



(51) International Patent Classification:

F25B 1/00 (2006.01) *F25B 49/02* (2006.01)
F25B 25/00 (2006.01) *F24F 11/84* (2018.01)
F25B 29/00 (2006.01) *F24F 3/10* (2006.01)

(21) International Application Number:

PCT/IB2021/051422

(22) International Filing Date:

19 February 2021 (19.02.2021)

(25) Filing Language:

Italian

(26) Publication Language:

English

(30) Priority Data:

102020000003386 19 February 2020 (19.02.2020) IT

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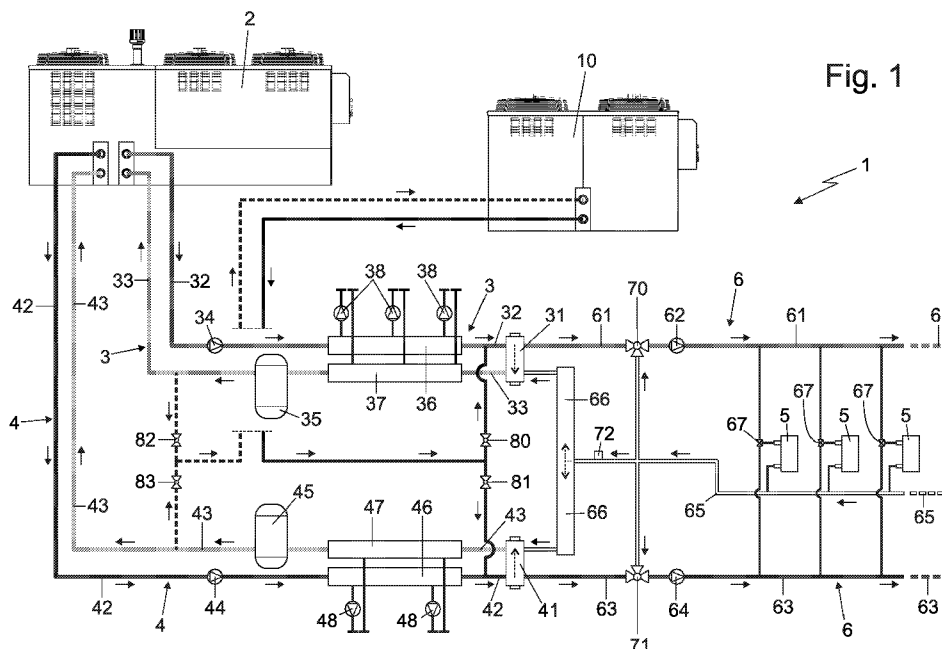
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: CENTRALIZED AIR-CONDITIONING SYSTEM



(57) Abstract: Air-conditioning system (1) comprising: a hydronic heat-pump machine (2) which is connected to a hot-water supply line (3) and to a cold-water supply line (4), and is adapted to heat up the water circulating in said hot-water supply line (3) and simultaneously cool down the water circulating in said cold-water supply line (4); a plurality of heat exchangers (5) for air conditioning; and a hydraulic connection circuit (6) having a three-pipes structure, which connects the heat exchangers (5) for air conditioning both to the hot-water supply line (3) and to the cold-water supply line (4).

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*
- *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

CENTRALIZED AIR-CONDITIONING SYSTEM

5

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application claims priority from Italian patent application no. 102020000003386 filed on 19/02/2020, the entire disclosure of which is incorporated herein by
10 reference.

TECHNICAL FIELD

The present invention relates to a centralized air-conditioning system.

More in detail, the present invention relates to a
15 centralized air-conditioning system for buildings with a high number of fan coil units and/or radiators and/or other air-conditioning terminals that operate independently of each other, such as for example hotels, hospitals and other residential complexes with a large number of rooms for
20 residential use. Use to which the follows description will make explicit reference without however losing generality.

BACKGROUND ART

As is known, centralized air-conditioning systems are normally made up of a series of fan coil units and/or
25 radiators and/or other air-conditioning terminals that are

strategically located in the various rooms of the building to be air conditioned, and of a high-power hydronic machine which is able to alternatively heat up or cool down the water circulating inside the various fan coil units and/or
5 radiators and/or other air-conditioning terminals that are part of the system, so that the latter ones are allowed to remove or give off heat to the air inside the room in which they are located.

Clearly operation of the individual fan coil units and/or
10 radiators and/or other air-conditioning terminals depends on the temperature of the water circulating inside them, with all the operating limits that this entails. This type of air-conditioning systems, in fact, does not allow a separate and independent temperature control for each single room
15 provided with fan coil units and/or radiators and/or other air-conditioning terminals, so as to be able to simultaneously air condition rooms with opposite thermal loads.

In other words, this type of air-conditioning systems
20 does not allow to some fan coil units and/or radiators and/or other air-conditioning terminals of the system to cool down the surrounding environment, while the remaining fan coil units and/or radiators and/or other air-conditioning terminals of the air-conditioning system are heating up the
25 surrounding environment.

To overcome this drawback, over the last few years there have been developed centralized air-conditioning systems wherein the hydronic machine is replaced by a multipurpose heat-pump machine (also called total-recovery multipurpose machine), which is capable to simultaneously provide in output a flow of hot-water and a flow of cold-water that are separate and distinct from each other; and the fan coil units and/or radiators and/or other air-conditioning terminals of the system are connected to the multipurpose machine via two water circulation lines that are separate and independent to one another, and can be selected alternatively through valves located immediately upstream of each fan coil unit, radiator or other air-conditioning terminal of the system.

The multipurpose heat-pump machine heats up the water circulating inside of the first supply line, and in parallel cools down the water circulating inside of the second supply line.

The first supply line is therefore made up of a hot-water delivery pipe and of a hot-water return pipe. The second supply line, on the other hand, is made up of a cold-water delivery pipe and of a cold-water return pipe.

Clearly the hot-water flowing along the hot-water return pipe has a lower temperature than the hot-water flowing along the hot-water delivery pipe. Similarly, the cold-water flowing along the cold-water return pipe has a higher

temperature than the cold-water flowing along the cold-water delivery pipe.

By acting on the valves located upstream of each fan coil unit, radiator or other air-conditioning terminal, the user or the local electronic control unit can, at his/its discretion and according to the preset target temperature, connect the corresponding fan coil unit, radiator or other air-conditioning terminal to the hot-water supply line or to the cold-water supply line, so as to be able to alternatively cool down or heat up the room where the same fan coil unit, radiator or other air-conditioning terminal is located.

Clearly these new centralized air-conditioning systems, despite a greater operating flexibility, have a construction cost significantly higher than that of the previous air-conditioning systems, because each fan coil unit, radiator or other air-conditioning terminal of the system must necessarily be reached by both the hot-water supply line and the cold-water supply line, with the higher costs that this entails.

In order to reduce the costs of the air-conditioning system without compromising the functional advantages deriving from the simultaneous presence of the hot-water supply line and the cold-water supply line, numerous attempts have been made in recent years to couple the multipurpose heat-pump machines with a three-pipes hydraulic circuit that

connects the machine to all the fan coil units, radiators and/or other air-conditioning terminals of the system, and provides a single return pipe that collects and channels, towards the multipurpose heat-pump machine, both the hot-
5 water and the cold-water flowing out of each fan coil unit, radiator or other air-conditioning terminal of the system.

Clearly the temperature of the water flowing along the return pipe, towards the multipurpose heat-pump machine, depends on the number of fan coil units, radiators or other
10 air-conditioning terminals that are momentarily connected to the hot-water delivery pipe, with respect to the number of fan coil units, radiators or other air-conditioning terminals that are temporarily connected to the cold-water delivery pipe.

15 A centralized air-conditioning system with a three-pipes hydraulic circuit is described in application WO2014/009565 A1.

Unfortunately, several experimental tests have shown that the multipurpose heat-pump machines, if connected to
20 fan coil units, radiators and/or other air-conditioning terminals of the system via a three-pipes hydraulic circuit, have an energy efficiency significantly lower than that measured in presence of a hot-water supply line and of a cold-water supply line, separate and independent from one
25 another. This phenomenon is basically due to the mixing of

the water returning from the fan coil units, radiators and/or other air-conditioning terminals that are in operation for heating, with the water returning from the fan coil units and/or other air-conditioning terminals that are in
5 operation for cooling.

In addition, the multipurpose heat-pump machines, if connected directly to the fan coil units, radiators and/or other air-conditioning terminals of the system through a three-pipes hydraulic circuit, are often subject to severe
10 and sudden variations in the flow rate of the hot- and/or cold-water, which often lead to the complete stop of the machine.

Most of the multipurpose heat-pump machines, in fact, are notoriously machines dimensioned for operating at a
15 constant flow rate, and therefore they solely tolerate flow-rate variations of small magnitude that moreover occur very slowly so as not to destabilise the thermal flows inside the machine.

DISCLOSURE OF INVENTION

20 Aim of the present invention is to realise a centralized air-conditioning system with a three-pipes hydraulic circuit, which uses a multipurpose heat-pump machine, minimises the drawbacks referred above, is structurally simpler and cheaper to realise than the one disclosed in
25 application WO2014/009565 A1, and finally can also provide

for the use of multipurpose machines requiring to maintain, during operation, a substantially constant flow rate at the user-side exchangers.

In accordance with the aims indicated above, according to the present invention there is provided a centralized air-conditioning system as defined in Claim 1 and preferably, though not necessarily, in any one of the claims depending on it.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described with reference to the attached drawings, which illustrate a non-limiting embodiment thereof, in which:

- Figure 1 schematically shows a centralized air-conditioning system realized according to the teachings of the present invention, with parts in section and parts removed for clarity's sake; whereas
- Figures 2, 3, 4 and 5 schematically show as many embodiments of the centralized air-conditioning system shown in Figure 1, with parts removed for clarity's sake.

BEST MODE FOR CARRYING OUT THE INVENTION

With reference to Figure 1, number 1 denotes as a whole a centralized air-conditioning system that can be advantageously installed in buildings which envisage a large number of fan coil units, radiators and/or other air-conditioning

terminals operating independently to one another, such as for example hotels, hospitals, office buildings and residential complexes with a large number of rooms for residential use.

5 The centralized air-conditioning system 1 firstly comprises: a preferably electrically operated, hydronic heat-pump machine 2 which is simultaneously connected to a hot-water supply line 3 and to a cold-water supply line 4, separated from each other and both substantially in a closed
10 loop, and which is structured so as to simultaneously and separately heat up the water circulating in the hot-water supply line 3, and cool down the water circulating in the cold-water supply line 4; and a plurality of air-liquid heat
15 exchangers 5 for air conditioning, such as for example fan coil units, radiators and/or other similar air-conditioning terminals, which are suitably located in the various rooms to be air conditioned.

More in detail, the hydronic heat-pump machine 2 is provided with a hot-water inlet and with a hot-water outlet
20 which are directly connected to the hot-water supply line 3, and is adapted to produce in output a more or less constant flow of hot-water, with a given temperature preferably ranging between 35°C and 60°C. In addition, the hydronic heat-pump machine 2 is also provided with a cold-water inlet
25 and with a cold-water outlet which are directly connected to

the cold-water supply line 4, and is adapted to produce in output a more or less constant flow of cold-water, with a given temperature preferably ranging between 4°C and 16°C.

In other words, the hydronic heat-pump machine 2 is a
5 hydronic machine capable of simultaneously providing in output a flow of hot-water and a flow of cold/chilled-water.

Obviously the water flowing out of the hot-water outlet of hydronic heat-pump machine 2 always has a higher temperature than the water flowing out of the cold-water
10 outlet of the same machine.

Clearly, the water circulating in the hot-water supply line 3 and/or in the cold-water supply line 4 can be replaced by any other heat transfer liquid.

In the example shown, in particular, the hydronic heat-
15 pump machine 2 is preferably a multipurpose heat-pump machine of known type.

More in detail, in the example shown the hydronic heat-pump machine 2 preferably, though not necessarily, consists of a multipurpose unit model NRP 0200-0750, of a multipurpose
20 unit model NRP 0804-3606, or of a multipurpose unit model NXP 0500-1650, all currently produced and marketed by the Applicant AERMEC S.P.A..

Clearly, being a machinery already known and easily available on the market, the multipurpose heat-pump machine
25 will not be further described.

The air-conditioning system 1 moreover also comprises a hydraulic connection circuit 6 with a three-pipes structure, which connects the air-liquid heat exchangers 5 to the hot-water supply line 3 and to the cold-water supply line 4, so that each air-liquid heat exchanger 5 can be reached and crossed, on choice and alternatively, by the hot-water coming from the hot-water supply line 3 or by the cold-water coming from the cold-water supply line 4.

With reference to Figure 1, the hot-water supply line 3 in turn comprises: a hydraulic separator 31; a delivery pipe 32 that connects the hot-water outlet of hydronic heat-pump machine 2 to the hydraulic separator 31; a return pipe 33 that connects the hot-water inlet of hydronic heat-pump machine 2 to the hydraulic separator 31; and a preferably electrically operated, circulation pump 34 which is placed along the delivery pipe 32, and is adapted to circulate the hot-water within the loop formed by the hydronic heat-pump machine 2, by the delivery pipe 32, by the hydraulic separator 31 and by the return pipe 33.

Preferably, the circulation pump 34 moreover works at a constant flow rate.

In addition, the hot-water supply line 3 preferably also comprises a large-capacity and preferably thermal-insulated, storage tank 35 which is placed along the return pipe 33, so as to contain a large quantity of hot-water which preferably

serves to regularise the operation of hydronic heat-pump machine 2.

In other words, the storage tank 35 is adapted to reduce/minimise the fluctuations of the flow rate and/or of the temperature of the water directed towards the hot-water inlet of hydronic heat-pump machine 2.

Preferably, the capacity of storage tank 35 is moreover a function of the nominal cooling capacity of the hydronic heat-pump machine 2.

More in detail, the ratio between the capacity of the storage tank 35 and the nominal cooling capacity of the hydronic heat-pump unit 2 preferably ranges between 10 and 18 litres/kW (litres per kilowatt), and is optionally equal to about 14 litres/kW.

Clearly, the circulation pump 34 could alternatively be placed along the return pipe 33, preferably, though not necessarily, downstream of storage tank 35.

Preferably, the hot-water supply line 3 additionally also comprises two connection manifolds 36 and 37, which are placed, respectively, along the delivery pipe 32 and along the return pipe 33, and are structured/dimensioned so as to reduce the speed of the water and bring it below a given limit value. Preferably, this limit value is also lower than 1 m/s (metre per second).

More in detail, the connection manifolds 36, 37 have a

passage section significantly higher than that of the delivery 32 and return 33 pipes on which they are placed, so as to reduce the speed of the water inside of the connection manifold 36 and/or 37 to a value preferably lower than or
5 equal to 0,5 m/s (metres per second) and optionally equal to about 0,2 m/s.

The connection manifolds 36 and 37 are adapted to supply hot-water to other branches, users and/or auxiliary devices of the air-conditioning system 1, preferably with the aid of
10 as many additional delivery pumps, branch connected to the connection manifold 36.

In other words, the hot-water supply line 3 preferably additionally comprises at least one and, more conveniently, a plurality of preferably electrically operated, auxiliary
15 delivery pumps 38, each of which is branch connected to the connection manifold 36, and is adapted to send a part of the hot-water circulating into the connection manifold 36, towards a corresponding branch, user or auxiliary device of the air-conditioning system 1.

20 In the example shown, in particular, the delivery pumps 38 are preferably adapted to send hot-water to the heat exchanger of a boiler for the production of sanitary hot-water (not shown), or to the evaporator of a water-water heat-pump equipment for production of sanitary hot-water
25 (not shown), and to an air handling unit (not shown).

With reference to Figure 1, similarly to the hot-water supply line 3, the cold-water supply line 4 comprises: a hydraulic separator 41; a delivery pipe 42 that connects the cold-water outlet of hydronic heat-pump machine 2 to the hydraulic separator 41; a return pipe 43 that connects the cold-water inlet of hydronic heat-pump machine 2 to the hydraulic separator 41; and a preferably electrically operated, circulation pump 44 which is placed along the delivery pipe 42, and is adapted to circulate the cold-water within the loop formed by the hydronic heat-pump machine 2, by the delivery pipe 42, by the hydraulic separator 41 and by the return pipe 43.

Preferably, the circulation pump 44 also works at a constant flow rate.

In addition, the cold-water supply line 4 preferably also comprises a large capacity and preferably thermal-insulated, storage tank 45 which is placed along the return pipe 43, so as to contain a large quantity of cold-water which preferably serves to regularise the operation of the hydronic heat-pump machine 2.

In other words, the storage tank 45 is adapted to reduce/minimise the fluctuations of the flow rate and/or of the temperature of the water directed towards the cold-water inlet of hydronic heat-pump machine 2.

Preferably, the capacity of storage tank 45 is moreover

a function of the nominal cooling capacity of the hydronic heat-pump machine 2.

More in detail, the ratio between the capacity of the storage tank 45 and the nominal cooling capacity of hydronic
5 heat-pump unit 2 preferably ranges between 10 and 18 litres/kW (litres per kilowatt), and is optionally equal to about 14 litres/kW.

Clearly, the circulation pump 44 could be placed along the return pipe 43, preferably, though not necessarily,
10 downstream of storage tank 45.

Preferably, the cold-water supply line 4 moreover also comprises two connection manifolds 46 and 47, which are placed, respectively, along the delivery pipe 42 and the return pipe 43, and are structured/dimensioned so as to
15 reduce the speed of the water and bring it below a given limit value. Preferably, this limit value is also lower than 1 m/s (metre per second).

More in detail, the connection manifolds 46, 47 have a passage section significantly higher than that of the
20 delivery 42 and return 43 pipe on which they are placed, so as to reduce the speed of the water inside of connection manifold 46 and/or 47 to a value preferably lower than or equal to 0,5 m/s (metres per second) and optionally equal to about 0,2 m/s.

25 Similarly to connection manifolds 36 and 37, connection

manifolds 46 and 47 are adapted to supply cold-water to other branches, users and/or auxiliary devices of the air-conditioning system 1, preferably with the aid of as many additional delivery pumps, branch connected to the
5 connection manifold 46.

In other words, the cold-water supply line 4 preferably additionally comprises at least one and, more conveniently, a plurality of preferably electrically operated, auxiliary delivery pumps 48, each of which is branch connected to the
10 connection manifold 46, and is adapted to send a part of the cold-water circulating into the connection manifold 46, towards a corresponding branch, user or auxiliary device of the air-conditioning system 1.

In the shown example, in particular, the delivery pumps
15 48 are preferably adapted to send cold-water to an air handling unit (not shown).

With reference to Figure 1, the hydraulic connection circuit 6 in turn comprises: a hot-water delivery pipe 61 that branches from the hydraulic separator 31 of hot-water
20 supply line 3, and is adapted to channel the water of hydraulic separator 31 towards the inlets of the various air-liquid heat exchangers 5 of the system; a hot-water delivery pump 62 which is placed along the hot-water delivery pipe 61, and is adapted to pump hot-water from the hydraulic
25 separator 31 of hot-water supply line 3 towards the inlets

of the air-liquid heat exchangers 5; a cold-water delivery pipe 63 that branches from the hydraulic separator 41 of cold-water supply line 4, and is adapted to channel the water of hydraulic separator 41 to the inlets of the various air-liquid heat exchangers 5 of the system; and a cold-water delivery pump 64, which is placed along the cold-water delivery pipe 63, and is adapted to pump cold-water from the hydraulic separator 41 of cold-water supply line 4 towards the inlets of the air-liquid heat exchangers 5.

More in detail, the hot-water delivery pump 62 is preferably adapted to suck/divert, along the hot-water delivery pipe 61, a limited percentage of the water flow crossing the hydraulic separator 31. Similarly, the cold-water delivery pump 64 is preferably adapted to suck/divert, along the cold-water delivery pipe 63, a limited percentage of the water flow crossing the hydraulic separator 41.

Preferably, hot-water delivery pump 62 and cold-water delivery pump 64 are electrically-operated pumps.

Preferably, the hot-water delivery pump 62 is moreover a variable flow pump, and is adapted to vary the flow rate of water directed towards the inlets of the air-liquid heat exchangers 5 according to the number of air-liquid heat exchangers 5 that momentarily require hot-water.

Similarly, the cold-water delivery pump 64 is moreover a variable flow pump, and is adapted to vary the flow rate

of water directed to the inlets of the air-liquid heat exchangers 5 according to the number of air-liquid heat exchangers 5 that momentarily require cold-water.

In addition, the hydraulic connection circuit 6 also
5 comprises: a lukewarm-water return pipe 65, which is adapted to channel the water flowing out of the various air-liquid heat exchangers 5 of the system towards the heat-pump machine 2; and a distribution manifold 66, which is interposed between the lukewarm-water return pipe 65 and the hydraulic
10 separators 31 and 41 of, respectively, the hot-water 3 and cold-water 4 supply line, and is adapted to dynamically distribute and channel the flow of lukewarm-water arriving from the lukewarm-water return pipe 65, towards the hydraulic separators 31 and 41.

15 More in detail, the distribution manifold 66 is structured/dimensioned so as to drastically reduce the speed of the water coming from the lukewarm-water return pipe 65, so that the water present in the manifold can be naturally and dynamically distributed to the hydraulic separators 31
20 and 41 of, respectively, the hot-water 3 and cold-water 4 supply line, substantially equalising the flow rate of water taken from the hot-water 61 and cold-water 63 delivery pipes.

In the example shown, in particular, the distribution manifold 66 is preferably dimensioned so as to reduce the
25 speed of the water crossing it to a value lower than or equal

to 0,5 m/s (metres per second) and optionally equal about 0,2 m/s.

Even in more detail, in the example shown, the distribution manifold 66 preferably consists of a large closed container oblong in shape and with a capacity preferably, 5 though not necessarily, ranging between 20 and 100 litres, which is preferably substantially tubular cylindrical in shape, is preferably connected centrally to the lukewarm-water return pipe 65, and is simultaneously connected to the 10 hydraulic separators 31 and 41 at the two ends thereof.

Clearly, the area of the cross-section of the oblong-shaped closed container is much greater than the area of the passage section of the lukewarm-water return pipe 65, so as to lower the speed of the water entering in the distribution 15 manifold 66.

The hydraulic connection circuit 6 moreover comprises, upstream of the inlet of each air-liquid heat exchanger 5 of the system, also a preferably electrically- or manually-operated, respective valve assembly 67 which is connected 20 both to the hot-water delivery pipe 61 and to the cold-water delivery pipe 63, and is structured so as to connect the inlet of the air-liquid heat exchanger 5, on choice and alternatively, to the hot-water delivery pipe 61 so that the hot-water is allowed to flow through the heat exchanger 5, 25 or to the cold-water delivery pipe 63 so that the cold-water

is allowed to flow through the heat exchanger 5.

With reference to Figure 1, preferably the hydraulic connection circuit 6 moreover comprises also: a first electronically-controlled mixing valve 70 that is interposed
5 between the hot-water delivery pipe 61 and the lukewarm-water return pipe 65, and is adapted to selectively inject, into the hot-water delivery pipe 61, a variable quantity of lukewarm-water coming from the lukewarm-water return pipe 65; and a second electronically-controlled mixing valve 71
10 that is interposed between the cold-water delivery pipe 63 and the lukewarm-water return pipe 65, and is adapted to selectively inject, into the cold-water delivery pipe 63, a variable quantity of lukewarm-water coming from the lukewarm-water return pipe 65.

15 More in detail, the mixing valve 70 is preferably placed along the hot-water delivery pipe 61, preferably upstream of the hot-water delivery pump 62, and is adapted to selectively inject lukewarm-water into the hot-water delivery pipe 61, so as to reduce the temperature of the hot-water directed
20 towards the inlets of the air-liquid heat exchangers 5.

In parallel, the mixing valve 71 is preferably placed along the cold-water delivery pipe 63, preferably upstream of the hot-water delivery pump 64, and is adapted to selectively inject lukewarm-water into the cold-water
25 delivery pipe 63, so as to increase the temperature of the

cold-water directed towards the inlets of the air-liquid heat exchangers 5.

In addition, the centralized air-conditioning system 1 is preferably provided with an electronic control unit (not shown), which is adapted to command the delivery pumps 62 and 64 and/or the mixing valves 70 and 71.

Preferably, the centralized air-conditioning system 1 additionally also comprises at least a first temperature sensor 72 that is adapted to detect the temperature of the lukewarm-water entering in the distribution manifold 66, and optionally also a second temperature sensor (not shown) that is adapted to detect the temperature of the hot-water flowing along the hot-water delivery pipe 61, towards the air-liquid heat exchangers 5, and/or a third temperature sensor (not shown) that is adapted to detect the temperature of the cold-water flowing along the cold-water delivery pipe 63, towards the air-liquid heat exchangers 5.

Preferably, the electronic control unit of the system is moreover programmed/configured so as to command the mixing valves 70 and 71 according to the signals coming from the temperature sensor 72.

In addition, the electronic control unit of the system is preferably adapted to command the mixing valve 70 so as to maintain, downstream of mixing valve 70, the temperature of the hot-water flowing along the hot-water delivery pipe

61 at a predetermined first target value. Preferably, the percentage of lukewarm-water injected into the hot-water delivery pipe 61 moreover will always be lower than or equal to the percentage of hot-water coming from the hydraulic separator 31.

In addition, the electronic control unit of the system is preferably adapted to command the mixing valve 71 so as to maintain, downstream of mixing valve 71, the temperature of the cold-water flowing along the cold-water delivery pipe 63 at a predetermined second target value. Preferably, the percentage of lukewarm-water injected into the cold-water delivery pipe 63 moreover will also always be lower than or equal to the percentage of hot-water coming from the hydraulic separator 41.

With reference to Figure 1, preferably the air-conditioning system 1 finally also comprises a preferably electrically operated, auxiliary heat-pump machine 10 which is selectively and alternatively adapted to heat up (i.e. raise the temperature) the hot-water circulating in the hot-water supply line 3, and to cool down (i.e. lower the temperature) the cold-water circulating in the cold-water supply line 4.

More in detail, the auxiliary heat-pump machine 10 is selectively and alternatively adapted to heat up the hot-water directed towards the hydraulic separator 31 of the

hot-water supply line 3 in parallel to the multipurpose heat-pump machine 2, and to cool down the cold-water directed to the hydraulic separator 41 of the cold-water supply line 4 in parallel to the multipurpose heat-pump machine 2.

5 Even in more detail, the auxiliary heat-pump machine 10 is provided with a water inlet and with a water outlet, which are branch connectable to the hot-water supply line 3 or to the cold-water supply line 4, respectively upstream and downstream of the corresponding hydraulic separator 31, 41.

10 In other words, the water inlet of auxiliary heat-pump machine 10 is preferably selectively and alternatively branch connectable to the hot-water supply line 3, or to the cold-water supply line 4, downstream of the corresponding hydraulic separator 31, 41 and optionally also downstream of
15 the corresponding storage tank 35, 45.

The water outlet of heat-pump machine 10, in turn, is preferably selectively and alternatively branch connectable to the hot-water supply line 3, or to the cold-water supply line 4, upstream of the corresponding hydraulic separator
20 31, 41, so that the water, after having crossed the heat-pump machine 10, re-enters into the hot-water 3 or cold-water 4 supply line upstream of the corresponding hydraulic separator 31, 41.

In the example shown, in particular, the water inlet of
25 auxiliary heat-pump machine 10 is preferably selectively

branch connectable to the return pipe 33 of hot-water supply line 3, downstream of connection manifold 37 and of storage tank 35, and is simultaneously selectively branch connectable to the return pipe 43 of the cold-water supply line 4, downstream of connection manifold 47 and of storage tank 45.

The water outlet of auxiliary heat-pump machine 10, on the other hand, is preferably selectively branch connectable to the delivery pipe 32 of hot-water supply line 3, between hydraulic separator 31 and connection manifold 36, and is simultaneously selectively branch connectable to the delivery pipe 42 of cold-water supply line 4, between hydraulic separator 41 and connection manifold 46.

Preferably, the electronic control unit of the system is furthermore programmed/configured so as to activate the auxiliary heat-pump machine 10, and connect it alternatively to the hot-water supply line 3 to raise the temperature of the hot-water directed towards the hydraulic separator 31, or to the cold-water supply line 4 to lower the temperature of the cold-water directed towards the hydraulic separator 41, according to the signals coming from the temperature sensor 72.

More in detail, the water outlet of auxiliary heat-pump machine 10 is preferably connected to the delivery pipe 32 of hot-water supply line 3 and to the delivery pipe 42 of

cold-water supply line 4 via an electronically-controlled first three-way valve assembly which is able to put the water outlet of auxiliary heat-pump machine 10 in communication with the delivery pipe 32 or with the delivery pipe 42.

5 Clearly, the first valve assembly is also able to isolate the water outlet of auxiliary heat-pump machine 10 from the delivery pipe 32 and from the delivery pipe 42.

The water inlet of auxiliary heat-pump machine 10, on the other hand, is preferably connected to the return pipe 10 33 of hot-water supply line 3 and to the return pipe 43 of cold-water supply line 4 via an electronically-controlled second three-way valve assembly which is able to put the water inlet of auxiliary heat-pump machine 10 in communication with the return pipe 33 or with the return pipe 43.

15 Clearly, the second valve group is also able to isolate the water inlet of auxiliary heat-pump machine 10 from the return pipe 33 and from the return pipe 43.

The electronic control unit of the system, in turn, is preferably programmed/configured so as to also command the 20 first and second valve assembly.

In the example shown, in particular, the water outlet of auxiliary heat-pump machine 10 is preferably connected to the delivery pipe 32 of hot-water supply line 3, preferably between hydraulic separator 31 and connection manifold 36, 25 via a first electronically-controlled shut-off valve 80, and

is simultaneously also connected to the delivery pipe 42 of cold-water supply line 4, preferably between hydraulic separator 41 and connection manifold 46, via a second electronically-controlled shut-off valve 81.

5 In a different embodiment, however, the water outlet of auxiliary heat-pump machine 10 could be connected to the delivery pipe 32 of hot-water supply line 3 upstream of connection manifold 36, i.e. between pump 34 and connection manifold 36, and to the delivery pipe 42 of cold-water supply
10 line 4 upstream of connection manifold 46, i.e. between pump 44 and connection manifold 46.

The water inlet of heat-pump machine 10, on the other hand, is preferably connected to the return pipe 33 of hot-water supply line 3, preferably downstream of tank 35, via
15 a third electronically-controlled shut-off valve 82, and it is simultaneously also connected to the return pipe 43 of cold-water supply line 4, preferably downstream of tank 45, via a fourth electronically-controlled shut-off valve 83.

The first valve assembly therefore comprises the shut-off valves 80 and 81, whereas the second valve assembly
20 comprises the shut-off valves 82 and 83.

The electronic control unit of the system is thus adapted to command the shut-off valves 80, 81, 82 and 83, so as to connect, when necessary, the auxiliary heat-pump machine 10
25 to the hot-water supply line 3 or to the cold-water supply

line 4.

More in detail, by opening the valves 80 and 82, the electronic control unit connects the water inlet and the water outlet of auxiliary heat-pump machine 10 to the hot-
5 water supply line 3, so that part of the hot-water circulating in the hot-water supply line 3 can also cross the auxiliary heat-pump machine 10, so as to raise the temperature of the hot-water entering in the hydraulic separator 31.

10 By opening the valves 81 and 83, on the other hand, the electronic control unit connects the water inlet and the water outlet of auxiliary heat-pump machine 10 to the cold-water supply line 4, so that part of the cold-water circulating in the cold-water supply line 4 can also cross
15 the auxiliary heat-pump machine 10, so as to lower the temperature of the cold-water entering in the hydraulic separator 41.

Operation of the air-conditioning system 1 is easily inferable from the above and does not require further
20 explanation.

As regards the mixing valves 70 and 71, by injecting lukewarm-water into the hot-water delivery pipes 61 and the cold-water delivery pipes 63, the mixing valves 70 and 71 are respectively able to lower the temperature of the hot-
25 water directed towards the air-liquid heat exchangers 5 for

air conditioning, i.e. to the various fan coil units, radiators and/or other air-conditioning terminals of the system, and/or to increase the temperature of the cold-water directed to the air-liquid heat exchangers 5 for air conditioning.

The advantages connected with the particular structure of the air-conditioning system 1 are remarkable.

Experimental tests have highlighted that the use of the hydraulic separators 31 and 41 in combination with the distribution manifold 66, allows to stabilize the flow rate and the temperature of the hot-water and of the cold-water circulating in the hydronic heat-pump machine 2, without the expedients described in application WO2014/009565 A1.

Additionally, the air-conditioning system 1 allows a normal hydronic heat-pump machine to be coupled to a three-pipes hydraulic circuit without the addition of further heat exchangers that reduce the overall efficiency of the system.

The presence of mixing valves 70 and 71 moreover allows the electronic control unit of the system to vary/regulate the temperature of the lukewarm-water entering in the distribution manifold 66, so as to minimise the deviations in the temperatures of the cold-water and of the hot-water that return to the hydronic heat-pump machine 2, with respect to the corresponding optimal values.

Furthermore the intervention of the auxiliary heat-pump

machine 10 prevents an excessive disequilibrium in the requests for hot-water and for cold-water from destabilising the hydronic heat-pump machine 2.

Lastly, the structure of air-conditioning system 1 makes
5 it very suitable for new buildings with a low environmental impact, where the considerable thermal insulation of the single rooms may require a high flow rate of cold-water even in the winter period. In fact, in this type of buildings, the solar radiation of the rooms arranged at the south can
10 cause the air temperature to rise well beyond 24°C even in winter.

It is finally clear that modifications and variations may be made to the centralized air-conditioning system 1 described above without however departing from the scope of
15 the present invention.

For example, instead of being interposed between the hot-water delivery pipe 61 and the lukewarm-water return pipe 65, the mixing valve 70 could be interposed between the hot-water delivery pipe 61 and the distribution manifold 66.

20 Similarly, instead of being interposed between the cold-water delivery pipe 63 and the lukewarm-water return pipe 65, the mixing valve 71 could be interposed between the cold-water delivery pipe 63 and the distribution manifold 66.

In addition, the auxiliary heat-pump machine 10 could be
25 connected only to the hot-water supply line 3, or only to

the cold-water supply line 4. In the first case, the auxiliary heat-pump machine 10 would only be able to heat up the water circulating in the hot-water supply line 3. In the second case, the auxiliary heat-pump machine 10 would only
5 be able to cool down the water circulating in the cold-water supply line 4.

With reference to Figure 2, moreover, in a first less-sophisticated embodiment the centralized air-conditioning system 1 lacks the mixing valves 70 and 71 and the
10 corresponding connection pipes to the lukewarm-water return pipe 65.

In this embodiment, therefore, all the lukewarm-water flowing out of the air-liquid heat exchangers 5, i.e. from the fan coil units, radiators or other air-conditioning
15 terminals, flows directly towards the distribution manifold 66.

With reference to Figure 3, in a second less-sophisticated embodiment the centralized air-conditioning system 1 lacks the auxiliary heat-pump machine 10 and the
20 shut-off valves 80, 81, 82 and 83 or similar, which allow the auxiliary heat-pump machine 10 to be branch connected to the hot-water supply line 3 or to the cold-water supply line 4.

Clearly, the centralized air-conditioning system 1 could
25 lack both the mixing valves 70 and 71, and the auxiliary

heat-pump machine 10.

With reference to Figure 4, in a more sophisticated embodiment the air-conditioning system 1 optionally also comprises an auxiliary water-water heat exchanger 100, which
5 is placed between the distribution manifold 66 and the hydraulic separator 41 of cold-water supply line 4, and is adapted to transfer heat from the lukewarm-water returning to the cold-water supply line 4, to the drinking water coming from the aqueduct.

10 More in detail, the first branch of the water-water heat exchanger 100 is preferably interposed between the distribution manifold 66 and the hydraulic separator 41 of cold-water supply line 4 so as to be crossed by the lukewarm-water returning to the cold-water supply line 4, whereas the
15 second branch is preferably placed along the pipeline that connects the water main to the device or the devices that produce sanitary hot-water, so as to be crossed by drinkable water directed towards the device or devices that produce sanitary hot-water. In this way it is possible to preheat
20 the drinkable water directed towards the device or devices that produce sanitary hot-water, removing heat from the water that returns to the cold-water supply line 4.

Clearly also in this case the centralized air-conditioning system 1 may lack the mixing valves 70 and 71,
25 and/or the auxiliary heat-pump machine 10.

With reference to Figure 5, moreover, in a further embodiment the centralized air-conditioning system 1 optionally also comprises an auxiliary heating device 200, which is placed along the hot-water supply line 3, and is
5 adapted to heat up (i.e. raise the temperature) the water circulating in the hot-water supply line 3.

More in detail, the auxiliary heating device 200 is preferably placed along the hot-water supply line 3, upstream of hydraulic separator 31, and is adapted to heat up (i.e.
10 raise the temperature) the hot-water directed towards the hydraulic separator 31.

In the example shown, in particular, the auxiliary heating device 200 preferably consists of a boiler or of an electric water-heater of a known type, and is preferably
15 branch connected to the delivery pipe 32 of hot-water supply line 3, optionally upstream of connection manifold 36.

Preferably, the water circulation inside the auxiliary heating device 200 is moreover controlled via two electronically-controlled shut-off valves 201, which are
20 interposed between the delivery pipe 32 and the heating device 200, and are preferably driven by the electronic control unit of the system.

Clearly also in this case the centralized air-conditioning system 1 may lack the mixing valves 70 and 71,
25 and/or the auxiliary heat-pump machine 10.

In addition, the auxiliary heat-pump machine 10, if any, may be connected only to the cold-water supply line 4, so as to selectively cool down (i.e. lower the temperature) the cold-water that returns to the multipurpose heat-pump machine 2 along the return pipe 43.

Finally, in a less sophisticated embodiment, the hydronic heat-pump machine 2, instead of being a multipurpose heat-pump machine, could be: a partial-recovery refrigeration assembly, a total-recovery refrigeration assembly, a water-water refrigeration assembly, or a water-water heat pump.

The partial-recovery refrigeration assembly is an air-water or water-water refrigeration machine that is provided, in the refrigeration circuit placed between the delivery of the compressor and the external heat exchanger, with an additional refrigerant-water heat exchanger whose function, during the cooling operation of the machine, is to recover part of the heat to be dissipated to heat up the water of an additional circuit. The recovered thermal power usually coincides with the power needed to desuperheat the refrigerant (i.e. to bring it from the temperature at outlet of the compressor to the condensing temperature), and depends on the type of machine, of the working conditions of the latter and on the chosen refrigerant (indicatively it can be recovered from 10% with R134a to about 25-30% with R410A of

the overall dissipated heat).

The total-recovery refrigeration assembly is a water-water or air-water refrigeration machine that is provided, in the refrigeration circuit usually placed in parallel to the external heat exchanger, with an additional refrigerant-water heat exchanger which is able to dissipate all the heat towards a hot-water circuit, and is crossed by the refrigerant fluid as an alternative to the main external heat exchanger thanks to special switching valves placed on the refrigeration circuit and controlled by the processor of the same assembly. Limited to the times in which the refrigeration assembly works in cooling mode, and in presence of suitable conditions (hot-water temperature in the recovery circuit below a set point value), the refrigerant is diverted to the recovery heat exchanger where the desuperheating and condensation step take place, allowing the full recovery of the heat to be dissipated.

Unlike a multipurpose heat-pump machine, the partial- and total- recovery refrigeration assemblies are unable to release heat to the recovery circuits if the cooling request is not active, and the recoverable thermal power is bound, at all times, by the required cooling power. They are therefore unable to meet the request for thermal and cooling energy simultaneously with any percentage of load on the two circuits, in particular with a request for heat power that

is significantly higher than the request for cooling power.

The water-water refrigeration assembly, on the other hand, is a refrigeration assembly that cools down the water of a user circuit (chilled) and dissipates the heat of the cycle on a circuit in which water flows (coming from a well, or from a water reserve, or from a circuit that uses a cooling tower, or from a circuit that uses a dry-cooler).

Finally, the water-water heat pump is a heat pump that heats up the water of a user circuit (hot), and takes the heat necessary for the cycle from a circuit in which water flows (coming from a well, or from a reserve of water, or from geothermal probes).

CLAIMS

1. An air-conditioning system (1) **characterised in that** it comprises: a hydronic heat-pump machine (2) which is connected to a hot-water supply line (3) and to a cold-water supply line (4), and is adapted to heat up the water circulating in said hot-water supply line (3) and simultaneously cool down the water circulating in said cold-water supply line (4); a plurality of heat exchangers (5) for air conditioning; and a hydraulic connection circuit (6) having a three-pipes structure, which connects the heat exchangers (5) to the hot-water supply line (3) and to the cold-water supply line (4);

the hot-water supply line (3) comprising: a first hydraulic separator (31); a first delivery pipe (32) that connects the hot-water outlet of the hydronic heat-pump machine (2) to the hydraulic separator (31); a first return pipe (33) that connects the hot-water inlet of the hydronic heat-pump machine (2) to said first hydraulic separator (31); and a first circulation pump (34) adapted to circulate the hot-water within the loop formed by the hydronic heat-pump machine (2), by the first delivery pipe (32), by the first hydraulic separator (31) and by the first return pipe (33);

the cold-water supply line (4) comprising: a second hydraulic separator (41); a second delivery pipe (42) that connects the cold-water outlet of the hydronic heat-pump

machine (2) to the second hydraulic separator (41); a second return pipe (43) that connects the cold-water inlet of the hydronic heat-pump machine (2) to the second hydraulic separator (41); and a second circulation pump (44) that is adapted to circulate the cold-water within the loop formed by the hydronic heat-pump machine (2), by the second delivery pipe (42), by the second hydraulic separator (41) and by the second return pipe (43);

the hydraulic connection circuit (6) comprising: a hot-water delivery pipe (61) that branches from the first hydraulic separator (31) and is adapted to channel the water from the first hydraulic separator (31) towards the inlets of the various heat exchangers (5); a first delivery pump (62) which is placed along the hot-water delivery pipe (61), and is adapted to pump the hot-water from the first hydraulic separator (31) towards the inlets of the heat exchangers (5); a cold-water delivery pipe (63) that branches from the second hydraulic separator (41) and is adapted to channel the water from the second hydraulic separator (41) towards the inlets of the heat exchangers (5); a second delivery pump (64) which is placed along the cold-water delivery pipe (63) and is adapted to pump the cold-water from the second hydraulic separator (41) towards the inlets of the heat exchangers (5); a lukewarm-water return pipe (65) which is adapted to channel the water flowing out of the various heat

exchangers (5) towards the hydronic heat-pump machine (2);
and a distribution manifold (66) which is interposed between
the lukewarm-water return pipe (65) and said hydraulic
separators (31, 41), and is adapted to dynamically distribute
5 and channel the flow of lukewarm-water arriving from said
lukewarm-water return pipe (65), towards the same hydraulic
separators (31, 41).

2. Air-conditioning system according to claim 1, wherein
the hot-water supply line (3) additionally comprises a first
10 connection manifold (36) which is placed along the first
delivery pipe (32), and a second connection manifold (37)
which is placed along the first return pipe (33); said first
connection manifold (36) and said second connection manifold
(37) being adapted to reduce the speed of the water below a
15 predetermined limit value.

3. Air-conditioning system according to claim 2, wherein
the hot-water supply line (3) additionally comprises one or
more first auxiliary delivery pumps (38), each of which is
branch connected to the first connection manifold (36), and
20 is adapted to send part of the hot-water circulating into
the first connection manifold (36) towards a corresponding
branch, user or other auxiliary device of the air-
conditioning system (1).

4. Air-conditioning system according to any one of the
25 preceding claims, wherein the cold-water supply line (4)

additionally comprises a third connection manifold (46) which is placed along the second delivery pipe (42), and a fourth connection manifold (47) which is placed along the second return pipe (43); said third connection manifold (46) and said fourth connection manifold (47) being adapted to reduce the speed of the water below a predetermined limit value.

5 5. Air-conditioning system according to claim 4, wherein the cold-water supply line (4) additionally comprises one or more second auxiliary delivery pumps (48), each of which is branch connected to the third connection manifold (46), and is adapted to send part of the cold-water circulating in the third connection manifold (46) towards a corresponding branch, user or other auxiliary device of the air-conditioning system (1).

15 6. Air-conditioning system according to any one of the preceding claims, wherein the hydraulic connection circuit (6) additionally comprises: a first mixing valve (70) which is interposed between the hot-water delivery pipe (61) and the lukewarm-water return pipe (65), and is adapted to selectively inject, into said hot-water delivery pipe (61), the lukewarm-water coming from said lukewarm-water return pipe (65); and a second mixing valve (71) which is interposed between the cold-water delivery pipe (63) and the lukewarm-water return pipe (65), and is adapted to selectively inject,

into said cold-water delivery pipe (63), the lukewarm-water coming from said lukewarm-water return pipe (65).

7. Air-conditioning system according to claim 6, characterised by additionally comprising an electronic control unit which is adapted to command said first mixing valve (70) and said second mixing valve (71).

8. Air-conditioning system according to claim 7, characterised by additionally comprising a temperature sensor (72) which is adapted to detect the temperature of the lukewarm-water entering in the distribution manifold (66); the electronic control unit being adapted to command said first mixing valve (70) and said second mixing valve (71) according to the signals from said temperature sensor (72).

9. Air-conditioning system according to any one of the preceding claims, characterised by additionally comprising an auxiliary heat-pump machine (10) which is selectively and alternatively adapted to heat up the water circulating inside the hot-water supply line (3), and to cool down the water circulating inside the cold-water supply line (4).

10. Air-conditioning system according to claim 9, wherein the auxiliary heat-pump machine (10) is selectively and alternatively adapted to heat up, in parallel with said hydronic heat-pump machine (2), the hot-water directed towards the first hydraulic separator (31) of the hot-water

supply line (3), and to cool down, in parallel with said hydronic heat-pump machine (2), the cold-water directed towards the second hydraulic separator (41) of the cold-water supply line (4).

5 11. Air-conditioning system according to claim 9 or 10, wherein the auxiliary heat-pump machine (10) is provided with a water inlet and with a water outlet which are branch connectable to the hot-water supply line (3) or to the cold-water supply line (4), respectively upstream and downstream
10 of the first (31) or of the second hydraulic separator (41).

12. Air-conditioning system according to claim 11, wherein the water outlet of said auxiliary heat-pump machine (10) is simultaneously connected to said first (32) and to said second (42) delivery pipes via a first three-way valve
15 assembly (80, 81); and wherein the water inlet of said auxiliary heat-pump machine (10) is simultaneously connected to said first (33) and to said second (43) return pipes via a second three-way valve assembly (82, 83).

13. Air-conditioning system according to claim 9, 10, 11
20 or 12, characterised by additionally comprising an electronic control unit which is adapted to command said auxiliary heat-pump machine (10) and/or said first (80, 81) and second (82, 83) three-way valve assemblies.

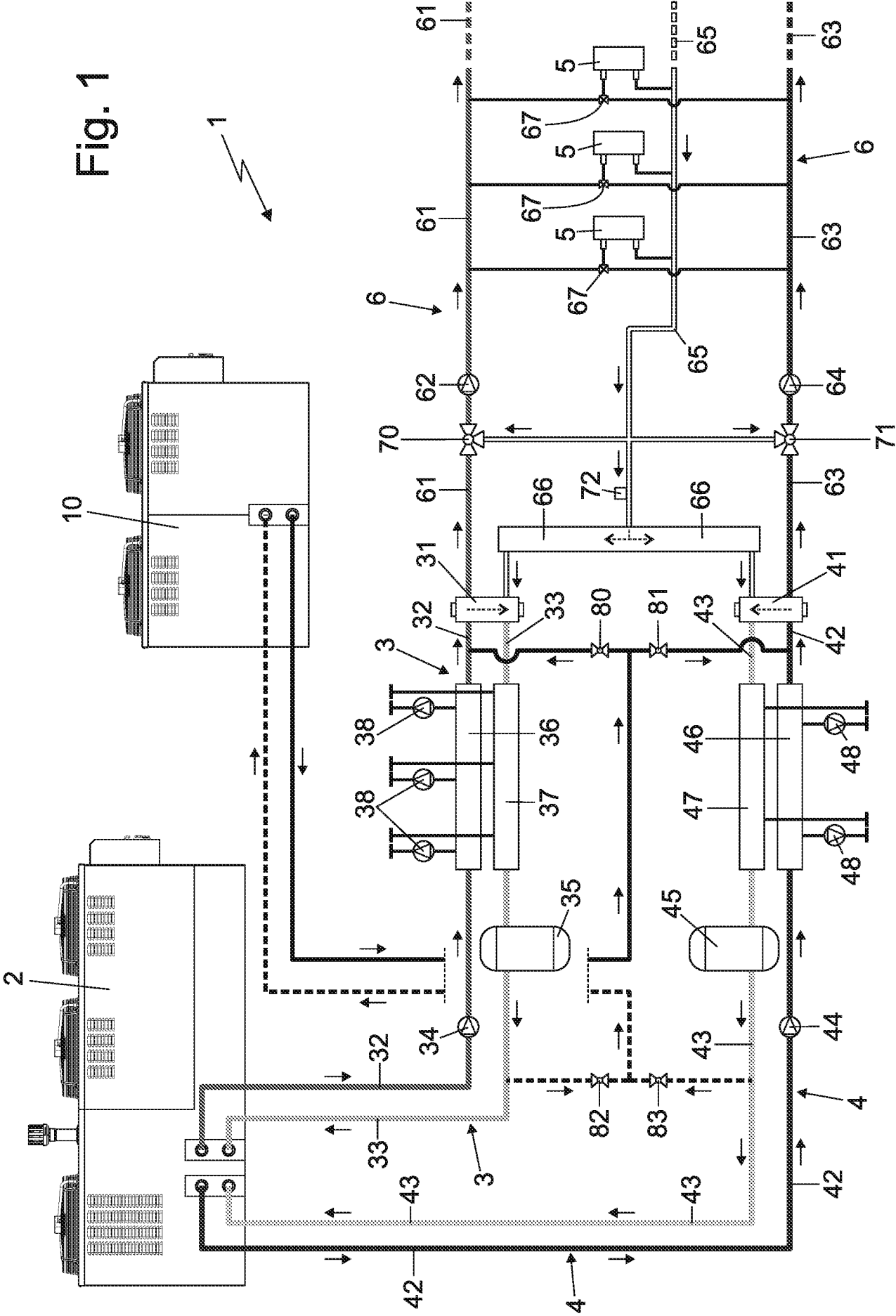
14. Air-conditioning system according to any one of the
25 preceding claims, wherein the hot-water supply line (3)

additionally comprises a first tank (35) which is placed along said first return pipe (33) and is adapted to accumulate hot-water.

15 15. Air-conditioning system according to any one of the preceding claims, wherein the cold-water supply line (4) additionally comprises a second tank (45) which is placed along said second return pipe (43) and is adapted to accumulate cold-water.

10 16. Air-conditioning system according to any one of the preceding claims, wherein the hydraulic connection circuit (6) additionally comprises, upstream of the inlet of each heat exchanger (5) for air conditioning, a third valve assembly (67) which is connected to both the hot-water delivery pipe (61) and the cold-water delivery pipe (63),
15 and is adapted to connect the inlet of the heat exchanger (5), on choice and alternatively, to the hot-water delivery pipe (61) or to the cold-water delivery pipe (63).

20 17. Air-conditioning system according to any one of the preceding claims, wherein said hydronic heat-pump machine (2) is a multipurpose heat-pump machine.



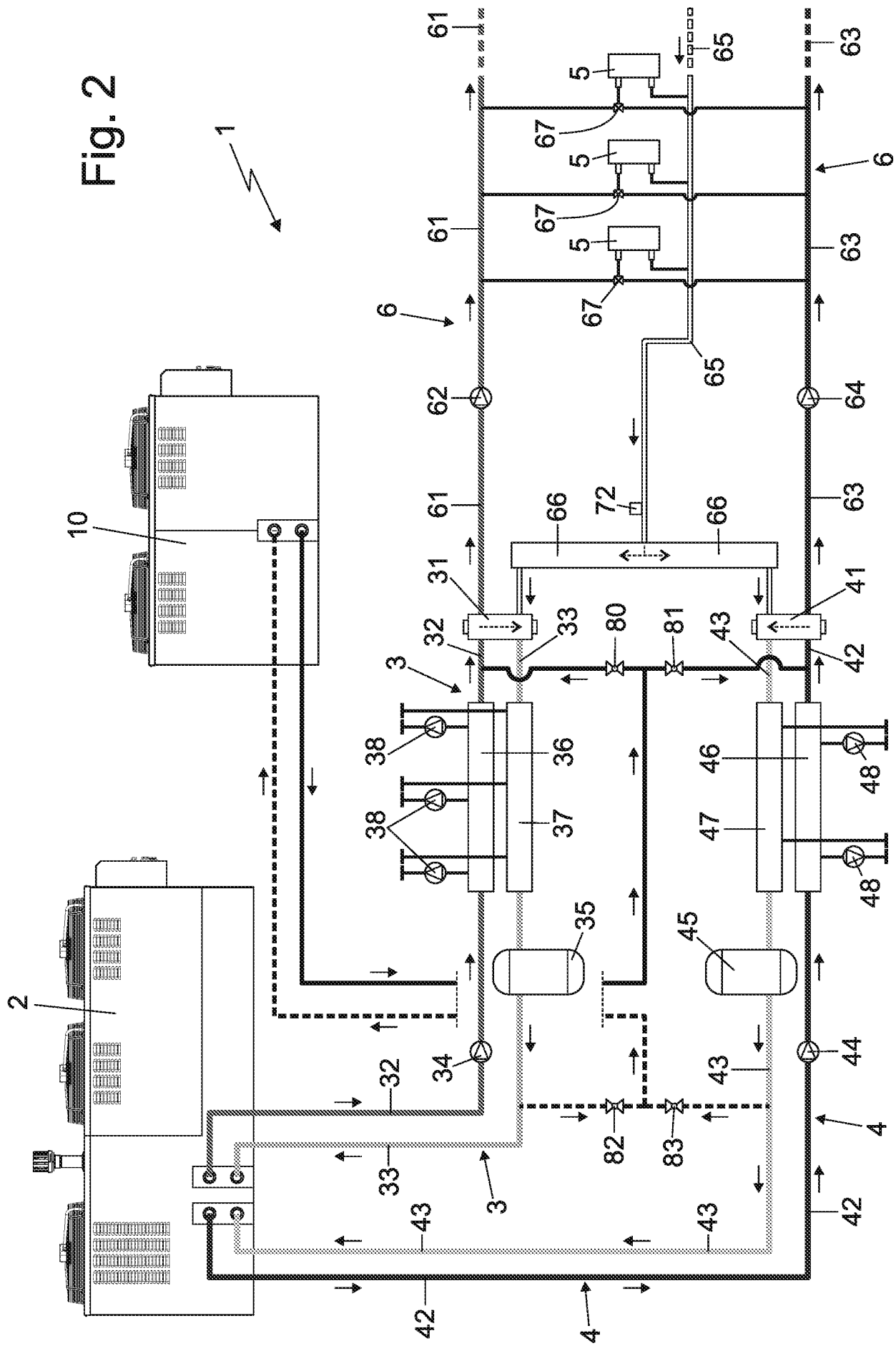


Fig. 3

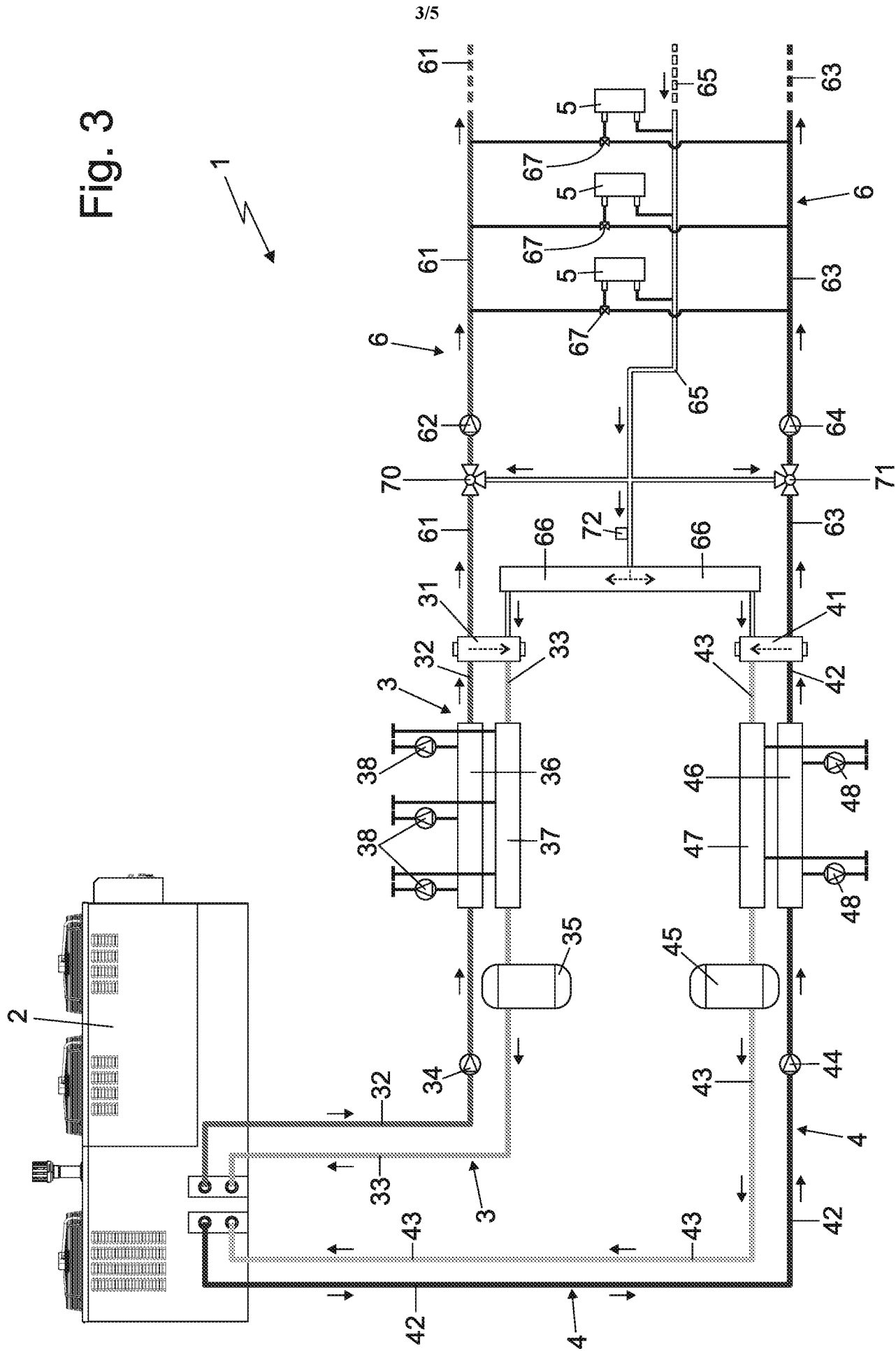
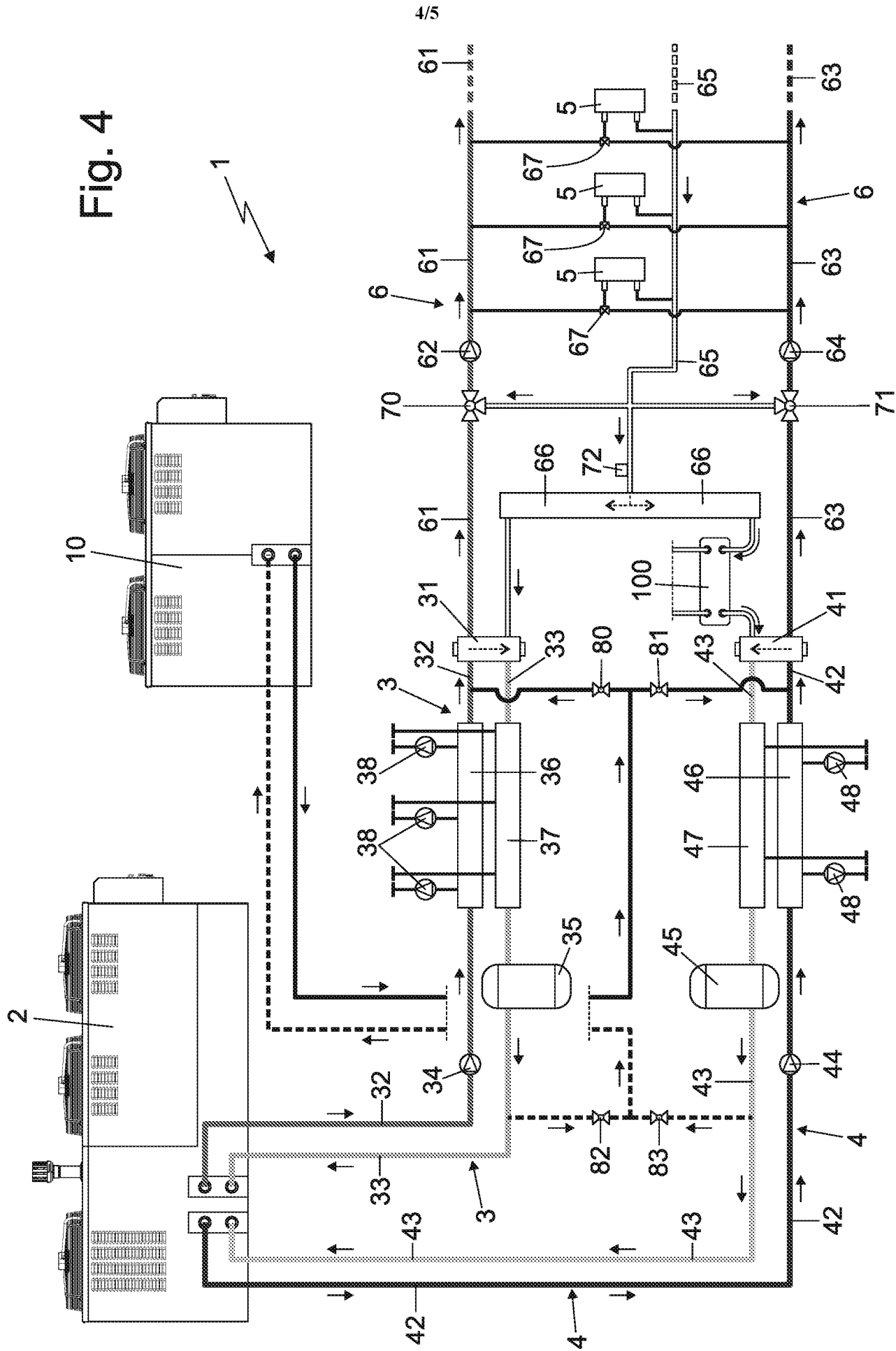
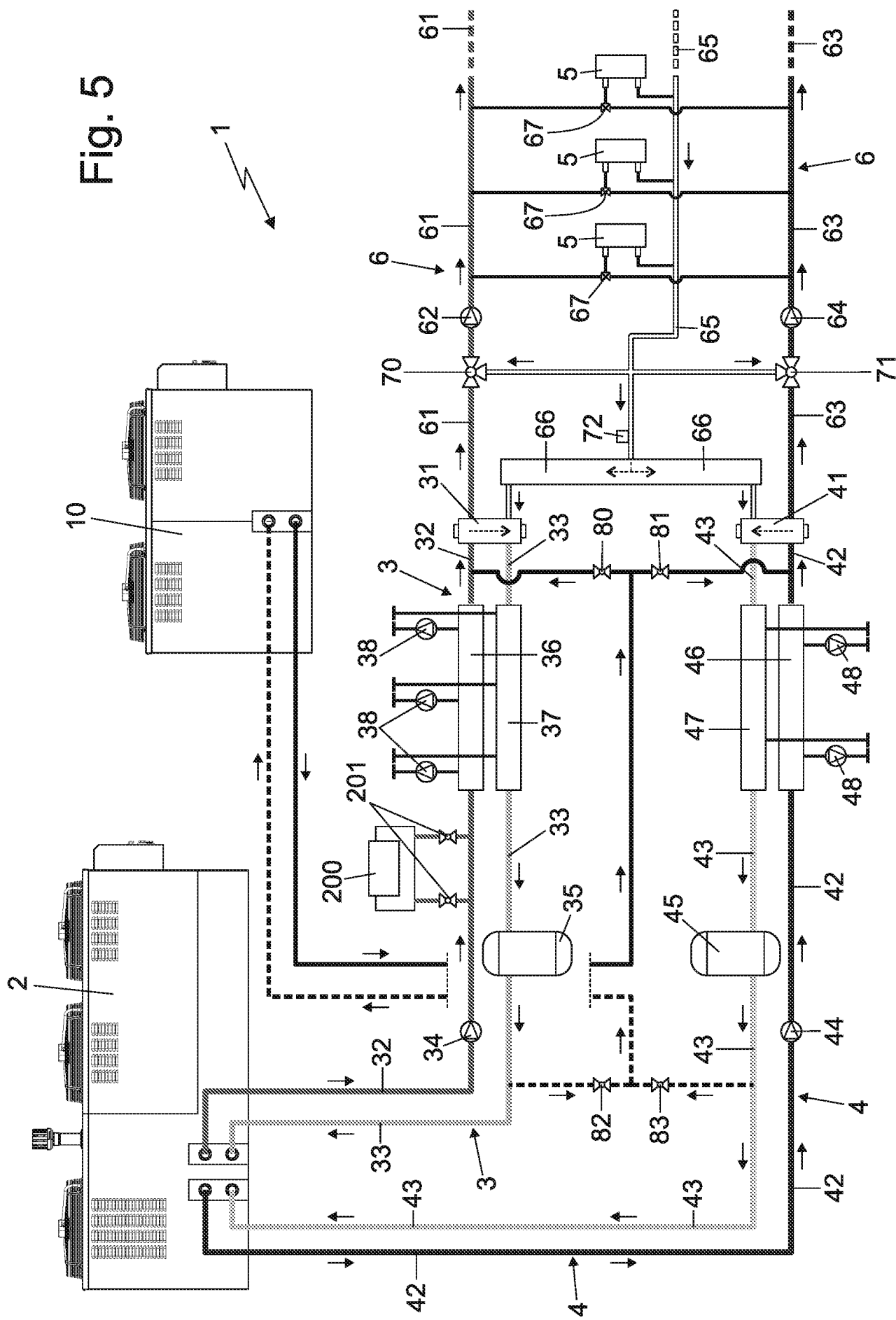


Fig. 4





INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2021/051422

A. CLASSIFICATION OF SUBJECT MATTER INV. F25B1/00 F25B25/00 F25B29/00 F25B49/02 F24F11/84 F24F3/10 ADD. According to International Patent Classification (IPC) or to both national classification and IPC																	
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) F25B F24F Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data																	
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Category*</th> <th style="width: 70%;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="width: 20%;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td style="vertical-align: top;"> WO 2014/009565 A1 (VAN DER HOFF MEINARDUS BERNARDUS ANTONIUS [NL]) 16 January 2014 (2014-01-16) cited in the application page 1; figures 1-3 </td> <td style="text-align: center; vertical-align: top;">1-5,9-17</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td style="vertical-align: top;"> ----- WO 2011/117712 A2 (REGOLA ENGINEERING SRL [IT]; BATTISTONI FRANCO [IT]) 29 September 2011 (2011-09-29) figure 1 </td> <td style="text-align: center; vertical-align: top;">6,7 8</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td style="vertical-align: top;"> ----- EP 0 985 891 A1 (SUPELLEX AG [CH]) 15 March 2000 (2000-03-15) paragraph [0022]; figure 2 </td> <td style="text-align: center; vertical-align: top;">1</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td style="vertical-align: top;"> ----- ----- -/- </td> <td style="text-align: center; vertical-align: top;">6,7</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	WO 2014/009565 A1 (VAN DER HOFF MEINARDUS BERNARDUS ANTONIUS [NL]) 16 January 2014 (2014-01-16) cited in the application page 1; figures 1-3	1-5,9-17	Y	----- WO 2011/117712 A2 (REGOLA ENGINEERING SRL [IT]; BATTISTONI FRANCO [IT]) 29 September 2011 (2011-09-29) figure 1	6,7 8	A	----- EP 0 985 891 A1 (SUPELLEX AG [CH]) 15 March 2000 (2000-03-15) paragraph [0022]; figure 2	1	Y	----- ----- -/-	6,7
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A	----- EP 0 985 891 A1 (SUPELLEX AG [CH]) 15 March 2000 (2000-03-15) paragraph [0022]; figure 2	1															
Y	----- ----- -/-	6,7															
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.																	
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family																	
Date of the actual completion of the international search 11 June 2021		Date of mailing of the international search report 22/06/2021															
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Schopfer, Georg															

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2021/051422

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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