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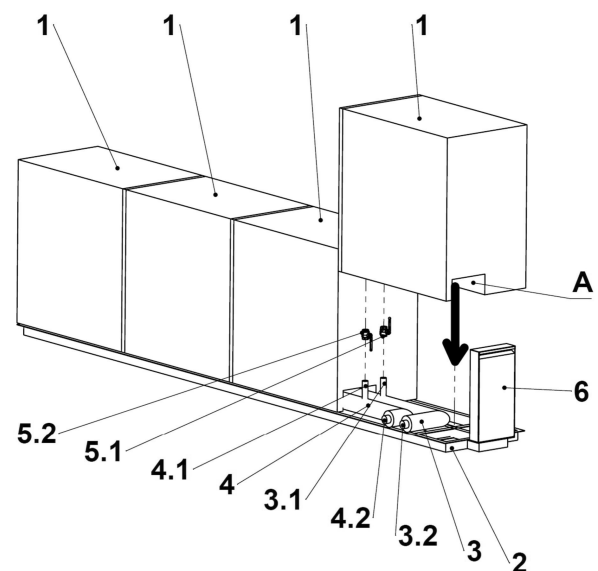
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(54) **MODULAR HEAT PUMP SYSTEM WITH THE POSSIBILITY OF ADDING AND/OR REMOVING MODULES WITHOUT INTERRUPTING SYSTEM OPERATION**

(57) The essential characteristic of the modular heat pump system with the possibility of adding and/or removing modules without interrupting system operation, which consists of several modules (1) according to the invention is in that each module (1) of the heat pump has a groove (A) made into its bottom surface, whereby all the modules (1), which are installed in the series in the system form a longitudinal flow channel into which all the required water and electrical installation is inserted, which enables the system to have a common function of operation and the appearance of a single modular heat pump of larger dimensions. Furthermore, essential characteristic of the system is also that its implementation enables a repair or replacement of the operation of a defective and excluded module (1) by adjusting or redistributing its heating or cooling power to other operating modules (1) by means of a main system electronic regulator (7). Its characteristic is also that it is possible to disconnect and remove each individual module (1) from the modular heat pump system without interrupting the operation of the remaining modules (1), which is enabled by a shut-off valve (5.1) and a non-return shut-off valve (5.2), which are installed into each individual module (1).



Description

The subject of the invention

[0001] The subject of the invention is a modular heat pump system with the possibility of adding and/or removing modules without interrupting system operation, whereby it is possible to add and/or remove modules without stopping and interrupting system operation and whereby each individual module represents a heat pump that can operate either independently or as a part of the entire modular heat pump system.

Technical problem

[0002] A technical problem solved by the present invention is such a construction of a modular heat pump system according to the present invention that will make any number of component modules possible, i.e. of heat pumps that are interconnected or integrated into one functional unit, which will operate as a device with single connections for water and electricity and which will make it possible to add or remove individual modules or heat pumps without stopping or interrupting heat pump system operation also in case of a defect of one module, i.e. of one heat pump.

Current state of the art

[0003] There are quite some modular heat pumps and modular coolers known that can be integrated into a modular system with greater heating or cooling power. Their components are prefabricated and they are usually inserted into the system on-site, where water and electrical connection to each module, i.e. to each heat pump, must be installed separately.

[0004] These known heat pumps are actually conventional heat pumps that are connected into a larger modular system at the installation site. Such systems basically do not include regulation to coordinate the operation of individual heat pumps, but this is usually left to system integrators, who usually do not have adequate knowledge about the composition and operation of such a system, nor do they have the possibility of adequately testing its operation. The weakness and deficiency of these known solutions is primarily in the artisanal production and assembly, and further in the delays and disruptions during each system upgrade or repair of a faulty heat pump. In case of a defect of one heat pump, also other heat pumps in the system do not operate and, consequently, the entire system does not work. The functionality of these known modular heat pumps or coolers is poorer and less reliable.

[0005] Based on the previously described known solutions of modular heat pumps, the problem of modern industrial production, assembly and installation of modular heat pump systems remains unsolved. Furthermore, the problem of mutual single connections for water and

electricity remains unsolved. Also, the problem of stopping and interrupting the system operation when building in additional modules or removing superfluous single modules, i.e. heat pumps from the system, which causes complete stopping of the system remains unsolved.

The description of the invention

[0006] Heat pumps are used for energy-efficient heating and cooling of buildings and rooms. The aim of their development is the need for more flexible modular heat pump systems enabling a simple production and assembly as well as simple maintenance, smooth upgrading and functional modularity. The structural design solution of the modular heat pump in the claimed system of the present invention enables all this with the possibility of easy addition of modules, heat pumps and their integration into a single system. The main aim of the invention is to enable the modules to be connected into a single modular system of heat pumps within the corresponding connection frame with an appropriate waterproof pipe and electrical assembly, which enables flexibility and uninterrupted operation of the entire system, even in case of a defect or any shutdown of a single module.

[0007] The modular heat pump system according to the invention is constructed from several independently operating modules or heat pumps, where each module includes all the necessary elements for independent operation of the system, including a compressor, a four-way valve, a heat exchanger - condenser, a heat exchanger - evaporator, a pump, a fan, an expansion valve, a water flow sensor and regulators of individual heat pumps or modules. Thereby modules are constructed in such a way that they are easily attached onto supporting, i.e. connection frame, which enables the factory connection into a single system of a single volume, without protruding pipes, connections or cables. The modular heat pump system is entirely assembled and tested in a factory and it is supplied as a prefabricated system to the installation location.

[0008] As previously mentioned, each module or each heat pump in the entire modular heat pump system includes all the key components necessary for its efficient operation, such as a compressor, a heat exchanger - condenser, a heat exchanger - evaporator, pumps, fans, expansion valves, a water flow sensor and a regulator. Modules are attached onto the connection frame, which includes water pipes for connecting modules into a larger unit and the electrical system for common power supply. The water pipe system is thermally insulated to reduce losses, and a valve system is also included for easy disconnection or connection of individual modules. The water and electrical pipes in the system enable integration of all the modules into one unit, which operates as a single device with single connections for water and electricity.

[0009] The modules are constructed to be easily attached onto the connection frame, which allows them to

be factory-connected into a prefabricated, single modular system of uniform volume, without protruding pipes, connections or cables. The heat pump, made up of modules, is assembled and tested at the factory and thus delivered prefabricated to the location of final installation.

[0010] The supporting structure, i.e a connection frame of the modular heat pump system consists of several key elements, such as a pipe assembly for water entry and exit, shut-off valves of individual modules and electrical cabinet for the distribution of power supply and communication cables.

[0011] The key feature of the construction of the modular heat pump system according to the present invention is a complete integration of the connection frame and the modules installed therein, as well as the pipe water and electricity system into a single volume, which is entirely produced and tested in the factory. Thus, the prefabricated modular heat pump operates as a single device with a single pipe and electricity connection, regardless of the number of modules in the system.

[0012] Each built-in module consists of a heat pump regulator with software ensuring safe, reliable and efficient operation of the module.

[0013] All modules within the modular heat pump system are connected with the main system regulator, which coordinates their operation in such a way that they function as a single device. The function of the main system regulator is to enable essential functionalities of the system modular heat pump, such as its maximum adaptability to the needs of the installation facility and its energy-efficient and maximum reliable operation.

[0014] In case of a defect of one of the heat pumps or heat modules operating within the modular system based on the air-water mode, the construction of the system is made in such a way that it enables continuous heating of the building. The air-water systems must, at certain temperatures of inlet air, periodically defrost the evaporator, which usually causes a temporary heating interruption. The described module design makes it possible that only one module or heat pump is defrosted at a time, whereas the remaining heat pumps perform heating without interruption. Thereby, the remaining operating modules or heat pumps temporarily increase their heating power and thus compensate for the loss of capacity of the module or heat pump that is in the phase of defrosting. In this way, in case of a defect of an individual module or heat pump, the remaining modules, heat pumps can continue to operate without interruption. Thereby the main system regulator automatically adjusts the operation of the remaining modules within the modular heat pump system so that they, with increased heating or cooling power, compensate for the module failure, which ensures uninterrupted operation of the system.

[0015] In the following, the modular heat pump system according to the invention will be more precisely described in connection with a feasibility example and figures, which shows as follows:

Fig. 1 schematic representation of a modular heat pump system composed of several individual modules, or heat pumps, installed in a sequential series, in projection

5 Fig. 2 schematic representation of the structure of individual modules or heat pumps and their mutual installation connection within the modular heat pump system

Fig. 3 schematic representation of the structure of an individual module, the heat pump

10 Fig. 4 schematic representation of the electrical cabinet execution

[0016] Thereby the reference numerals in the Figures indicate as follows:

- | | | |
|----|-----|----------------------------------|
| | A | groove |
| | 1 | module - heat pump |
| | 1.1 | compressor |
| | 1.2 | four-way valve |
| 20 | 1.3 | heat exchanger - condenser |
| | 1.4 | water flow sensor |
| | 1.5 | circulation pump |
| | 1.6 | heat exchanger - evaporator |
| 25 | 1.7 | fan |
| | 1.8 | electronic expansion valve |
| | 1.9 | electronic regulator |
| | 2 | connection frame |
| | 3 | inlet pipe |
| 30 | 3.1 | inlet connection |
| | 3.2 | inlet connection |
| | 4 | outlet pipe |
| | 4.1 | outlet connection |
| | 4.2 | outlet connection |
| 35 | 5.1 | shut-off valve |
| | 5.2 | non-return shut-off valve |
| | 6 | electrical cabinet |
| | 6.1 | power supply terminal blocks |
| | 6.2 | communication terminal blocks |
| 40 | 6.3 | electrical fuse |
| | 7 | main system electronic regulator |
| | 8 | electrical distribution cabinet |
| | 9 | power supply cable |
| | 10 | module power supply cables |
| 45 | 11 | power supply cable |
| | 12 | communication cable |
| | 13 | module communication cables |

50 **[0017]** The modular heat pump system according to the invention is formed from several independently operating modules 1, where each module represents an independent heat pump, which includes all the elements necessary for independent operation, including a compressor 1.1, a four-way valve 1.2, a heat exchanger - condenser 1.3, a heat exchanger - evaporator 1.6, a circulation pump 1.5, a fan 1.7, an electronic expansion valve 1.8, a water flow sensor 1.4 and an electronic regulator 1.9. The described is shown in Fig. 3.

[0018] As shown in Fig. 1, modules 1 essentially represent independent heat pumps that function in accordance with one of the systems air-water, water-water or ground-water and that are executed in such a way that they are easily attached onto a connection frame 2, which enables a factory connection of the modules 1 into a single system of a single volume, without protruding pipes, connections or cables. A completely factory-assembled and tested modular heat pump system of the selected volume is delivered to the installation location without additional interventions in the system.

[0019] It is also shown in Fig. 1 that each module 1 has pipe assembly comprising an inlet pipe 3 and an outlet pipe 4, which are thermally insulated water pipes to reduce heat losses in case of heating or cooling. These pipes, together with a non-return shut-off valve 5.2 enable uninterrupted water circulation between individual modules 1. A shut-off valve 5.1 enables shutting off of water circulation if that is necessary. The valves 5.1 and 5.2 are placed at each module 1 and on one side, they enable water circulation between modules 1 in the modular heat pump system, whereas, on the other side, they enable shutting off of water circulation and thereby disconnection of any individual module 1 from the system in case of its defect, whereby the remaining modules 1 continue operating without interruptions.

[0020] At the bottom of each module 1 or below it, an inlet connection 3.1 and an inlet connection 3.2 being connected with an inlet pipe 3, as well as outlet connections 4.1 and 4.2, which are connected with an outlet pipe 4, are attached to the connection frame 2.

[0021] At the bottom of each module 1, there is a groove A, whereby the grooves A s are placed successively so that they form a longitudinal channel, which runs along the entire set of modules 1 on the connection frame 2 and which is intended for inserting the entire pipe connection among modules 1 with electrical and water installations.

[0022] Each module 1 is placed onto the connection frame 2 in such a way that it rests on an inlet pipe 3 and outlet pipe 4 with corresponding inlet connections 3.1, 3.2 and outlet connections 4.1, 4.2, located below it.

[0023] The modular heat pump system can comprise any number of modules 1 placed along the connection frame 2, depending on the required capacity of heating and/or cooling of a building. At the head of the modules 1 set, an electrical cabinet 6 is attached to the connection frame 2 and represents the starting point for the distribution of power supply cables 9, 10, 11 and communication cables 12, 13 and which is described in more detail in the text that follows.

[0024] Furthermore, it is shown in Fig. 1 that in the modular heat pump system operating in the air-water mode, the pipe set of the inlet pipe 3 and of the outlet pipe 4 consists of two pipes in the sense of an inlet connection 3.1 and an outlet connection 4.1 for individual modules 1, and an inlet connection 3.2 and an outlet connection 4.2 for connecting the modular heat pump

system to the heating system of the building.

[0025] In the examples where module 1 or modular heat pump operates based on the system water-water or ground-water, the pipe set of the inlet pipe 3 and of the outlet pipe 4 includes four pipes with connections for connecting to the heating system of the building and the heating source, which can be the groundwater, warm industrial waste water or a mixture of water and antifreezing fluid. This is not shown in the figures.

[0026] As shown in Fig. 1 and Fig. 2 that a shut-off valve 5.1 and a non-return shut-off valve 5.2, placed at each module 1, enable disconnection of an individual module 1 in case of defect, whereby the remaining modules 1 continue operating without interruptions and standstills.

[0027] Fig. 4 shows the execution of an electrical cabinet 6 equipped with power supply terminal blocks 6.1 for powering the module power supply cable 10 of module 1 or modular heat pump, and equipped with communication terminal blocks 6.2 for a modular communication cable 13 for each individual module 1, and via communication cable 12, with the main system electronic regulator 7 shown in Fig. 2. The electrical fuses 6.3, built into electrical cabinet 6, are intended for protection of individual modules 1. Power supply cable 9, module power supply cable 10 and electrical distribution cabinet 8 are used to connect the electrical cabinet 6 with individual modules 1 to ensure their appropriate power supply, whereas the communication cables 12 and 13 are used for communication between the modules 1.

[0028] Each module 1 includes an electronic regulator 1.9 with dedicated software that ensures its safe, reliable and efficient operation. The described is shown in Fig. 3.

[0029] It is shown in Fig. 2 that all the modules 1 are connected with the main system electronic regulator 7, which coordinates their operation in such a way that they function as a single device. Thereby the main system electronic regulator 7 enables the following functionalities:

- maximum adjustability in a way that the modular heat pump system is adjusted to specific needs of the building as, depending on the actual heating or cooling needs, the number of active modules 1 within the system is increased or decreased,
- maximum efficiency in such a way that all the modules 1 within the system operate in a coordinated way in optimum operating points, which ensures energetically efficient operation of the modular heat pump,
- maximum reliability in such a way that the main system electronic regulator 7 ensures that all the modules 1 within the system are equally loaded as it ensures equal running hours for all modules 1, which increases their lifetime and system reliability.

[0030] In case of modular heat pump systems air-water, their implementation is specially adapted for continuous heating. At certain temperatures of incoming air, the systems air-water must periodically defrost the heat

exchanger - evaporator 1.6, which usually brings about temporary interruption of heating. The modular execution according to the present invention makes it possible to defrost only one module 1 at a time, whereas the remaining modules 1 continue the heating process without interruptions. Thereby the remaining modules 1 can temporarily increase their heating power and thus compensate for the loss of capacity of the module 1 that is in the defrosting phase. This is made possible by the main system electronic regulator 7.

[0031] A similar situation occurs in the case of defect of an individual module 1, where the remaining modules 1 can still continue to operate without interruptions, as the main system electronic regulator 7 automatically adjusts the operation of the remaining modules 1 so that they replace the defective module 1 by increased heating or cooling power to ensure uninterrupted operation of the system.

[0032] The modular heat pump system according to the invention operates in heating or cooling mode. Thereby the modular heat pump system consists of several identical modules 1. Each individual module 1 operates independently and in coordination with all other modules 1 in the modular heat pump, which means that all the modules 1 operate simultaneously with the same heating or cooling power. Each module 1 transfers heat to the water in an inlet pipe 3 and/or outlet pipe 4 on a connection frame 2. The regulation of module 1 or modular heat pump is carried out by the main system electronic regulator 7, which is communicatively connected to the electrical cabinet 6 via the main communication cable 12, and from there via the module communication cable 13 with each individual module 1. The regulation of an individual module 1 is carried out by the electronic regulator 1.9, which regulates the operation of the individual module 1 that belongs to it, whereas the main system electronic regulator 7 ensures coordinated operation of all modules 1 and, thereby, the regulation of the heating system.

[0033] To operate, the modular heat pump system with the main system electronic regulator 7 needs electrical energy, which it receives via power supply cable 11 and main power supply cable 9 from the electrical distribution cabinet 8 in the building.

[0034] Modules 1 operate in such a way that they use the heat from the surrounding air for heating rooms and for preparing hot sanitary water, whereas in case of reversed process, they can also cool the rooms. This is an energetically efficient system, which uses renewable sources of energy for its operation and enables significant savings in comparison with classical heating systems.

[0035] There are several ways of heating buildings or their spaces with the modular heat pump system according to the invention. One of them is to collect heat from the air, which can be converted into usable energy by modules 1 as the air contains sufficient heat also in case of low outside temperatures. Thereby a fan 1.7 directs external

air via heat exchanger - evaporator 1.6, which contains coolant that warms up and evaporates in contact with the heat from the air. For air flow, the fan 1.7 requires electrical energy, which is supplied to an individual module 1 via module power supply cable 10 from the electrical cabinet 6. Then vaporised coolant flows via four-way valve 1.2 into a compressor 1.1, where the pressure and temperature of the coolant significantly increase. The vaporised coolant flows via four-way valve 1.2 from the compressor 1.1 to a heat exchanger - condenser 1.3, where it cools and turns into liquid, whereby the warmth acquired in the heat exchanger - evaporator 1.6 is released, the warmth is further transferred to the water in the heating system circulated by a circulation pump 1.5. This hot water is then used to heat the building or provide hot sanitary water.

[0036] The cooled and liquidised coolant travels then through an electronic expansion valve 1.8, where pressure and temperature of the coolant are significantly reduced, afterwards the procedure starts again.

[0037] The previously described modules 1 in the modular heat pump system according to the invention can be used also for cooling. In the cooling mode, the process is the same as in the heating mode, with the difference that the coolant flows in the opposite direction. The coolant flow direction is reversed by switching the four-way valve 1.2.

[0038] The coolant of low pressure and temperature flows through the heat exchanger - condenser 1.3, which, in the cooling mode, acts as an evaporator, whereby the heat of the water is used to vaporise the coolant because of which the water gets cooler. The water flow through the heat exchanger 1.3 is ensured by a circulation pump 1.5, which, for its functioning, requires the supply of electrical energy, which comes to each individual module 1 through a power supply cable 11 from the electrical cabinet 6. The coolant vaporised in this way flows through a four-way valve 1.2 into the compressor 1.1, where the pressure and the temperature of the coolant increase significantly. From there, the coolant flows through the piping via four-way valve 1.2 to the heat exchanger - evaporator 1.6, which, in the cooling mode, acts as a condenser. In the heat exchanger 1.6, the heat is transferred to the air that is directed by a fan 1.7, whereby the coolant gets cooler and turns into liquid.

[0039] Then the chilled and liquified coolant travels through an electronic expansion valve 1.8, where the pressure and the temperature of the coolant decrease significantly and the process of cooling starts again.

[0040] In the normal mode of operation of the modular heat pump system according to the invention, either in the heating process or in the cooling process, all modules 1 operate parallelly and are coordinated and have the same heating or cooling power.

[0041] The characteristic of the modular heat pump system according to the invention is in the fact that it enables operation and ensures comfort with heating/-cooling also in case of one or more defective modules 1

within the system.

[0042] In case of a defect of one of the modules 1, the remaining modules 1 keep operating and they compensate for the loss of the heating or cooling capacity in such a way that the main system electronic regulator 7 redistributes the necessary capacities to the remaining operating modules 1.

[0043] The replacement of the defective module 1 is carried out in such a way that electrical fuses 6.3 of the defective module 1 are disconnected in order to interrupt its power supply.

[0044] Then a power supply cable 11 and module communication cable 13 are disconnected in the defective module 1. Furthermore, the shut-off valve 5.1 and the non-return shut-off valve 5.2 are closed. Water is released from the defective module 1 via discharge valves placed on the shut-off valve 5.1 and non-return shut-off valve 5.2. The module 1 is removed from the connection frame 2 and sent to repair, whereas the remaining modules 1 in the modular heat pump system according to the invention, despite the removed module 1, continue to operate without interruption.

[0045] The reinstallation of the repaired or new module 1 is carried out by placing it onto connection frame 2 and fixing it. Then, the inlet pipe 3 and outlet pipe 4 of water pipes are connected to the shut-off valve 5.1 and non-return shut-off valve 5.2. The shut-off valve 5.1 and non-return shut-off valve 5.2 are opened so that the inserted module 1 is filled with water. Afterwards the power supply cable 11 and module communication cable 13 are connected. In the electrical cabinet 6, electrical fuses 6.3 are turned on again in order to provide power supply of the inserted module 1. Then its software setting in the main system electronic regulator 7 is performed. After this procedure, the inserted module 1 operates as all the other modules 1. Full functionalities and heating and cooling capacities of the modular heat pump system according to the invention are established again.

Claims

1. The modular heat pump system with the possibility of adding and/or removing modules without interrupting the system operation consists of several modules (1), whereby each module (1) consists of a compressor (1.1), a four-way valve (1.2), a heat exchanger - condenser (1.3), a heat exchanger - evaporator (1.6), a circulation pump (1.5), a fan (1.7), an electronic expansion valve (1.8), water flow sensor (1.4) and an electronic regulator (1.9) with software for safe and efficient operation; the system includes also a joint inlet pipe (3) for supplying the heating/cooling medium and a joint outlet pipe (4) for discharging the heating/cooling medium; said system further includes an electrical set of an electrical cabinet (6), module power supply cables (10) and module communication cables (13) that enable a connection of

modules (1) into a single system and that are attached onto connection frame (2), **characterised in that** each module (1) in the modular heat pump system has a groove (A) in its bottom surface, whereby said grooves (A) of the modules (1) together in a set form a longitudinal flow channel into which all the necessary water and electrical installation is inserted, which enables the system to have the common operating function and the appearance of a single modular heat pump of larger dimensions; the water and electrical installation inserted within the longitudinal flow channel carried out of said grooves (A), consists of inlet pipe (3), inlet connections (3.1) and (3.2), outlet pipe (4), outlet connections (4.1) and (4.2), shut-off valve (5.1), non-return shut-off valve (5.2) and module communication cables (13), which are in this way integrated into a single volume of the system; that each module (1) has an electronic regulator (1.9) and is connected to a main system electronic regulator (7), which coordinates the operation of all modules (1), enabling continuous heating, reliability and optimal energy efficiency of the system.

2. The system according to Claim 1 **characterised in that** the shut-off valve (5.1) and the non-return shut-off valve (5.2), which are installed into each individual module (1), enable the disconnection of each individual module (1) from the modular heat pump system without interrupting the operation of the remaining modules (1).
3. The system according to one of Claims 1 or 2, **characterised in that** the pipe set of the inlet pipe (3) and outlet pipe (4) includes the non-return shut-off valve (5.2) to ensure a correct water circulation within the system.
4. The system according to Claim 1, **characterised in that** the modular heat pump system execution enables the replacement of operation of the defective module (1) excluded from operation by adjusting or redistributing its heating or cooling power to other operating modules (1) by means of the main system electronic regulator (7).

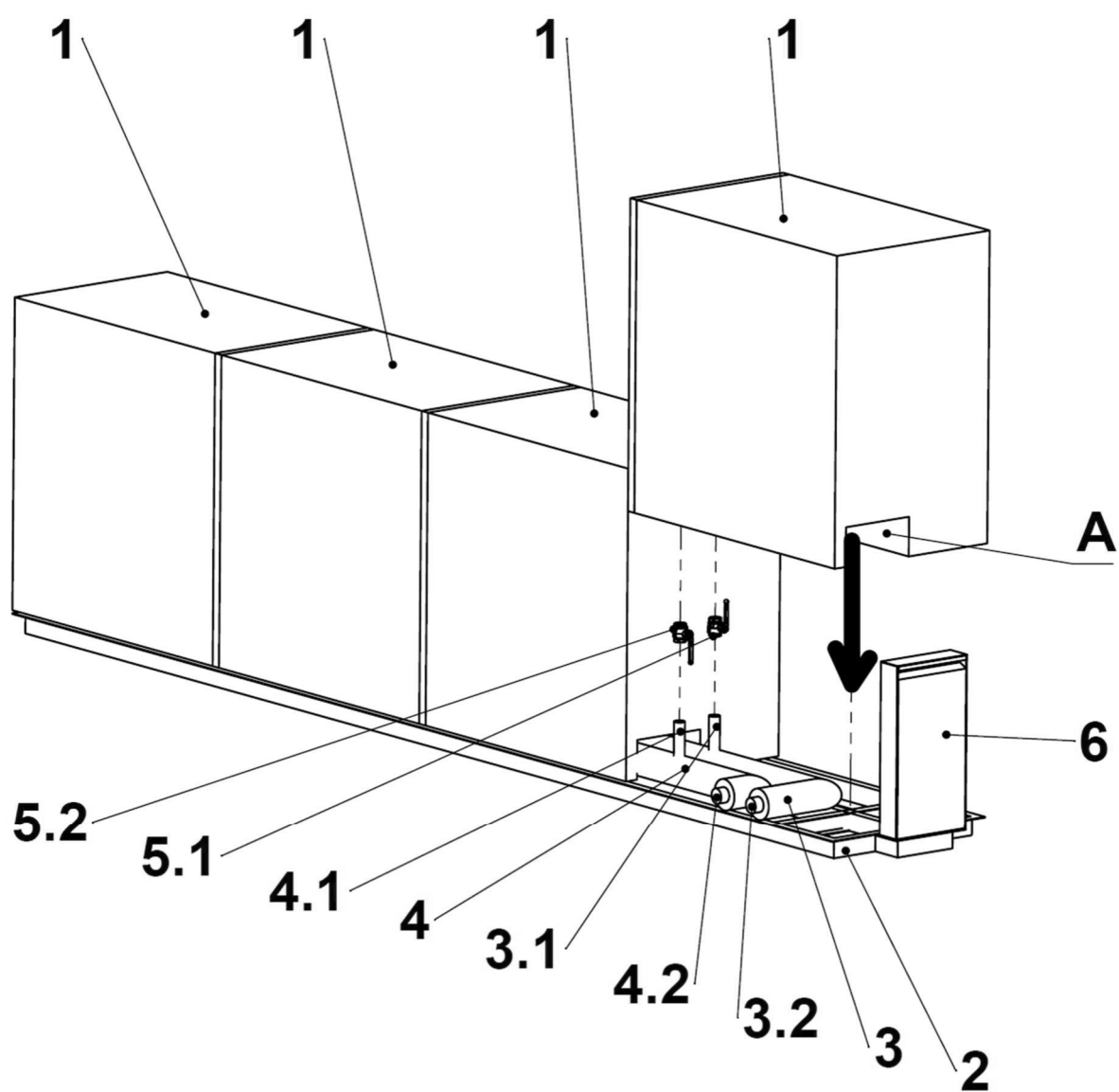


Fig. 1

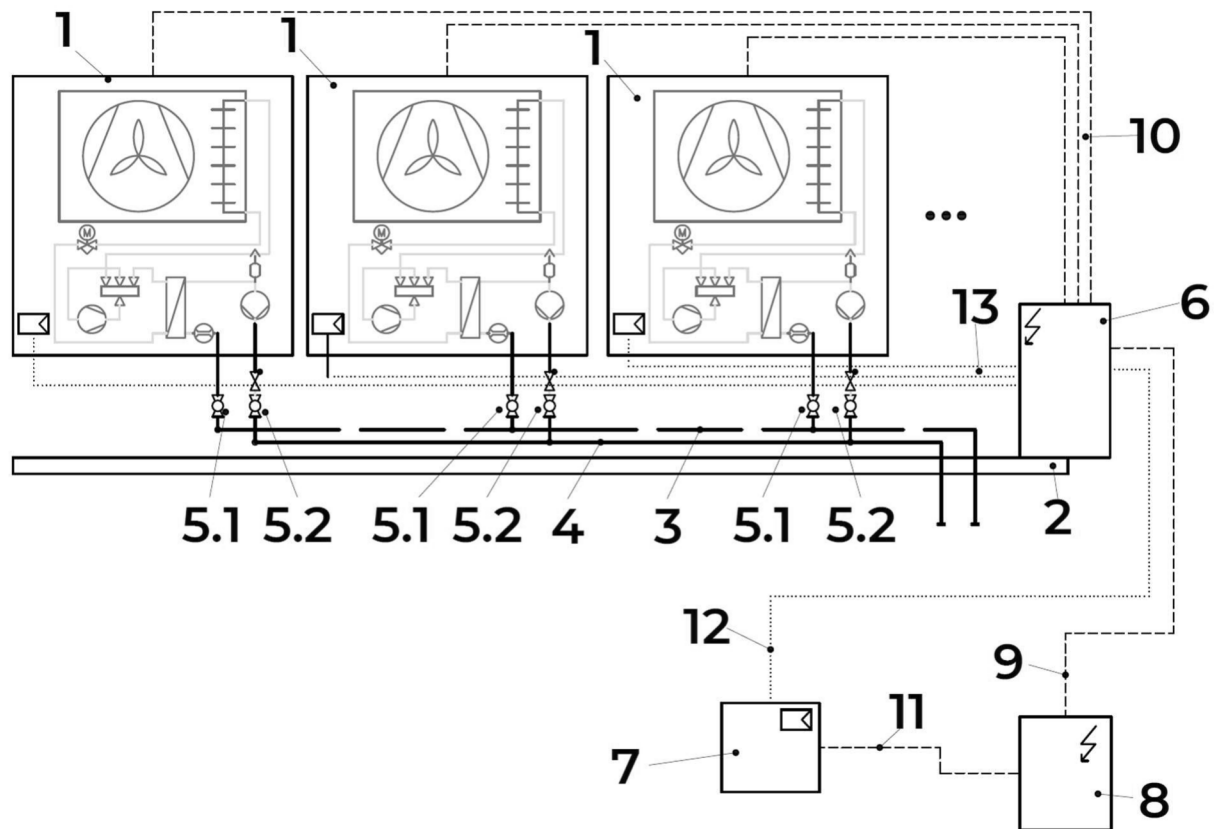


Fig. 2

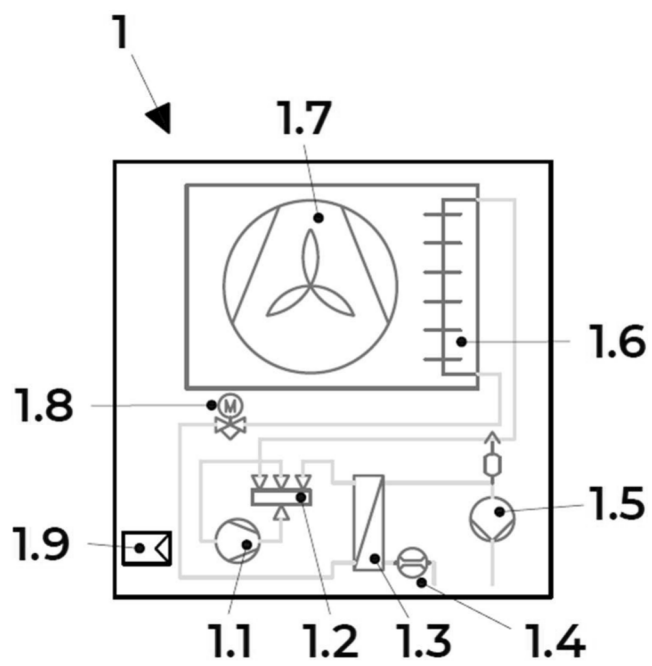


Fig. 3

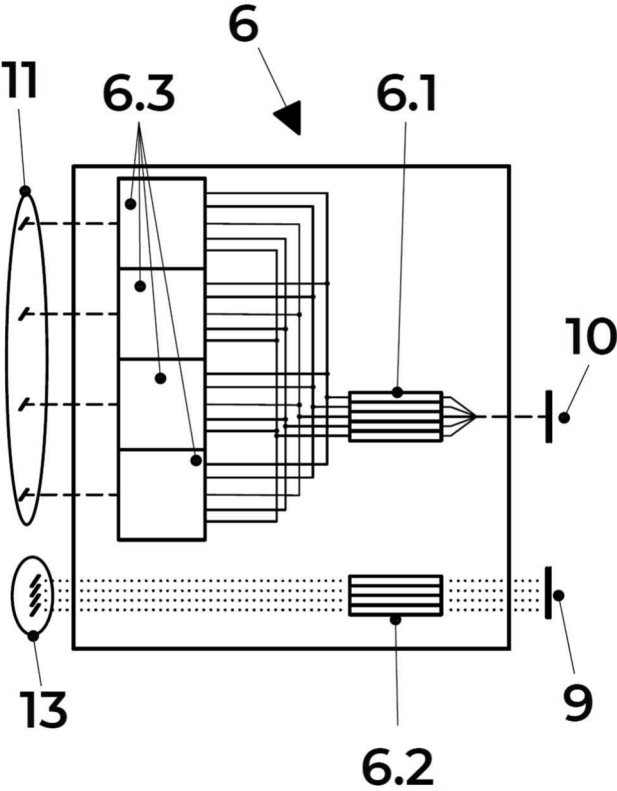


Fig. 4



EUROPEAN SEARCH REPORT

Application Number

EP 25 20 6514

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 11 015 854 B2 (JACOBI ROBERT W [US]) 25 May 2021 (2021-05-25) * column 2 - column 8; figures 1, 4, 21, 34 A, 34B *	1-4	INV. F24H4/02 F24F1/005 F24H9/02 F25B41/24
A	WO 2016/113871 A1 (MITSUBISHI ELECTRIC CORP [JP]) 21 July 2016 (2016-07-21) * the whole document *	1-4	
A	DE 20 2024 107216 U1 (OVUM HEIZTECHNIK GMBH [AT]) 3 January 2025 (2025-01-03) * the whole document *	1-4	
A	US 2023/358425 A1 (CLEMENZI RICHARD A [US] ET AL) 9 November 2023 (2023-11-09) * the whole document *	1-4	
A	DE 10 2016 115824 A1 (FUTRON GMBH [DE]) 1 March 2018 (2018-03-01) * the whole document *	1-4	
			TECHNICAL FIELDS SEARCHED (IPC)
			F24F F24H F25B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		26 February 2026	Riesen, Jörg
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
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EPO FORM 1503 03.82 (P34C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 25 20 6514

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26-02-2026

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 11015854 B2	25-05-2021	CA 3031935 A1	01-02-2018
		EP 3488162 A1	29-05-2019
		US 2018142935 A1	24-05-2018
		US 2018363969 A1	20-12-2018
		WO 2018022503 A1	01-02-2018

WO 2016113871 A1	21-07-2016	CN 207230769 U	13-04-2018
		JP 6250194 B2	20-12-2017
		JP WO2016113871 A1	15-06-2017
		WO 2016113871 A1	21-07-2016

DE 202024107216 U1	03-01-2025	AT 527730 A4	15-06-2025
		DE 202024107216 U1	03-01-2025

US 2023358425 A1	09-11-2023	AU 2021344408 A1	25-05-2023
		EP 4232754 A2	30-08-2023
		JP 2023543085 A	12-10-2023
		US 2023358425 A1	09-11-2023
		WO 2022060913 A2	24-03-2022
		ZA 202304414 B	30-05-2024

DE 102016115824 A1	01-03-2018	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82