high-temperature circuit 9 and simultaneously in the second low-temperature circuit 19.

[0051] The water that arrives from the fourth duct 10, partially cooled during its passage through the radiators until it reaches a temperature that is approximately 5 ÷ 10 °C lower than the boiler temperature, enters in the third duct 6 and from there, depending on the mixing valve 7, partially enters the eighth duct 23 and partially enters the manifold 18 to return to the boiler 4.

[0052] The fraction of water that enters the eighth duct 23 increases as the demand for heat in the room heated by the radiating panels increases; likewise, an equivalent amount of water flows from the sixth duct 20 into the mixing valve 7 and from there to the manifold 18 and to the boiler.

[0053] When the demand for heating decreases, the adjustment of the mixing valve 7 varies, so as to have a low flow-rate of water arriving from the sixth duct 20 and likewise a low flow-rate of water entering the eighth duct 23.

[0054] A first application of the module 1 is shown in Figure 2; in addition to the boiler 4, which is provided with the first built-in pump 11, the figure shows a first area that is heated by means of radiators (only one radiator, designated by the reference numeral 27, has been shown for the sake of simplicity), and a second area that is heated by means of radiating panels, one of which is designated by the reference numeral 28.

[0055] The first and second areas can be mutually distinct or can be the same if differentiated heating is required or if winter heating by means of radiators 27 and summer cooling by means of radiating panels 28 is required.

[0056] Usually, in any case, this first application of the invention is suitable for use in homes, for example by using radiators for heating the bathrooms and radiating panels to heat and cool the other rooms; this solution also has the advantage of not requiring installation of the second pump 50, since the flow-rate required by the first circuit 9 is very low.

[0057] Temperature control in the second areas is provided for example by means of a room thermostat, designated by the reference letters TA and by the reference numeral 29, which is connected to an electrical panel 30 suitable to provide the electrical wiring of the mixing valve 7 and of the feed pumps.

[0058] The electrical panel 30 is advantageously integrated in the module 1, so that the connections, not shown in the figures, to the valves and pumps, integrated in the module 1, are provided directly during production and are not left to the installer.

[0059] Figure 3 illustrates a second application of the module 1, which is more complicated because it comprises two sets of radiating panels, designated by the reference numerals 28a and 28b, and two sets of radiators 27a and 27b.

[0060] In this manner it is possible to heat four independent areas, such as for example a daytime area, a night area, and two bathrooms.

[0061] Temperature control of each area is advantageously performed by means of room thermostats, designated by the reference numerals 29a, 29b, 29c and 29d in Figure 3, which are all connected to the electrical panel 30.

[0062] Each one of the sets of radiators 27a and 27b and of radiating panels 28a and 28b is fed by means of zone valves, such as valves of the type commonly known as "on/off" (i.e., "fully-open or fully closed"), conveniently connected to the electrical panel 30 and controlled thereby.

[0063] The example shown in Figure 3 illustrates a first pair of zone valves 31a and 31b for feeding the radiating panels and a second pair of zone valves 32a and 32b for feeding the radiators.

[0064] The first pair of zone valves 31a and 31b adjusts the feeding of water from the eighth duct 23 to the radiating panels 28a and 28b; likewise, the second pair of zone valves 31c and 31d connects the first duct 3a to the radiators 27a and 27b.

[0065] Figure 4 illustrates a third application of the invention, which is suitable to feed three sets of radiating panels 28 and three sets of radiators 29, which are respectively controlled by room thermostats generally designated by the reference numeral 29.

[0066] Feed control is performed, in this particular application which is illustrated only by way of example, by means of separate zone valves, designated by the reference numeral 32, which are installed proximate to the radiating panels 28 and are appropriately connected electrically to the electrical panel 30.

[0067] In all these applications, the mixing valve 7 can

be controlled in various manners.

[0068] A first manner consists in using a first capillary probe, designated by the reference numeral 51 in Figure 1, which is suitable to read the temperature of the water at the delivery of the third pump 25 and to send the corresponding signal to a thermostatic actuator; such actuator directly controls the mixing valve 7 according to the reference temperature preset by the user.

[0069] A second manner of controlling the mixing valve 7 uses an electric servo control operated by an electronic control unit, designated by the reference numeral 52 in Figure 5 and connected to the electrical panel 30.

[0070] The electronic control unit 52 processes the signals sent by a second temperature probe 53, located at the delivery of the third pump 25, and by a third probe 54 for detecting the external temperature.

[0071] A variation of the module 1, shown in Figure 5, comprises preinstalled ducts suitable to allow the interconnection of a water cooling unit, designated by the reference numeral 33, which is provided with a built-in fourth feed pump 34.

[0072] The ducts are constituted for example by a second manifold 35, arranged along the first duct 3a downstream of the first flow control valve 5a, which is fed by a ninth duct, designated by the reference numeral 36, which is suitable to send the cold water (at a temperature of 15 ÷ 16 °C).

[0073] Return of the water, heated in passing within the radiating panels 28, to the cooling unit 33 is ensured by a tenth duct 37, which affects the second duct 3b upstream of the second flow control valve 5b.

[0074] The operation of the cooling system requires the closure of the first and second valves 5a and 5b in order to cut off the boiler 4; the lockshield valve 8 is preferably arranged in a fully open position, so as to exclude circulation of water in the first circuit 9.

[0075] As shown in Figure 1, one manner for fully avoiding any circulation in the first circuit 9 consists in providing the first tee 14 at a lower height than the lockshield valve 8, so as to produce a head or riser, designated by the reference numeral 38, which is suitable to facilitate the passage of the water through said lockshield valve.

[0076] Use of the invention entails that the installer places the compartment 2, which contains the components and the distribution and adjustment elements described above, in the preset location (for example, but not necessarily, in a cupboard or recessed into a wall).

[0077] The installer must then merely provide the hydraulic connections for delivery and return to the boiler and to the heating elements and the electrical connections from any external control and monitoring devices (for example external probes and control panels) to the electrical panel 30.

[0078] It is thus evident that the invention has achieved the intended aim and objects, a module for distributing heating or cooling water for a heating system of a building having been devised which allows quick and easy installation of such heating system.

[0079] The installation does not require highly specialized personnel, since most of the hydraulic and electrical connections have already been provided during the production of the module.

[0080] The invention therefore allows to provide easy, efficient, unified and simultaneous management of a plurality of high- and low-temperature circuits, and to use the same system for summer cooling.

[0081] By way of the above described module it is possible to greatly reduce both installation times and installation costs.

[0082] Finally, the installation is compact, reliable over time and aesthetically pleasant, since all the adjustment and control elements are located inside the compartment.

[0083] The invention is of course susceptible of numerous modifications and variations, all of which are within the scope of the appended claims .

[0084] Thus, for example, it is possible to provide a module in which one or both of the first and second manifolds 18 and 35 are replaced with ordinary pipes, preferably offset with respect to the plane on which the other pipes lie.

[0085] Although this solution is less valid from the point of view of robustness and thermal efficiency of the system, it is simpler and cheaper.

[0086] Likewise, the mechanical and electrical adjustment of the heating system can be the most appropriate according to the specific requirements of the installer and/or user.

[0087] The materials used, as well as the dimensions that constitute the individual components of the invention, may of course be more pertinent according to specific requirements.

[0088] The various means for performing certain different functions must not coexist certainly only in relation to the illustrated embodiment but can be present per se in many embodiments, even if such embodiments have not been illustrated.

[0089] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A distribution module, particularly for distributing heating or cooling water, comprising a containment compartment (2) for a plurality of ducts suitable to connect at least one first high-temperature circuit (9) and one second low-temperature circuit (19), which are mutually connected by means of at least one adjustment valve (7) and a calibration valve (8), said

compartment (2) further comprising a first duct (3a) for the inflow of hot water arriving from an external heat source (4), such as a boiler, and a second duct (3b) for returning to said heat source (4) the water circulated in at least one of said at least one first and second circuits (9, 19), **characterized in that** said first duct (3a) is affected by a third duct (6) for connection to said adjustment valve (7), which is constituted by a mixing valve such as a three-way valve, said third duct (6) connecting said first high-temperature circuit (9) to said second low-temperature circuit (19) by means of

(i) a fourth duct (10) arranged downstream of said calibration valve (8) and allowing the outflow of water from said first high-temperature circuit (9) toward a first tee (14) located along said third duct (6); and
(ii) a feed duct (23) of said second low-temperature circuit (19) connected to said third duct (6) downstream of said first tee (14) and upstream of said adjustment valve (7).

2. The distribution module according to claim 1, **characterized in that** it comprises an electrical panel (30) for the electrical wiring of said valves.

3. The distribution module according to one or more of the preceding claims, **characterized in that** said first duct comprises a portion or segment (12) that can be replaced with a second pump (50), arranged in series to a first feeder pump (11) of said heat source and suitable to ensure the correct feeding of said first circuit (9).

4. The distribution module according to claim 3, **characterized in that** said compartment comprises a third pump (25) suitable to circulate water in said second low-temperature circuit (19).

5. The distribution module according to one or more of the preceding claims, **characterized in that** said first high-temperature circuit (9) is suitable to distribute heating water to one or more heating bodies (27), such as radiators and/or fan coils.

6. The distribution module according to one or more of the preceding claims, **characterized in that** said second low-temperature circuit (19) is suitable to distribute heating or cooling water to one or more radiating panel (28), of the floor- or wall-mounted type.

7. The distribution module according to claim 1, **characterized in that** along said third duct (6) them is said calibration valve (8), which is constituted by a micrometric lockshield valve suitable to adjust the flow-rate of hot water that circulates in said first high-temperature circuit.

8. The distribution module according to one or more of the preceding claims, **characterized in that** it comprises, along said fourth duct (10), a first one-way valve (13) which is arranged upstream of said first tee between said fourth and third ducts (10,6) and allows the water to circulate in said first circuit (9) only clockwise.

9. The distribution module according to one or more of the preceding claims, **characterized in that** the extent of the opening of said calibration valve (8) determines the flow-rate of water diverted toward said mixing valve (7).

10. The distribution module according to claims 1 and 9, **characterized in that** when said calibration valve (8) is fully open, the flow-rate along said first duct (3a) is approximately equal to zero, since said calibration valve, when open, has much lower load losses than those generated by said first circuit (9).

11. The distribution module according to one or more of the preceding claims, **characterized in that** said mixing valve (7) diverts the incoming water into a fifth duct (16) for connection to a first end (17a) of a first manifold (18), which is advantageously arranged horizontally.

12. The distribution module according to claims 1 and 11, **characterized in that** said second duct (3b) for returning the water to said heat source (4) is connected to a second end (17b) of said manifold (18).

13. The distribution module according to one or more of claims 6-12, **characterized in that** it comprises a sixth duct (20) for connection between said radiating panels (28) and said mixing valve (7).

14. The distribution module according to claim 13, **characterized in that** a second one-way valve (21) is arranged along said sixth duct (20) and allows circulation of the water in said second circuit (15) exclusively clockwise.

15. The distribution module according to claim 13, **characterized in that** it comprises a seventh bypass duct (22) for mutually connecting said sixth duct (20) and said feed duct (23).

16. The distribution module according to claim 15, **characterized in that** said seventh duct (22) is suitable to send at least part of the water flow-rate leaving said second one-way valve (21) toward a second tee (24), between said seventh duct (22) and said feed duct (23), which is located upstream of a third feed pump (25) for said second circuit (19).

17. The distribution module according to claim 16, **char-**

acterized in that said third pump circulates water between said sixth duct, seventh duct and feed duct and said radiating panels.

18. The distribution module according to claims 11 and 13, **characterized in that** said mixing valve (7) adjusts the inflow of water from said third duct into said feed duct (23) and also proportionally adjusts the inflow of water in input from said sixth duct (20), so as to ensure a substantially constant flow-rate along said fifth duct (16).

19. The distribution module according to one or more of claims 15-18, **characterized in that** said mixing valve, by adjusting the flow-rates of hot water arriving from said third duct and of cooled water arriving from said radiating panels, determines the temperature of the water in output from said feed duct.

20. The distribution module according to one or more of claims 2-19, **characterized in that** said mixing valve (7) is controlled by said electrical panel (30), integrated in said module, according to one or more temperature sensing devices, such as a room thermostat or a capillary probe.

21. The distribution module according to one or more of claims 5-20, **characterized in that** it comprises one or more zone valves (31,32), such as "on/off" or "fully open or fully closed" valves, for selectively sending water from said first duct and/or feed duct to said heating bodies and/or radiating panels.

22. The distribution module according to claim 4, **characterized in that** the adjustment of said mixing valve (7) is performed by means of a first capillary probe which is suitable to read the temperature of the water at the delivery of said third pump (25) and to send the corresponding signal to a thermostatic control actuator for said mixing valve (7), depending on a reference temperature preset by the user.

23. The distribution module according to claim 4, **characterized in that** said mixing valve (7) is adjusted by means of an electric servo control, controlled by an electronic controller which is connected to said electrical panel, on the basis of signals sent by a second temperature probe located at the delivery of said third pump (25), and by a third temperature probe for detecting the external temperature.

24. The distribution module according to one or more of the preceding claims, **characterized in that** said first and second ducts are preferably controlled by a first flow control valve (5a) and a second flow control valve (5b), such as a ball valve.

25. The distribution module according to one or more of the preceding claims, **characterized in that** it comprises a third flow control valve and a fourth flow control valve, located respectively proximate to the outlet of said first duct (30) and the inlet of said fourth duct (10).

26. The distribution module according to claim 13, **characterized in that** it comprises a fifth flow control valve (26a) and a sixth flow control valve (26b), which are located proximate to the outlet of said feed duct and the inlet of said sixth duct, respectively.

27. The distribution module according to one or more of the preceding claims, **characterized in that** it comprises a plurality of separate ducts (36,37) suitable to allow the interconnection of a known type of water cooling unit (33), which is provided with a fourth built-in feed pump (34).

28. The distribution module according to claims 24 and 27, **characterized in that** said separate ducts (36,37) are constituted by a second manifold (35) which is arranged, along said first duct (3a), downstream of said first flow control valve (5a) and is fed by a ninth duct (36) connected upstream to said cooling unit (33).

29. The distribution module according to claim 28, **characterized in that** it comprises a tenth duct (37) for connection between said second duct (3b) and said cooling unit (33), suitable for the return of the water heated in said radiating panels (28) into said cooling unit (33).

Patentansprüche

1. Ein Verteilungsmodul, insbesondere für die Verteilung von Heiz- oder Kühlwasser, bestehend aus einem Einschlussraum (2) für eine Vielzahl von Rohrleitungen, welcher geeignet ist, um wenigstens einen ersten Hochtemperaturkreislauf (9) und einen zweiten Niedertemperaturkreislauf (19) zu verbinden, welche mittels wenigstens einem Stellventil (7) und einem Kalibrierungsventil (8) miteinander verbunden sind, wobei besagter Einschlussraum (2) ferner eine erste Rohrleitung (3a) für den Zufluss von Warmwasser, welches von einer externen Wärmequelle (4) wie zum Beispiel einem Boiler einläuft, und eine zweite Rohrleitung (3b) zum Zurückführen des in wenigstens einem von besagten ersten und zweiten Kreisläufen (9, 19) zirkulierenden Wassers zur besagten Wärmequelle (4) einschließt, **dadurch gekennzeichnet, dass** besagte erste Rohrleitung (3a) von einer dritten Rohrleitung (6) für die Verbindung zu besagtem Stellventil (7), welches durch ein Mischventil wie zum Beispiel ein Dreiwegeventil gebildet wird, beeinflusst wird, wobei besagte dritte

Rohrleitung (6) besagten ersten Hochtemperaturkreislauf (9) mit besagtem zweiten Niedertemperaturkreislauf (19) verbindet, und zwar mittels:

(i) einer vierten Rohrleitung (10), welche nachgelagert von besagtem Kalibrierungsventil (8) angeordnet ist und den Wasserabfluss aus besagtem ersten Hochtemperaturkreislauf (9) in Richtung einer ersten, längsseits von besagter dritten Rohrleitung (6) angeordneten Verzweigung (14) ermöglicht; und
(ii) einer Speisungsrohrleitung (23) von besagtem zweiten Niedertemperaturkreislauf (19), welcher nachgeschaltet von besagter Verzweigung (14) und vorgeschaltet von besagtem Stellventil (7) mit besagter dritten Rohrleitung (6) verbunden ist.

2. Das Verteilungsmodul nach Anspruch 1, **dadurch gekennzeichnet, dass** es eine elektrische Tafel (30) zur elektrischen Schaltung von besagten Ventilen einschließt.

3. Das Verteilungsmodul nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** besagte erste Rohrleitung einen Bereich oder ein Segment (12) einschließt, welcher bzw. welches durch eine zweite Pumpe (50) ersetzt werden kann, die in Folge zu einer ersten Speisungspumpe (11) von besagter Wärmequelle (4) angeordnet und geeignet ist, die ordnungsgemäße Beschikkung von besagtem ersten Kreislauf zu gewährleisten.

4. Das Verteilungsmodul nach Anspruch 3, **dadurch gekennzeichnet, dass** besagter Einschlussraum eine dritte Pumpe (25) einschließt, die geeignet ist, Wasser in besagtem zweiten Niedertemperaturkreislauf (19) zirkulieren zu lassen.

5. Das Verteilungsmodul nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** besagter erster Hochtemperaturkreislauf (9) geeignet ist, Heizwasser auf einen oder mehrere Heizkörper (27), wie zum Beispiel Radiatoren und/oder Gebläsekonvektoren, zu verteilen.

6. Das Verteilungsmodul nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** besagter zweiter Niedertemperaturkreislauf (19) geeignet ist, Heiz- oder Kühlwasser zu einem oder mehreren Abstrahlungselementen (28) des im Boden oder in der Wand installierten Typs zu verteilen.

7. Das Verteilungsmodul nach Anspruch 1, **dadurch gekennzeichnet, dass** es längsseits von besagter dritten Rohrleitung (6) besagtes Kalibrierungsventil (8) gibt, welches durch ein mikrometrisches Sperrschutzventil gebildet wird, das geeignet ist, den Durchfluss von heißem Wasser, das in besagtem ersten Hochtemperaturkreislauf zirkuliert, zu regeln.

8. Das Verteilungsmodul nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es längsseits von besagter vierten Rohrleitung (10) ein erstes Einwegeventil (13) einschließt, welches der besagten ersten Verzweigung vorgeschaltet zwischen besagten vierten und dritten Rohrleitungen (10, 6) angeordnet ist und dem Wasser ermöglicht, in besagtem ersten Kreislauf (9) nur im Uhrzeigersinn zu zirkulieren.

9. Das Verteilungsmodul nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Ausmaß der Öffnung von besagtem Kalibrierungsventil (8) den Durchfluss des in Richtung von besagtem Mischventil (7) umgeleiteten Wassers bestimmt.

10. Das Verteilungsmodul nach Ansprüchen 1 und 9, **dadurch gekennzeichnet, dass**, wenn besagtes Kalibrierungsventil vollständig geöffnet ist, der Durchfluss entlang besagter ersten Rohrleitung (3a) näherungsweise gleich null ist.

11. Das Verteilungsmodul nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** besagtes Mischventil (7) das zuströmende Wasser in eine fünfte Rohrleitung (16) für die Verbindung mit einem ersten Ende (17a) von einem ersten Verteiler (18), welcher zweckmäßigerweise horizontal angeordnet ist, umleitet.

12. Das Verteilungsmodul nach Ansprüchen 1 und 11, **dadurch gekennzeichnet, dass** besagte zweite Rohrleitung (3b) zum Zurückführen des Wassers zu besagter Wärmequelle (4) mit einem zweiten Ende (17b) von besagtem Zweigrohr (18) verbunden ist.

13. Das Verteilungsmodul nach einem oder mehreren der Ansprüche 6-12, **dadurch gekennzeichnet, dass** es eine sechste Rohrleitung (20) als Verbindung zwischen besagten Abstrahlungselementen (28) und besagtem Mischventil (7) einschließt.

14. Das Verteilungsmodul nach Anspruch 13, **dadurch gekennzeichnet, dass** ein zweites Einwegeventil (21) längsseits besagter sechsten Rohrleitung (20) angeordnet ist und die Wasserzirkulation in besagtem zweiten Kreislauf (19) ausschließlich im Uhrzeigersinn erlaubt.

15. Das Verteilungsmodul nach Anspruch 13, **dadurch gekennzeichnet, dass** es einen siebten Bypass-Kanal (22) einschließt, um besagte sechste Rohrlei-

tung (20) und besagte Speisungsrohrleitung (23) miteinander zu verbinden.

16. Das Verteilungsmodul nach Anspruch 15, **dadurch gekennzeichnet, dass** besagte siebente Rohrleitung (22) geeignet ist, wenigstens einen Teil des Wasserdurchflusses, der aus besagtem zweiten Einwegeventil (21) in Richtung einer zweiten Verzweigung (24), die vorgeschaltet zu einer dritten Speisepumpe (25) für besagten zweiten Kreislauf (19) zwischen besagter siebenten Rohrleitung (22) und besagter Speisungsrohrleitung (23) angeordnet ist, austritt, zu befördern.

17. Das Verteilungsmodul nach Anspruch 16, **dadurch gekennzeichnet, dass** besagte dritte Pumpe Wasser zwischen besagter sechsten Rohrleitung, siebten Rohrleitung und Speisungsrohrleitung und besagten Abstrahlungselementen zirkulieren lässt.

18. Das Verteilungsmodul nach Ansprüchen 11 und 13, **dadurch gekennzeichnet, dass** besagtes Mischventil (7) den Wasserzufluss von besagter dritten Rohrleitung (6) in besagte Speisungsrohrleitung (23) regelt und auch verhältnismäßig den Wasserzufluss im Zulauf von besagter sechsten Rohrleitung (20) regelt, um einen im Wesentlichen konstanten Wasserdurchfluss entlang besagter fünften Rohrleitung (16) zu gewährleisten.

19. Das Verteilungsmodul nach einem oder mehreren der Ansprüche 15-18, **dadurch gekennzeichnet, dass** besagtes Mischventil durch das Regeln des Durchflusses von heißem Wasser, welches von besagter dritten Rohrleitung ankommt, und von kaltem Wasser, welches von besagten Abstrahlungselementen ankommt, die Temperatur des Wassers im Ablauf von besagter Speisungsrohrleitung festlegt.

20. Das Verteilungsmodul nach einem oder mehreren der Ansprüche 2-19, **dadurch gekennzeichnet, dass** besagtes Mischventil (7) durch besagte in besagtes Modul integrierte elektrische Tafel (30) in Übereinstimmung mit einer oder mehreren Temperaturfühleinrichtungen, wie zum Beispiel einem Raumthermostat oder einem Kapillarfühler, gesteuert wird.

21. Das Verteilungsmodul nach einem oder mehreren der Ansprüche 5-20, **dadurch gekennzeichnet, dass** es ein oder mehrere Zonenventile (31, 32), wie zum Beispiel "Ein/Aus" oder "völlig geöffnete/völlig geschlossene" Ventile, zum wahlweise Wasserbefördern von besagter ersten Rohrleitung und/oder Speisungsrohrleitung zu besagten Heizkörpern und/oder Abstrahlungselementen einschließt.

22. Das Verteilungsmodul nach Anspruch 4, **dadurch gekennzeichnet, dass** die Einstellung von besagtem Mischventil (7) durch einen ersten Kapillarfühler ausgeführt wird, der geeignet ist, die Wassertemperatur am Zuflussstrom von besagter dritten Pumpe (25) zu fühlen und das entsprechende Signal zum thermostatischen Steuerungsorgan für besagtes Mischventil (7) zu senden, abhängig von der durch den Nutzer voreingestellten Bezugstemperatur.

23. Das Verteilungsmodul nach Anspruch 4, **dadurch gekennzeichnet, dass** besagtes Mischventil (7) mittels einer elektrischen Stellvorrichtung geregelt wird, die, auf der Basis von Signalen, die von einem zweiten Temperaturfühler, der am Zuflussstrom von besagter dritten Pumpe (25) angeordnet ist, und von einem dritten Temperaturfühler zum Ermitteln der externen Temperatur gesendet werden, mittels einer elektronischen Steuerung, die mit besagter elektronischen Tafel verbunden ist, gesteuert wird.

24. Das Verteilungsmodul nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** besagte erste und zweite Speisungsrohrleitungen vorzugsweise durch einen ersten Durchflusssregler (5a) und einen zweiten Durchflussregler (5b), wie zum Beispiel ein Kugelventil, gesteuert werden.

25. Das Verteilungsmodul nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es einen dritten Durchflussregler und einen vierten Durchflussregler einschließt, die jeweils nahe zum Auslass von besagter ersten Rohrleitung (30) und zum Einlauf von besagter vierten Rohrleitung (10) angeordnet sind.

26. Das Verteilungsmodul nach Anspruch 13, **dadurch gekennzeichnet, dass** es einen fünften Durchflussregler (26a) und einen sechsten Durchflussregler (26b) einschließt, die jeweils nahe an dem Auslass von besagter Speisungsrohrleitung und dem Zulauf von besagter sechsten Rohrleitung angeordnet sind.

27. Das Verteilungsmodul nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es eine Vielzahl von getrennten Rohrleitungen (36, 37) einschließt, die geeignet sind, um die Verbindung von einer Kühlwassereinheit (33) bekannter Bauart, die mit einer vierten eingebauten Speisepumpe (34) versehen ist, zu ermöglichen.

28. Das Verteilungsmodul nach Ansprüchen 24 und 27, **dadurch gekennzeichnet, dass** besagte einzelne Rohrleitungen (36, 37) durch eine zweite Rohrverzweigung (35), die entlang besagter ersten Rohrleitung (3a) nachgeschaltet von besagtem ersten Durchflussregler (5a) angeordnet ist, gebildet wer-

den und durch eine neunte Rohrleitung (36), die mit besagter Kühleinheit (33) stromaufwärts verbunden ist, beschickt wird.

29. Das Verteilungsmodul nach Anspruch 28, **dadurch gekennzeichnet, dass** es eine zehnte Rohrleitung (37) zur Verbindung zwischen besagter zweiten Rohrleitung (3b) und besagter Kühleinheit (33) einschließt, die für den Rückfluss von dem in besagten Abstrahlungselementen (28) erwärmten Wasser in besagte Kühleinheit (33) geeignet ist.

Revendications

1. Module de distribution, en particulier pour la distribution d'eau de chauffage et de refroidissement, comprenant un compartiment (2) de retenue pour une pluralité de conduits adaptés pour relier au moins un premier circuit (9) à haute température et un deuxième circuit (19) à basse température, qui sont mutuellement reliés au moyen d'au moins une vanne de réglage (17) et d'une vanne de calibrage (8), ledit compartiment (2) comprenant également un premier conduit (3a) pour l'entrée d'eau chaude issue d'une source de chaleur externe (4), telle qu'une chaudière, et un deuxième conduit (3b) pour renvoyer à ladite source de chaleur (4) l'eau circulée dans au moins l'un desdits au moins un premier et deuxième circuits (9, 19), **caractérisé en ce que** ledit premier conduit (3a) est affecté d'un troisième conduit (6) pour la liaison à ladite vanne de réglage (7), qui est constituée par une vanne de mélange telle qu'une vanne à trois voies, ledit troisième conduit (6) reliant ledit premier circuit (9) à haute température audit deuxième circuit (19) à basse température au moyen de:

(i) un quatrième conduit (10) agencé en aval de ladite vanne de calibrage (8) et permettant le flux de sortie d'eau dudit premier circuit (9) à haute température vers un premier raccord (14) situé le long dudit troisième conduit (6); et
(ii) un conduit d'alimentation (23) dudit deuxième circuit (19) relié audit troisième conduit (6) en aval dudit premier raccord (14) et en amont de ladite vanne de réglage (7).

2. Module de distribution selon la revendication 1, **caractérisée en ce qu'**il comprend un panneau électrique (30) pour le câblage électrique desdites vannes.

3. Module de distribution selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit premier conduit comprend une partie ou segment (12) qui peut être remplacé par une deuxième pompe (50), agencée en série à une première pompe d'alimentation (11) de ladite source de chaleur et adaptée pour assurer la correcte alimentation dudit premier circuit (9).

4. Module de distribution selon la revendication 3, **caractérisé en ce que** ledit compartiment comprend une troisième pompe (25) adaptée pour faire circuler l'eau dans ledit deuxième circuit (19) à basse température.

5. Module de distribution selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit premier circuit (9) à haute température est adapté pour distribuer de l'eau de chauffage à un ou plusieurs corps de chauffage (27), tels que des radiateurs et/ou des ventilo-convecteurs.

6. Module de distribution selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ledit deuxième circuit (19) à basse température est adapté pour distribuer de l'eau de chauffage ou de refroidissement à un ou plusieurs panneaux radiants (28), du type mural ou au sol.

7. Module de distribution selon la revendication 1, **caractérisé en ce que** le long dudit troisième conduit (6) est présente une vanne de calibrage (8), qui est constituée d'un raccord de réglage micrométrique adaptée pour régler le débit d'eau chaude qui circule dans ledit premier circuit à haute température.

8. Module de distribution selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce qu'**il comprend, le long dudit quatrième conduit (10), une première vanne à voie unique (13) qui est agencée en amont dudit premier raccord entre lesdits quatrième et troisième conduits (10, 6) et permet à l'eau de circuler dans ledit premier circuit (9) seulement dans le sens des aiguilles d'une montre.

9. Module de distribution selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** l'extension de l'ouverture de ladite vanne de calibrage (8) détermine le débit d'eau dirigé vers ladite vanne de mélange (7).

10. Module de distribution selon les revendications 9 et 10, **caractérisé en ce que** lorsque ladite vanne de calibrage (8) est totalement ouverte, le débit le long dudit premier conduit (3a) est approximativement égal à zéro, étant donné que ladite vanne de calibrage, lorsque elle est ouverte, présente des pertes de charge inférieures à celles générées par ledit premier circuit (9).

11. Module de distribution selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** ladite vanne de mélange (7) dirige l'eau entrant dans

un cinquième conduit (16) pour la liaison à une première extrémité (17a) d'un premier collecteur (18) qui est avantageusement agencé horizontalement.

12. Module de distribution selon les revendications 1 et 11, **caractérisé en ce que** ledit deuxième conduit (3b) pour le retour de l'eau à ladite source de chaleur (4) est relié à une deuxième extrémité (17b) dudit collecteur (18).

13. Module de distribution selon l'une ou plusieurs des revendications 6 à 12, **caractérisé en ce qu'**il comprend un sixième conduit (20) pour la liaison entre lesdits panneaux radiants (28) et ladite vanne de mélange (7).

14. Module de distribution selon la revendication 13, **caractérisé en ce qu'**une deuxième vanne à deux voies (21) est agencée le long dudit sixième conduit (20) et permet la circulation de l'eau dans ledit deuxième circuit (19) exclusivement dans le sens des aiguilles d'une montre.

15. Module de distribution selon la revendication 13, **caractérisé en ce qu'**il comprend un septième conduit de dérivation (22) pour raccorder entre eux ledit sixième conduit (20) et ledit conduit d'alimentation (23).

16. Module de distribution selon la revendication 15, **caractérisé en ce que** ledit septième conduit (22) est adapté pour envoyer au moins une partie dudit flux d'eau quittant ladite vanne à voie unique (21) vers un deuxième raccord (24), entre ledit septième conduit (22) et ledit conduit d'alimentation (23), qui est situé en amont d'une troisième pompe d'alimentation (25) pour ledit deuxième circuit (19).

17. Module de distribution selon la revendication 16, **caractérisé en ce que** ladite troisième pompe fait circuler l'eau entre lesdits sixième conduit, septième conduit et conduit d'alimentation et lesdits panneaux radiants.

18. Module de distribution selon les revendications 11 et 13, **caractérisé en ce que** ladite vanne de mélange (7) règle le flux d'entrée d'eau dudit troisième conduit (6) vers ledit conduit d'alimentation (23) et règle également proportionnellement le flux d'entrée d'eau depuis ledit sixième conduit (20), de façon à assurer un débit sensiblement constant le long du cinquième conduit (16).

19. Module de distribution selon l'une ou plusieurs des revendications 15 à 18, **caractérisé en ce que** ladite vanne de mélange, par le réglage des débits d'eau chaude arrivant dudit troisième conduit et d'eau refroidie desdits panneaux radiants, détermine la température de l'eau en sortie dudit conduit d'alimentation.

20. Module de distribution selon l'une ou plusieurs des revendications 2 à 19, **caractérisé en ce que** ladite vanne de mélange (7) est contrôlée par ledit panneau électrique (30), intégré dans ledit module, selon un ou plusieurs systèmes de détection de température, tels qu'un thermostat ou une sonde capillaire.

21. Module de distribution selon l'une ou plusieurs des revendications 5 à 20, **caractérisé en ce qu'**il comprend une ou plusieurs vannes de zone (31, 32), telles que des vannes «marche/arrêt» ou «ouvertes totalement ou fermées totalement», pour envoyer sélectivement de l'eau dudit premier conduit et/ou conduit d'alimentation auxdits corps de chauffages et/ou panneaux radiants.

22. Module de distribution selon la revendication 4, **caractérisé en ce que** le réglage de ladite vanne de mélange (7) est exécuté au moyen d'une première sonde capillaire qui est adaptée pour lire la température de l'eau au refoulement de ladite troisième pompe (25) et d'envoyer le signal correspondant à un actionneur de contrôle thermostatique pour ladite vanne de mélange (7), selon une température de référence prédéterminée par l'utilisateur.

23. Module de distribution selon la revendication 4, **caractérisé en ce que** ladite vanne de mélange (7) est réglée au moyen d'une servocommande électrique, contrôlée par un contrôleur électronique qui est relié audit panneau électrique, sur la base de signaux envoyés par une deuxième sonde de température située au refoulement de ladite troisième pompe (25), et par une troisième sonde de température pour détecter la température externe.

24. Module de distribution selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce que** lesdits premier et deuxième conduits sont préférablement contrôlés par une première vanne de contrôle de flux (5a) et une deuxième vanne de contrôle de flux (5b), telles qu'une vanne à bille.

25. Module de distribution selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce qu'**il comprend une troisième vanne de contrôle de flux et une quatrième vanne de contrôle de flux, situées respectivement à proximité de la sortie dudit premier conduit (30) et de l'entrée dudit quatrième conduit (10).

26. Module de distribution selon la revendication 13, **caractérisé en ce qu'**il comprend une cinquième vanne de contrôle de flux (26a) et une sixième vanne

de contrôle de flux (26b), qui sont situées respectivement à proximité de la sortie dudit conduit d'alimentation et de l'entrée dudit sixième conduit.

27. Module de distribution selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce qu'**il comprend une pluralité de conduits séparés (36, 37) adaptés pour permettre l'interconnexion avec un type connu d'unité de refroidissement d'eau (33), qui est munie d'une quatrième pompe (34) d'alimentation incorporée.

28. Module de distribution selon les revendications 24 et 27, **caractérisé en ce que** lesdits conduits séparés (36, 37) sont constitués par un deuxième collecteur (35) qui est agencé, le long dudit premier conduit (3a), en aval de ladite première vanne de contrôle de flux (5a) et est alimentée par un neuvième conduit (36) relié en amont à ladite unité de refroidissement (33).

29. Module de distribution selon la revendication 28, **caractérisé en ce qu'**il comprend un dixième conduit (37) pour la liaison entre ledit deuxième conduit (3b) et ladite unité de refroidissement (33), adapté pour le retour de l'eau chauffée dans lesdits panneaux radiants (28) dans ladite unité de refroidissement (33).

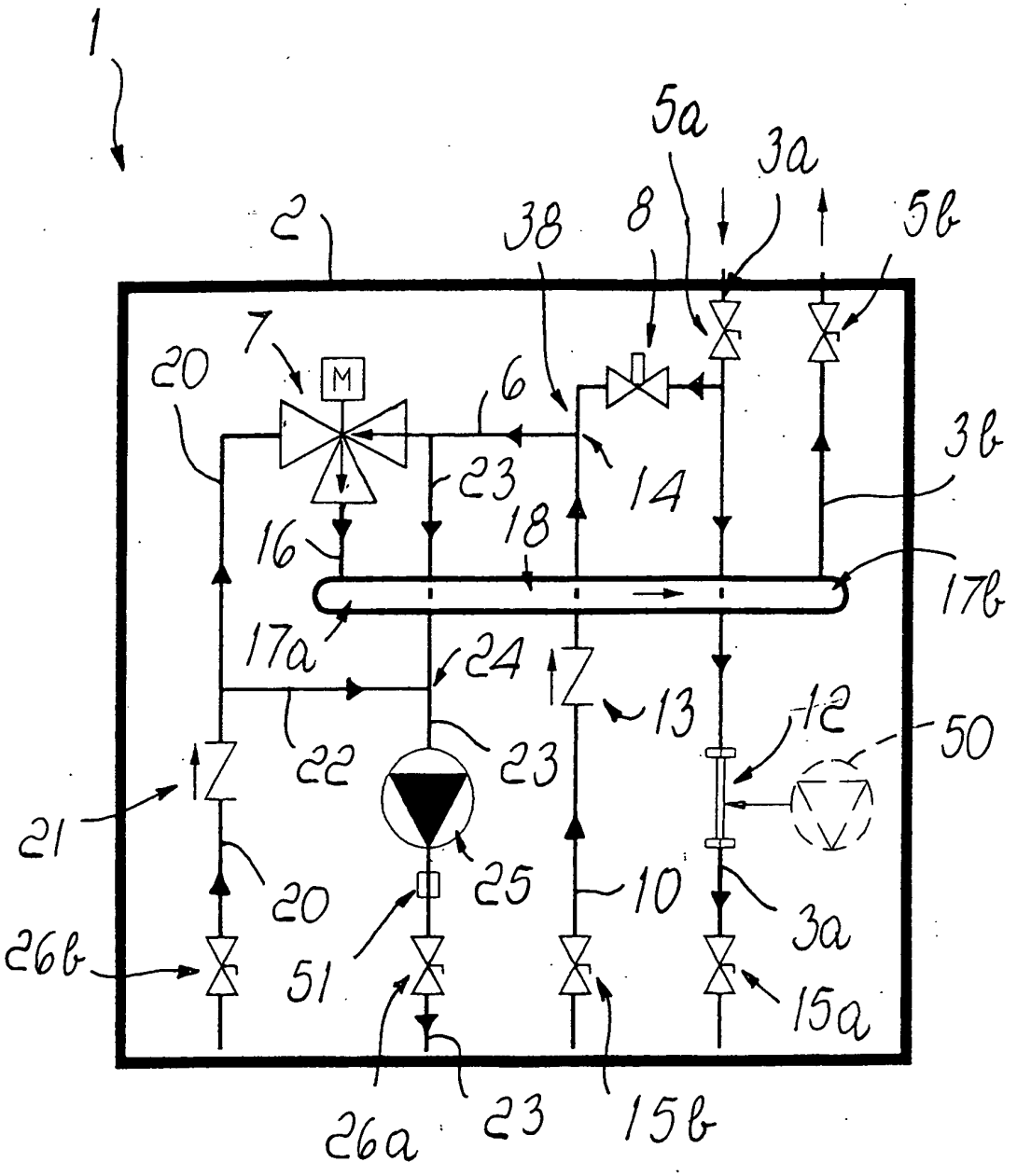
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Fig. 1

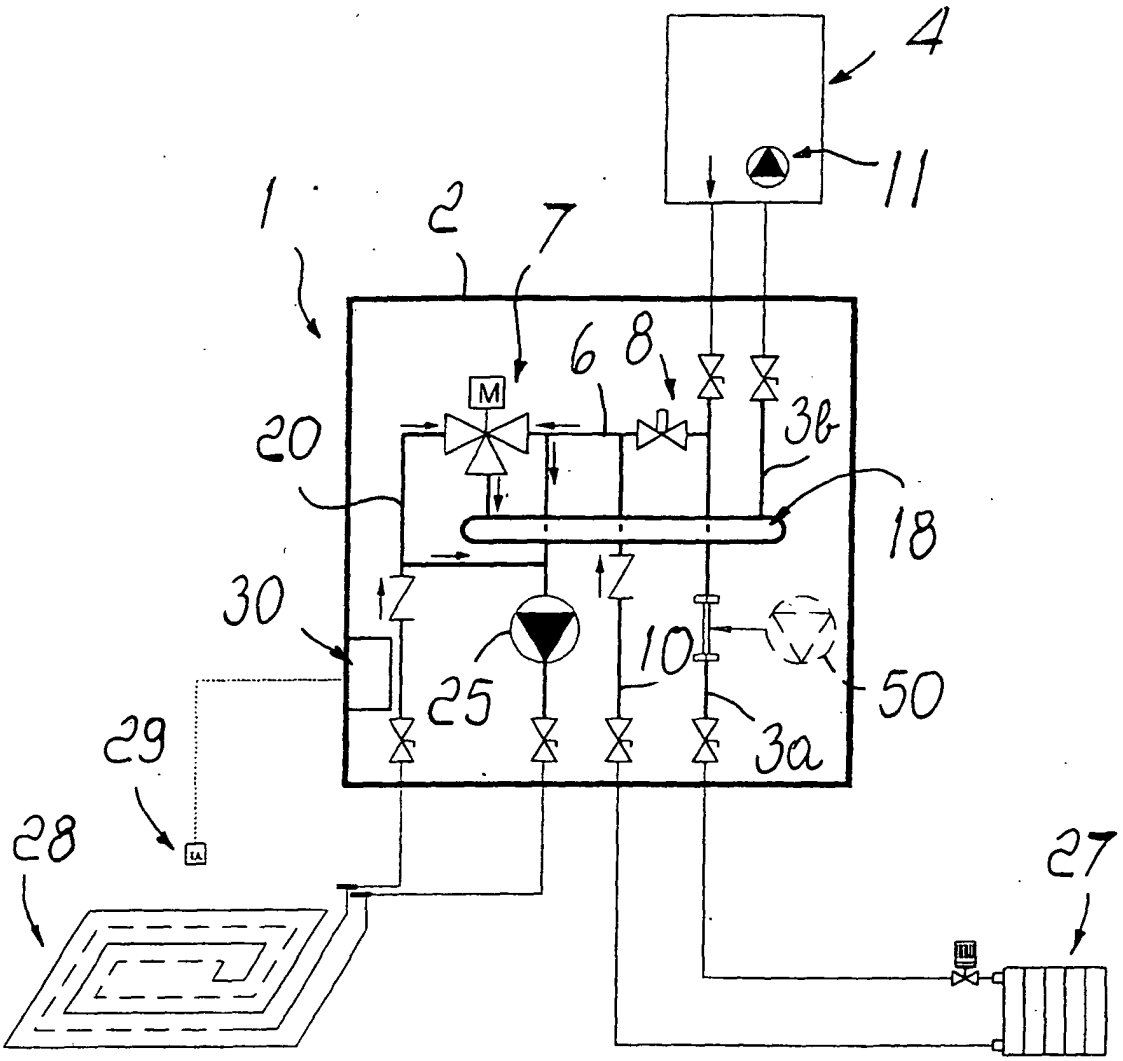

Fig. 2

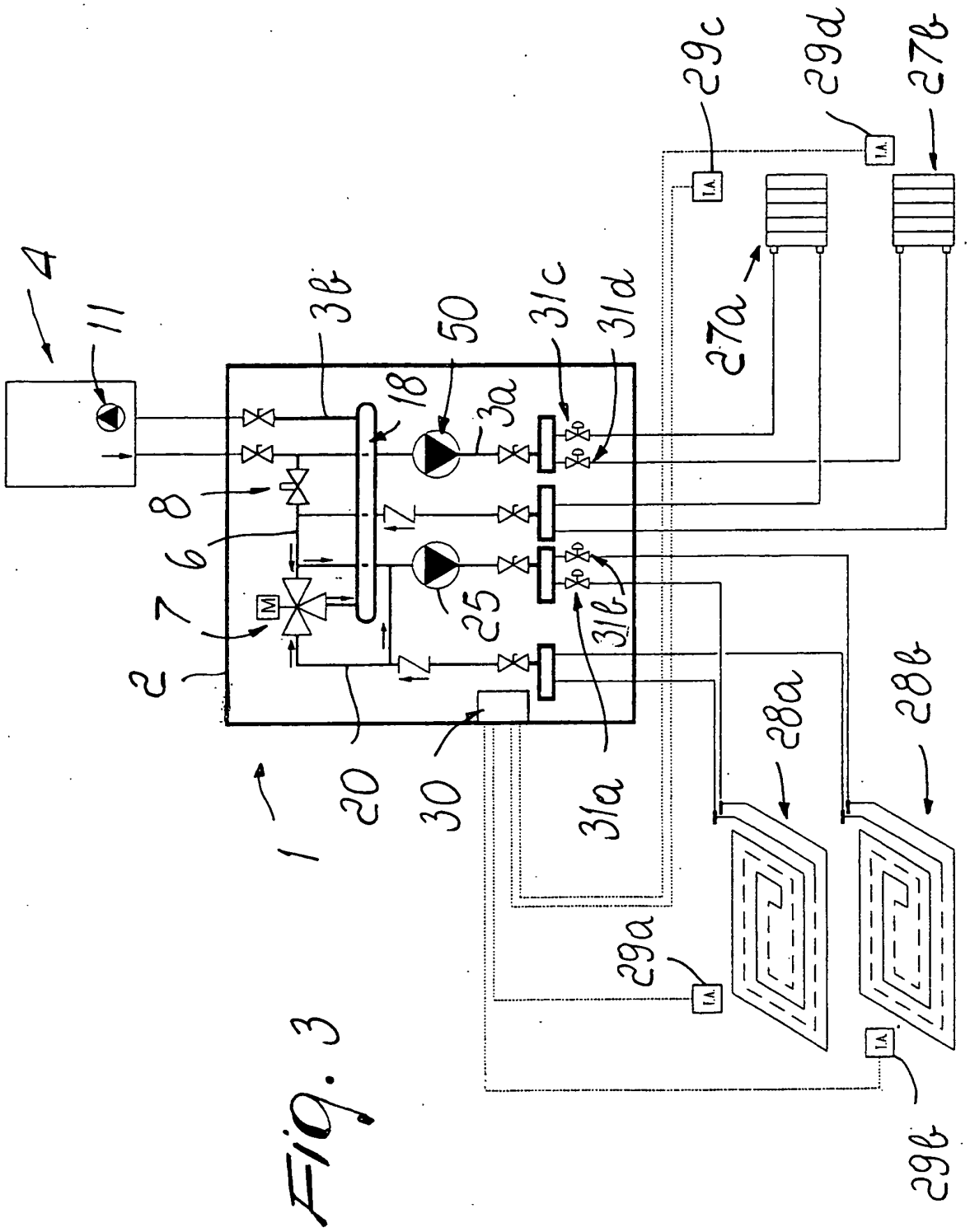
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Fig. 3

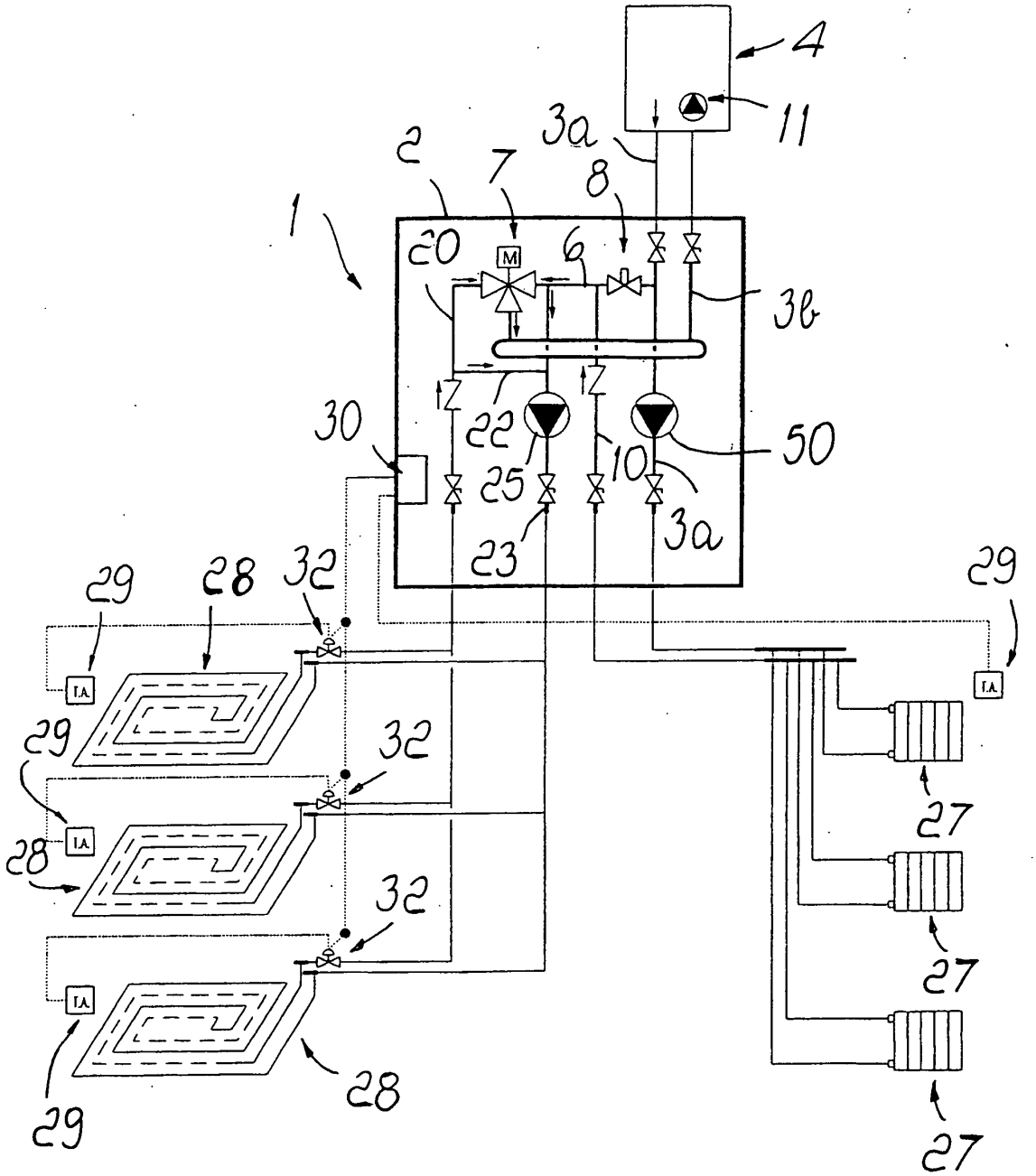
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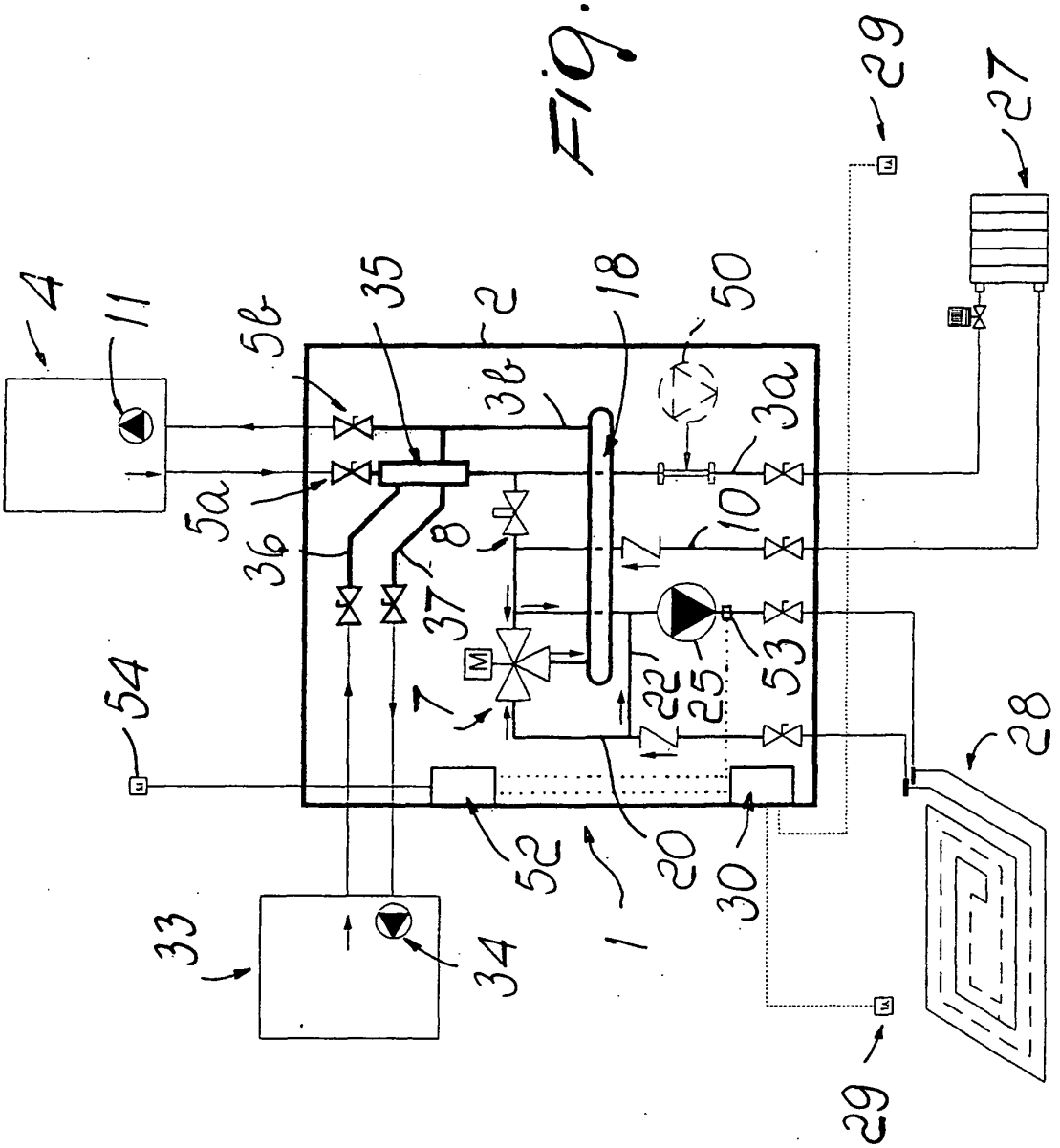
Fig. 4

Fig. 5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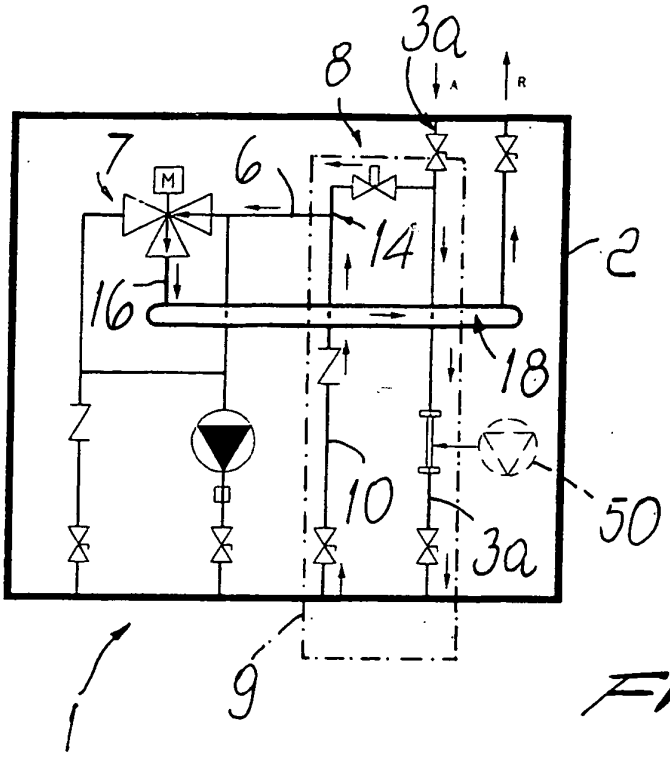
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FIG. 6

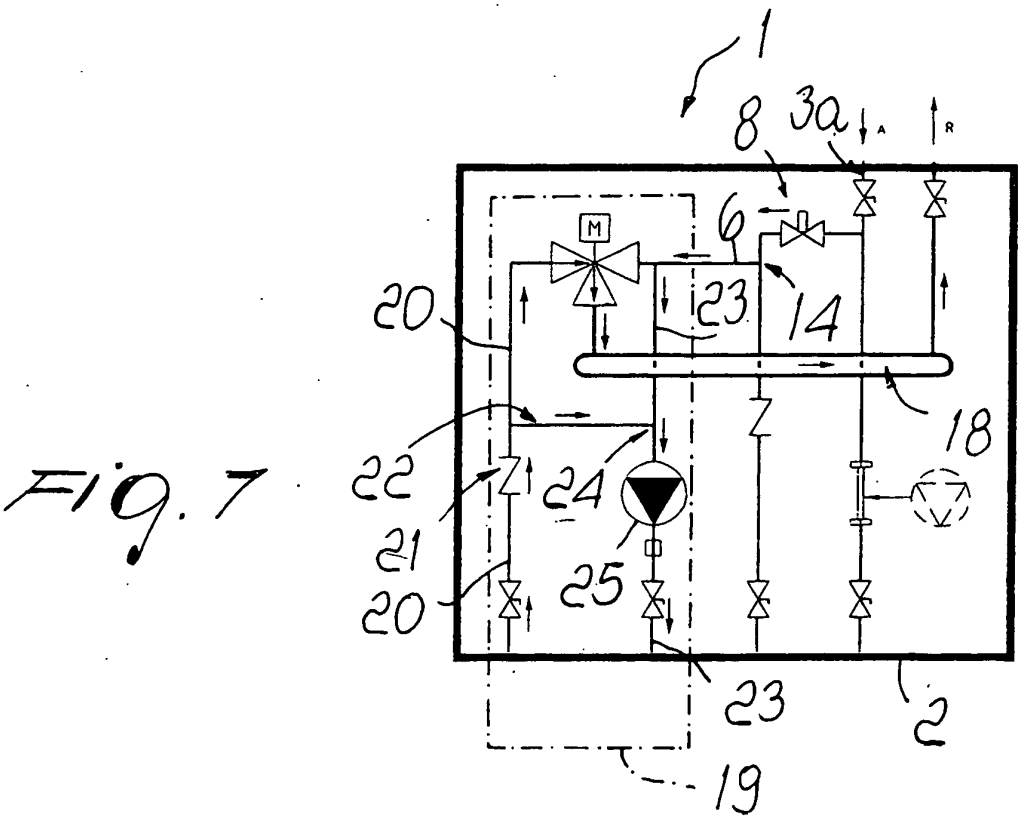
1
8
3a
A
R
6
M
20
23
14
18
22
24
21
25
20
23
2
19

FIG. 7

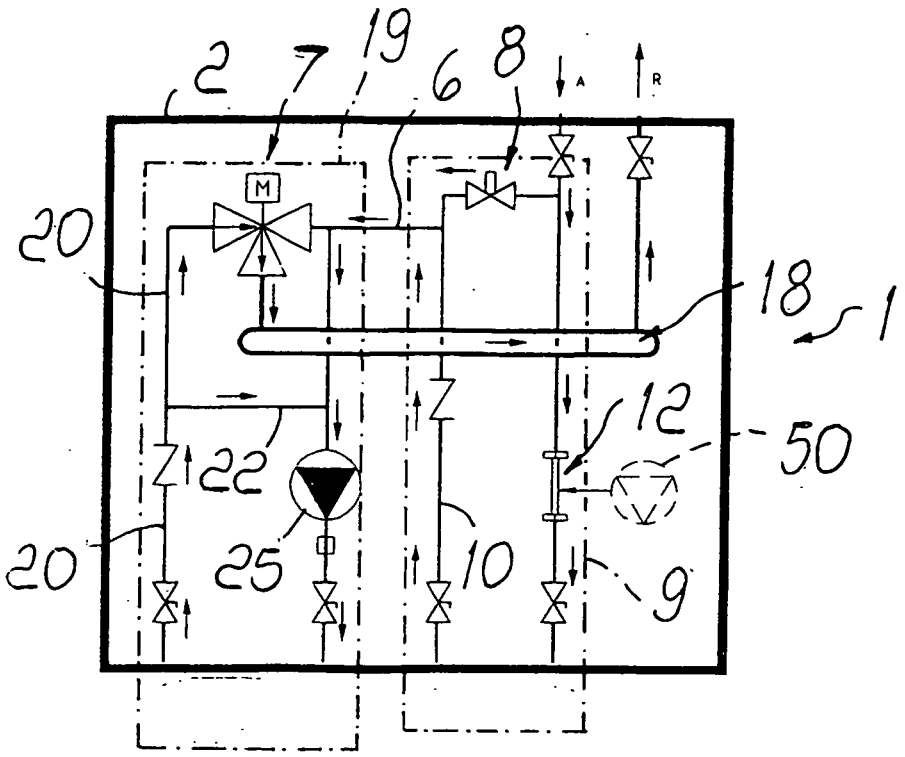

FIG. 8