(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 361 518 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.05.2024 Bulletin 2024/18

(21) Application number: **22204019.8**

(22) Date of filing: **27.10.2022**

(51) International Patent Classification (IPC):
F24F 13/20 *(2006.01)* ***F24H 4/02*** *(2022.01)*

(52) Cooperative Patent Classification (CPC):
F24F 11/36; F24F 13/20; F24H 4/02; F24H 15/12;
F25B 49/005

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **BDR Thermea Group B.V.**
7332 BD Apeldoorn (NL)

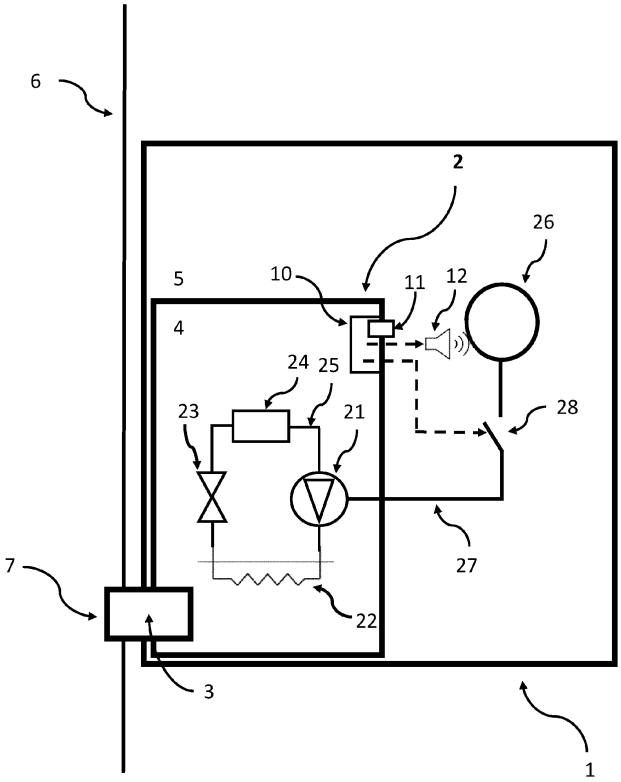
(72) Inventors:
- **BICHLER, Arnaud**
  7332 BD Apeldoorn (NL)
- **BOEHM, Jean-François**
  7332 BD Apeldoorn (NL)
- **ANTOINE, Florian**
  7332 BD Apeldoorn (NL)

(74) Representative: **Dennemeyer & Associates S.A.**
Postfach 70 04 25
81304 München (DE)

(54) ENCLOSURE FOR A HEAT PUMP

(57) The invention relates to an enclosure (2) for a heat pump (1), containing one or more heat pump components configured to carry a heat transfer fluid. The enclosure (2) is sealed and comprises a pressure reducer to reduce a pressure inside the enclosure to create a pressure difference between the inner space and the outer space of the enclosure. The enclosure (2) comprises a safety system (10) the safety system being configured to switch to an alarm state dependent on an indication of the pressure difference.

Fig. 1



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Description

[0001] The invention relates to an enclosure for a heat pump, the enclosure containing one or more heat pump components configured to carry a heat transfer fluid. The invention further relates to a heat pump comprising such an enclosure, a method of operating a heat pump and the use of such an enclosure, use of a flammable heat transfer fluid in such an enclosure or heat pump.

[0002] Heat pumps are used to provide warm water for heating purposes, cold water for cooling purposes, as well as for providing warm domestic water.

[0003] A heat pump comprises a heat exchanging circuit to extract heat calories from a source, such as external water, ambient air or the ground. The extracted calories are used to heat water. Different types of heat pumps are known based on the fluid used as source fluid and destination fluid. The more common fluids used are air and water, both for source and destination. Additionally, heat pumps are known in which the ground is used as source for extracting heat calories for heating the destination fluid.

[0004] The heat exchanging circuit typically comprises a compressor, a condenser, an expansion valve and an evaporator through which a heat transfer fluid is subsequently and repeatedly cycled to transfer heat from the source to the destination fluid. The condenser and the evaporator may be referred to as heat pump heat exchangers. The compressor, the condenser, the expansion valve and the evaporator are fluidly connected by means of refrigerant piping.

[0005] The heat transfer fluid is compressed and thereby heated by the compressor. From the compressor, the compressed and heated heat transfer fluid flows to the condenser to transfer heat to the destination fluid to be heated e.g. water. Next, the cooled down heat transfer fluid flows to the expansion valve, where the pressure is reduced, thereby further cooling the heat exchange fluid. The decompressed and cooled down heat exchange fluid then flows to the evaporator to be heated by the source fluid before it is returned to the compressor.

[0006] By reversing the process, heat pumps may also be used for cooling purposes.

[0007] Such heat transfer fluids may also be referred to as refrigerants.

[0008] According to the prior art, most of the refrigerants used were synthetic fluids. They had the advantage of being not flammable but had a significant impact on global warming. As such, legislation and regulation stimulate the use of natural heat transfer fluids, such as propane (R290). However, natural heat transfer fluids have the disadvantage of being flammable and therefore require additional precautions. In particular, leakage has to be prevented as much as possible to prevent ignition and explosion of the refrigerant. Leakage can easily result in an explosion, as sources of ignition (electrical elements, hot spots etc.) may be present nearby. It is therefore important to prevent leaks as much as possible.

[0009] The heat exchange fluid carrying heat pump components may be placed in a separate compartment which is sealed, for instance using a gasket, to prevent leaked heat exchange fluid to spread through the product where ignition sources may be present and through the room or building in which the heat pump is placed. Disadvantage of these solutions is that gaskets tend to deteriorate over time. A tight seal is therefore not guaranteed over the lifetime of the heat pump.

[0010] According to FR3070755, refrigeration components of the heat pump are positioned in a sealed box, which may be connected to the outside/outdoors to allow venting of the sealed box with the aid of a fan in case of a leak. In use, the box can be closed to prevent refrigerant leaking into the interior of the building in which the heat pump is positioned.

[0011] However, in case the fan malfunctions, leaked heat exchange fluid may leak through the sealed box, especially when the gaskets are deteriorated.

[0012] The object of the invention is therefore to provide a heat pump with improved safety.

[0013] The object is solved by an enclosure for a heat pump, the enclosure containing one or more heat pump components configured to carry a heat transfer fluid, wherein the enclosure is sealed and comprises a pressure reducer to reduce a pressure inside the enclosure to create a pressure difference between the inner space and the outer space of the enclosure, wherein the enclosure comprises a safety system, the safety system is configured to switch to an alarm state dependent on an indication of the pressure difference.

[0014] The safety system may be positioned in the inner space of the enclosure, in the outer space of the enclosure, or partially in the inner space and partially in the outer space of the enclosure.

[0015] The safety system may comprise a pressure sensor to obtain the indication of the pressure difference. The pressure sensor may be placed inside the enclosure or outside the enclosure. If positioned outside the enclosure, a connection may be provided to the inner space, e.g. by means of a small pipe. If positioned inside the enclosure, a connection may be provided to the outer space, e.g. by means of a small pipe.

[0016] The term sealed is used to indicate the enclosure is substantially air tight. Preferably, the enclosure is sealed with one or more gaskets. Alternatively, the enclosure can be sealed using compressed insulation foam.

[0017] The heat pump components configured to carry the heat transfer fluid may be selected from a first heat exchanger (evaporator in heating mode), a compressor, a second heat exchanger (condenser in heating mode) and an expansion valve. The heat pump components configured to carry the heat transfer fluid may further comprise refrigerant piping. The refrigerant piping is provided to fluidly connect the other heat pump components such that the heat transfer fluid can be subsequently and repeatedly cycled through the first heat exchanger (evap-

orator in heating mode), a compressor, a second heat exchanger (condenser in heating mode) and an expansion valve to transfer heat from the source to the water to be heated. By reversing the cycle, the heat pump can be used for cooling purposes.

[0018] By placing one or more heat pump components configured to carry a heat transfer fluid in a sealed enclosure, leakage of heat transfer fluid into the remainder of the heat pump, the room or building in which the heat pump is placed is prevented. Also, the pressure reducer ensures that in case of leakage, the leaked heat transfer fluid is vented, preferably to the outdoors. This also ensures that the applicable standards are respect during the lifetime of the product.

[0019] In addition, in case the pressure reducer malfunctions, this will be noticed by the safety system as the pressure difference will become less. Furthermore, in case the tightness of the enclosure is not sufficient, for instance by deterioration of the seals/gaskets, the pressure difference will decrease, resulting in a reduced pressure difference.

[0020] By switching to an alarm state it is ensured that action can be taken to prevent or reduce leaked heat transfer fluid from leaking into the room or building the heat pump is placed in.

[0021] The pressure reducer may be provided by a fan or a vacuum pump, configured to blow air out of the enclosure, preferably to the outdoors.

[0022] According to an embodiment switching to the alarm state comprises:

- switching off one or more of the heat pump components and/or
- generating an alarm signal.

[0023] Switching off one or more of the heat pump components, prevents further circulation of the heat transfer fluid and thereby minimizes further leakage, as the heat transfer fluid is no longer pushed through the heat pump components. Also, by switching off at least parts of the heat pump, the chance of explosions and the like is further reduced as ignition sources may also be switched off: switched off electrical elements are no longer activated, hence no electrical sparks are produced. Additionally, there is no more heat generation from the various electrical components, which could cause an explosion. The switching off one or more of the heat pump components can automatically occur. That means, no human action is necessary for shutting off one or more heat pump components.

[0024] The one or more heat pump components that are switched off may be inside the enclosure and/or outside the enclosure. According to an embodiment at least the compressor is switched off. Preferably, all heat pump components configured to carry a heat transfer fluid (refrigerant) are inside the enclosure and are switched off. It is noted that the pressure reducer is preferably not switched off to continue venting.

[0025] Alternatively, an alarm signal may be generated to alert users and/or maintenance personnel about the situation. According to an embodiment, both one or more of the heat pump components are switched off and an alarm signal is generated.

[0026] The safety system may switch to the alarm state when the pressure difference is below a predetermined threshold.

[0027] According to an embodiment the safety system comprises a pressure sensor to obtain an indication of the pressure difference and the safety system is configured to switch to the alarm state if the pressure difference is below a predetermined pressure threshold.

[0028] The term pressure sensor as used in this text covers any element that is sensitive to pressure (differences) or reacting to a change in pressure. The pressure sensor may be a sensor that actually measures pressure values, but may also be a pressure (differential) switch that functions as a switch based on an experienced pressure difference, examples of which are provided below. For the case the pressure sensor works as a pressure switch no control unit is necessary to interpret the measured value and to provide a control signal. Using a pressure switch enables that the switch to the alarm state is done by using only mechanical means.

[0029] The pressure sensor maybe a safety pressure differential sensor or pressure switch that automatically switches off one or more of the heat pump components and/or generates an alarm signal if the pressure difference is not sufficient, indicating a leak of the enclosure or a malfunctioning pressure reducer.

[0030] According to an embodiment the pressure sensor is configured to obtain a pressure measurement in the inner space of the enclosure and the indication of the pressure difference is the obtained pressure measurement. In this embodiment the safety system is configured to obtain an indication of the pressure difference by measuring the pressure in the inner space of the enclosure. This provides an indication of the pressure difference as the ambient pressure outside the enclosure is relatively constant, although depending on the altitude. For instance, at sea level the ambient pressure is typically 1000 hPa. According to this embodiment the predefined threshold could be determined based on the altitude of the installation site. The predefined threshold could be set at a value of 20 Pa to 100 Pa, in particular 40 Pa, below the defined or measured ambient pressure at the altitude. The ambient pressure can be measured and updated upon installation or when the pressure reducer is not working. For instance, at sea level the pressure inside the enclosure can be selected from the range 900 hPa - 960 hPa.

[0031] Selecting a lower value than mentioned in the above range is not advantageous as unnecessary for venting purposes and requiring a relatively strong, power-consuming pressure reducer. Selecting a higher value than mentioned in the above range would not be suitable for effective venting of the inner space of the enclosure,

given fluctuations in the ambient pressure.

[0032] It is possible to perform a measurement of the pressure without any pressure reduction in the enclosure. Said pressure corresponds to the ambient pressure. Thus, the measured pressure value can be used as a nominal value. The nominal value is used for the determination whether an alarm state is present. In particular, it can be determined whether the pressure difference between said nominal value and the pressure measured after a pressure reduction occurred is below the predefined threshold.

[0033] According to an embodiment the predefined pressure threshold is in the range of 20 Pa - 100 Pa, in particular 40 Pa. This pressure threshold is for an actual pressure difference.

[0034] Maintaining a bigger pressure difference between the inner space and the outer space of the enclosure is not required for venting purposes and would require a relatively strong, power-consuming pressure reducer. Maintaining a smaller pressure difference would not be suitable for effective venting of the inner space of the enclosure.

[0035] According to an embodiment the safety system comprises a pressure sensor that is exposed to the inner space of the enclosure and to the outer space of the enclosure. Such a pressure sensor could comprise two pressure sensors for obtaining a first and second pressure measurement inside and outside the enclosure, or maybe a pressure switch, such as a membrane pressure gauge, as will be described in more detail below.

[0036] This embodiment has the advantage that the actual pressure difference, or at least an indication thereof, is obtained, which makes it independent from fluctuations in the ambient pressure.

[0037] According to an embodiment the safety system comprises a pressure sensor, the pressure sensor comprising a first pressure sensor exposed to the inner space of the enclosure to obtain a first pressure measurement and a second pressure sensor exposed to the outer space of the enclosure to obtain a second pressure measurement and the indication of the pressure difference is a pressure difference between the first and the second pressure measurements.

[0038] These first and second pressure sensors may be positioned in the inner space or in the outer space. The first pressure sensor may be positioned in the inner space or in the outer space with a connection to the inner space, e.g. by means of a small pipe. The second pressure sensor may be positioned in the outer space or in the inner space with a connection to the outer space, e.g. by means of a small pipe.

[0039] According to an embodiment the safety system comprises a pressure sensor, the pressure sensor being a pressure switch or a membrane pressure gauge, which is with a first side exposed to the inner space of the enclosure and with a second side exposed to the outer space of the enclosure.

[0040] As the membrane of the membrane pressure gauge is flexible, it deflects inwards or outwards depending on the pressure difference between the inner space and the outer space of the enclosure.

[0041] The movement of the membrane may mechanically or electronically trigger the safety system to perform any of the selected actions (switching off or alarm). For instance, a lever or arm may be mechanically connected to the membrane which, by movement of the membrane, opens or closes a switch, e.g. power switch, when the predetermined threshold is reached.

[0042] According to an embodiment the safety system comprises a pressure switch, the pressure switch being

- configured to trigger the alarm state depending on the pressure or pressure difference the pressure switch is exposed to and/or
- electrically connected to a power supply of one or more of the heat pump components configured to carry the heat exchange fluid and/or
- electrically connected to an alarm output device.

[0043] The pressure switch may be positioned in series to a power supply of the heat pump or connected in series to a power supply of one or more of the heat pump components configured to carry the heat exchange fluid or to an alarm output device. When the pressure switch is activated, the power supply can be disconnected.

[0044] The electrical connection to the power supply or alarm output device may be accomplished by positioning the pressure switch in series in a power supply line or alarm output device. The power supply line being with one end connected to a power supply and with another end connected to one or more of the heat pump components configured to carry the heat exchange fluid. Alternatively, the pressure switch may be electrically connected to the power supply line or alarm output device line via a relais arrangement.

[0045] This is a reliable way to trigger the alarm state, as it doesn't rely on computer or electronical controls.

[0046] According to an embodiment the alarm signal is selected from: a warning light, an error code, a light signal, an acoustic signal, a message signal transmitted to a remote receiver.

[0047] This embodiment has the advantage that users or maintenance personnel is informed about the alarm state. Users or maintenance personnel are thus enabled to take action by repairing the pressure reducer and/or switching off the heat pump or one or more heat pump components. According to an embodiment, the safety system is arranged to first generate an alarm signal, wait a predetermined time interval and then switch off one or more of the heat pump components when the indication of the pressure difference is still below the predefined threshold.

[0048] According to an embodiment the heat transfer fluid is a flammable heat transfer fluid.

[0049] An example of a flammable heat transfer fluid is propane, butane and isobutane.

[0050] The term flammable is used with reference to the ASHRAE standards for refrigerants and EN 378-2, defining the following classes: 1, 2L, 2, or 3, ranging from no flame propagation to high flame propagation and high heat of combustion.

[0051] The term flammable is used to refer to refrigerants that are highly flammable, class 3, such as R290 (propane), R600 (butane) and R600a (isobutane). Class 3 refrigerants, when tested, exhibit flame propagation at 140°F (60°C) and 14.7 psi (101.3 kPa) and that either has a heat of combustion of 19,000 kJ/kg (8,174 BTU/lb) or greater or an LFL of 0.10 kg/m3 or lower.

[0052] The term flammable may also be used here to refer to refrigerants from class 2 (less flammable), such as R-152a or class 2L (mildly flammable) such as R-32, R-1234yf, R-1234ze.

[0053] According to a further aspect there is provided a heat pump for heating or cooling water, the heat pump comprising an enclosure, as described above.

[0054] The heat pump may be configured to produce hot domestic water generation and/or central heating. The heat pump may also be configured to produce cold water for cooling purposes.

[0055] The enclosure is part of the heat pump. In particular, the enclosure may be configured to be positioned inside a cabinet or housing of a heat pump. Some elements of the heat pump may be positioned outside the enclosure, but inside the cabinet or housing of the heat pump.

[0056] The heat pump components configured to carry the heat transfer fluid may be selected from a first heat exchanger (evaporator in heating mode), a compressor, a second heat exchanger (condenser in heating mode) and an expansion valve. The enclosure also comprises at least part of the refrigerant piping. According to an embodiment the enclosure contains all of the heat the heat pump components configured to carry the heat transfer fluid. In practice, this includes the at least two heat exchangers (condenser, evaporator), the compressor, the expansion valve and the refrigerant piping.

[0057] By having some or all the heat pump components in the enclosure, the risk of leakages is significantly reduced, as none of the heat transfer fluid carrying heat pump components are accessible by users or maintenance personnel.

[0058] According to an alternative, some of the heat transfer fluid carrying heat pump components may be positioned outside of the enclosure. These components may for instance be components that can be maintained relatively easily without a significant risk of errors and leaks. The heat transfer fluid carrying heat pump components positioned outside the enclosure maybe inside a cabinet or housing of the heat pump, the cabinet or housing containing the enclosure. Alternatively, some heat transfer fluid carrying heat pump components outside the enclosure may be positioned on a remote location, such as outdoors (in the open air), where leaks are less risky. In particular one of the heat exchangers may be positioned outdoors.

[0059] According to an embodiment the heat pump is configured to be located inside a building, wherein the heat pump comprises an outlet for the pressure reducer, the outlet being configured to discharge air from the inner space of the enclosure to the outside of the building.

[0060] This ensures that possibly flammable leaked heat transfer liquid is discharged to the outdoors, where it causes least risks in terms of explosions.

[0061] According to an embodiment the heat pump carries or is arranged to carry a flammable heat transfer fluid.

[0062] The flammable heat transfer fluid may be propane or in general a class 3 (highly flammable) heat transfer fluid. Further it may refer to a class 2 (less flammable), or a class 2L (mildly flammable) heat transfer fluid as described in more detail above.

[0063] According to a further aspect there is provided a method of operating a heat pump according to the above, wherein the method comprises

- obtaining an indication of the pressure difference,
- deciding to switch to an alarm state or not dependent on the indication of the pressure difference.

[0064] The method may further comprise controlling the heat pump components in accordance with a heat or cold request and/or controlling the pressure reducer to create a pressure difference between the inner space and the outer space of the enclosure.

[0065] Switching to the alarm state may comprise switching to a safe mode of operation, switching off one or more or all of the heat pump components and/or generating an alarm signal, such as a noise, a light and/or a message. The alarm signal may be produced on the heat pump and/or on a different remote device such as a computer, telephone, control unit etc. Switching to the alarm state is decided when the indication of the pressure difference is below a predefined threshold.

[0066] The invention further relates to use of an enclosure according to the above, in a heat pump according to the above or use of a flammable heat transfer fluid in an enclosure according to the above in a heat pump according to the above.

[0067] In the figures, the subject-matter of the invention is schematically shown, wherein identical or similarly acting elements are usually provided with the same reference signs:

Figure 1	schematically shows an embodiment of a heat pump comprising an enclosure,
Figure 2	schematically shows a perspective view of a heat pump according to an embodiment,
Figure 3	schematically shows the internals of the enclosure according to an embodiment,
Figures 4	schematically shows a perspective view of the enclosure.

[0068] Fig. 1 schematically shows an enclosure 2 for

a heat pump 1. The enclosure 2 contains one or more heat pump components configured to carry a heat transfer fluid. Fig. 1 schematically depicts a first heat exchanger 24 (evaporator in heating mode), a compressor 21, a second heat exchanger 22 (condenser in heating mode) and an expansion valve 23, which are fluidly connected by means of refrigerant piping 25.

[0069] The heat pump 1 has a housing and the enclosure 2 is positioned inside the housing of the heat pump 1.

[0070] The heat pump components configured to carry the heat transfer fluid may further comprise refrigerant piping 25. The refrigerant piping 25 is provided to fluidly connect the heat pump components such that the heat transfer fluid can be subsequently and repeatedly cycled through the heat pump components 21, 22, 23, 24.

[0071] The enclosure 2 is sealed to make the enclosure substantially airtight. The enclosure 2 comprises a pressure reducer 3, for instance a fan, configured to reduce a pressure inside the enclosure. The air removed from the enclosure 2 is preferably discharged to the outdoors, i.e. outside of the building in which the heat pump 1 is located. The pressure reducer hereby creates a pressure difference between the inner space 4 and the outer space 5 of the enclosure 2. The enclosure 2 comprises a safety system 10, which may be positioned inside, outside or partially inside and outside the inner space. The safety system 10 is configured to switch to an alarm state dependent on an indication of the pressure difference.

[0072] The alarm state may be switching off one or more of the heat pump components. Fig. 1 shows compressor 21 being connected to a power supply 26 via power supply line 27. Further shown is power switch 28 being positioned in series with the power supply line 27. The safety system 10 is configured to switch to the alarm state by opening power switch 28 thereby interrupting the power supply to the compressor 21. Fig. 1 shows only compressor 21 being connected to the power supply 26, but it will be understood that other heat pump components may also be connected to the power supply 26.

[0073] Fig. 1 further schematically shows a pressure sensor 11 that is exposed to the inner space 4 of the enclosure 2 and to the outer space 5 of the enclosure 2.

[0074] The pressure sensor 11 may comprise a first pressure sensor positioned inside the enclosure 2 to obtain a first pressure measurement and a second pressure sensor positioned outside the enclosure 2 to obtain a second pressure measurement. The first and second pressure sensors are not shown in Fig. 1.

[0075] The alarm state may further be generating an alarm signal, such as a warning light, an error code, a light signal, an acoustic signal, a message signal transmitted to a remote receiver. There may be provided an alarm output device 12 for generating such an alarm signal. Fig. 1 schematically depicts an example of such an alarm output device 12 provided by a speaker for generating an acoustic signal. The alarm output device is preferably positioned outside the enclosure 2.

[0076] The heat pump 1 with enclosure 2 may be located inside a building. Fig. 1 schematically shows a wall 6 of the building. An outlet 7 of the pressure reducer is positioned outside of the building, such that air or gas from the inner space of the enclosure 2 can be discharged to the outside of the building. This ensures that possibly flammable leaked heat transfer liquid is discharged to the outdoors, where it causes least risks in terms of explosions.

[0077] Fig. 2 schematically depicts a perspective view of a heat pump 1.

[0078] Fig. 3 schematically depicts the internals of a heat pump 1 as shown in Fig. 1, comprising the enclosure 2.

[0079] Fig. 4 schematically depicts the internals of the enclosure, showing the heat pump components configured to carry a heat transfer fluid: first heat exchanger 24 (evaporator in heating mode), a compressor 21, a second heat exchanger 22 (condenser in heating mode) and an expansion valve 23, which are fluidly connected by means of refrigerant piping 25. Fig. 4 further depicts safety system 10.

[0080] Fig. 5 shows a perspective view of the enclosure 2 showing the pressure reducer 3 provided by a fan.

[0081] The depicted embodiments are configured to operate the heat pump 1 by controlling the heat pump components in accordance with a heat or cold request. The method may further comprise controlling the pressure reducer 3 to create a pressure difference between the inner space 4 and the outer space 5 of the enclosure 2. Furthermore, the operation of the heat pump comprises

a) obtaining an indication of the pressure difference, by means of the pressure sensor 11 of the safety system, and
b) deciding to switch to an alarm state or not dependent on the indication of the pressure difference.

[0082] The heat pump may comprise one or more controllers to provide the heat pump 1 with the functionality to perform the above. The one or more controllers may be dedicated hardware devices or computers programmed to perform the above. In particular, actions a) and b) may be performed by a controller provided as part of the safety system 10.

Reference Signs

[0083]

1. Heat pump
2. Enclosure
3. Pressure reducer
4. Inner space of enclosure
5. Outer space of enclosure
6. Wall
7. Outlet pressure reducer
10. Safety system

11. Pressure sensor
12. Alarm output device
21. Compressor
22. Second heat exchanger
23. Expansion valve
24. First heat exchanger
25. Refrigerant piping
26. Power supply
27. Power supply line
28. Power switch

Claims

1. Enclosure (2) for a heat pump (1), the enclosure (2) containing one or more heat pump components configured to carry a heat transfer fluid, wherein the enclosure (2) is sealed and comprises a pressure reducer (3) to reduce a pressure inside the enclosure (2) to create a pressure difference between the inner space (4) and the outer space (5) of the enclosure (2), wherein the enclosure (2) comprises a safety system (10), the safety system (10) is configured to switch to an alarm state dependent on an indication of the pressure difference.

2. Enclosure (2) according to claim 1, wherein switching to the alarm state comprises:

- switching off one or more of the heat pump components and/or
- generating an alarm signal.

3. Enclosure (2) according to any one of the preceding claims, wherein the safety system (10) comprises a pressure sensor (11) to obtain an indication of the pressure difference and the safety system (10) is configured to switch to the alarm state if the pressure difference is below a predetermined pressure threshold.

4. Enclosure (2) according to claim 3, wherein the predetermined pressure threshold is in the range of 20 Pa - 100 Pa.

5. Enclosure (2) according to any one of the preceding claims, wherein the safety system (10) comprises a pressure sensor (11) that is exposed to the inner space (4) of the enclosure (2) and to the outer space (5) of the enclosure (2).

6. Enclosure (2) according to any one of the preceding claims, wherein the safety system (10) comprises a pressure sensor (11), the pressure sensor (11) comprising a first pressure sensor exposed to the inner space (4) of the enclosure (2) to obtain a first pressure measurement and a second pressure sensor exposed to the outer space (5) of the enclosure (2) to obtain a second pressure measurement and the indication of the pressure difference is a pressure difference between the first and the second pressure measurements.

7. Enclosure (2) according to any one of the preceding claims, wherein the safety system (10) comprises a pressure sensor (11), the pressure sensor (11) being a pressure switch or a membrane pressure gauge, which is with a first side exposed to the inner space (4) of the enclosure (2) and with a second side exposed to the outer space (5) of the enclosure (2).

8. Enclosure (2) according to any one of the preceding claims, wherein the safety system (10) comprises a pressure switch, the pressure switch being

- configured to trigger the alarm state depending on the pressure or pressure difference the pressure switch is exposed to and/or
- electrically connected to a power supply (26) of one or more of the heat pump components configured to carry the heat exchange fluid and/or
- electrically connected to an alarm output device (12).

9. Enclosure (2) according to any one of the preceding claims, wherein the alarm signal is selected from: a warning light, an error code, a light signal, an acoustic signal, a message signal transmitted to a remote receiver.

10. Enclosure (2) according to any one of the preceding claims, wherein the heat transfer fluid is a flammable heat transfer fluid.

11. Heat pump (1) for heating or cooling water, the heat pump (1) comprising an enclosure (2) according to any one of the claims 1 - 10.

12. Heat pump (1) according to claim 11, wherein the heat pump (1) is configured to be located inside a building, wherein the heat pump (1) comprises an outlet (7) for the pressure reducer (3), the outlet (7) being configured to discharge air from the inner space (4) of the enclosure (2) to the outside of the building.

13. Heat pump (1) according to any one of the claims 11 - 12, wherein the heat pump (1) carries or is arranged to carry a flammable heat transfer fluid.

14. Method of operating a heat pump (1) according to any one of the claims 11 - 13, wherein the method comprises:

- obtaining an indication of the pressure differ-

ence,
- deciding to switch to an alarm state or not dependent on the indication of the pressure difference.

15. Use of an enclosure (20) according to any one of the claims 1 - 10 in a heat pump (1) according to any one of the claims 11 - 14 or use of a flammable heat transfer fluid in an enclosure (2) according to any one of the claims 1 - 10 or in a heat pump (1) according to any one of the claims 11 - 14.

Fig. 1

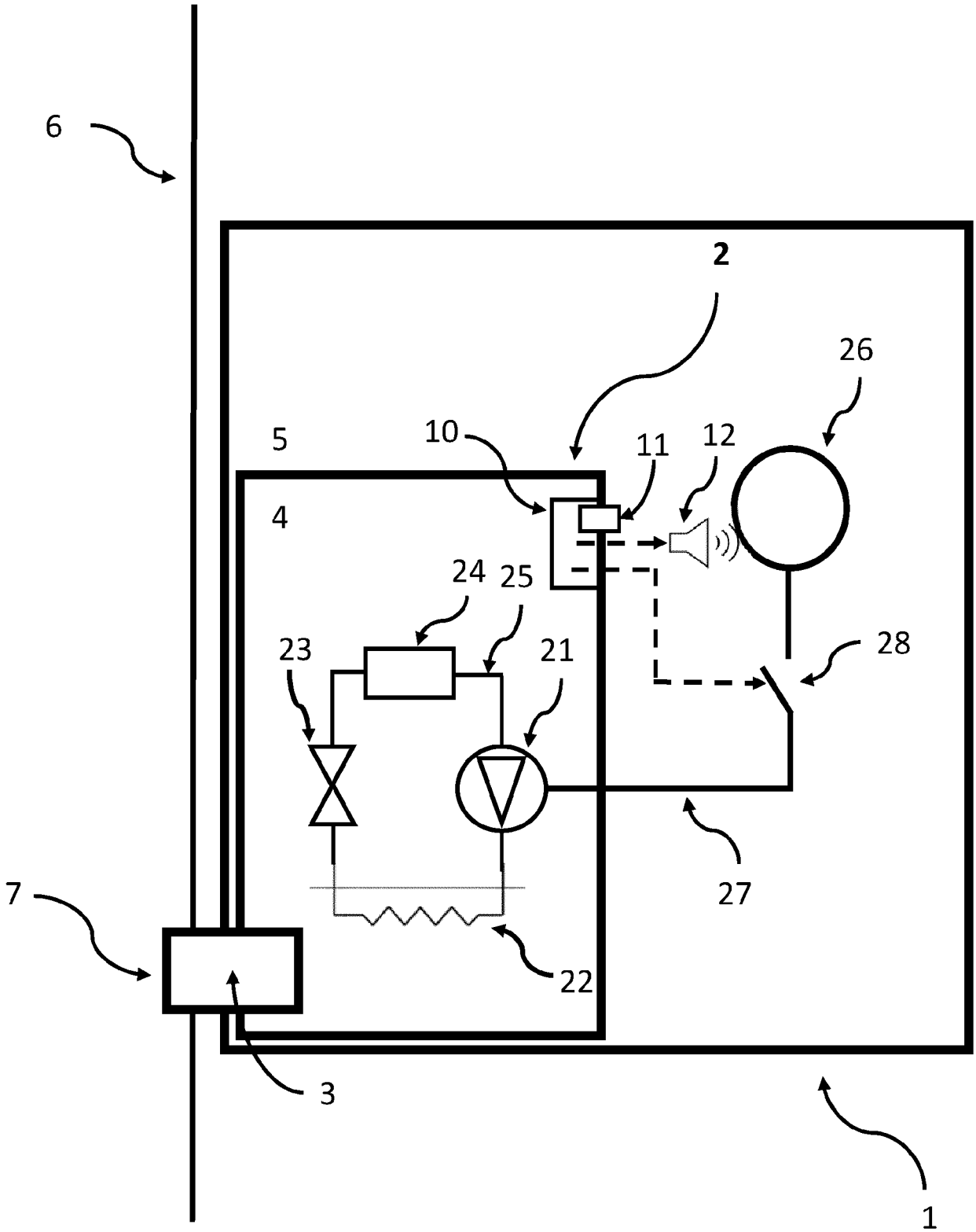


Fig. 2

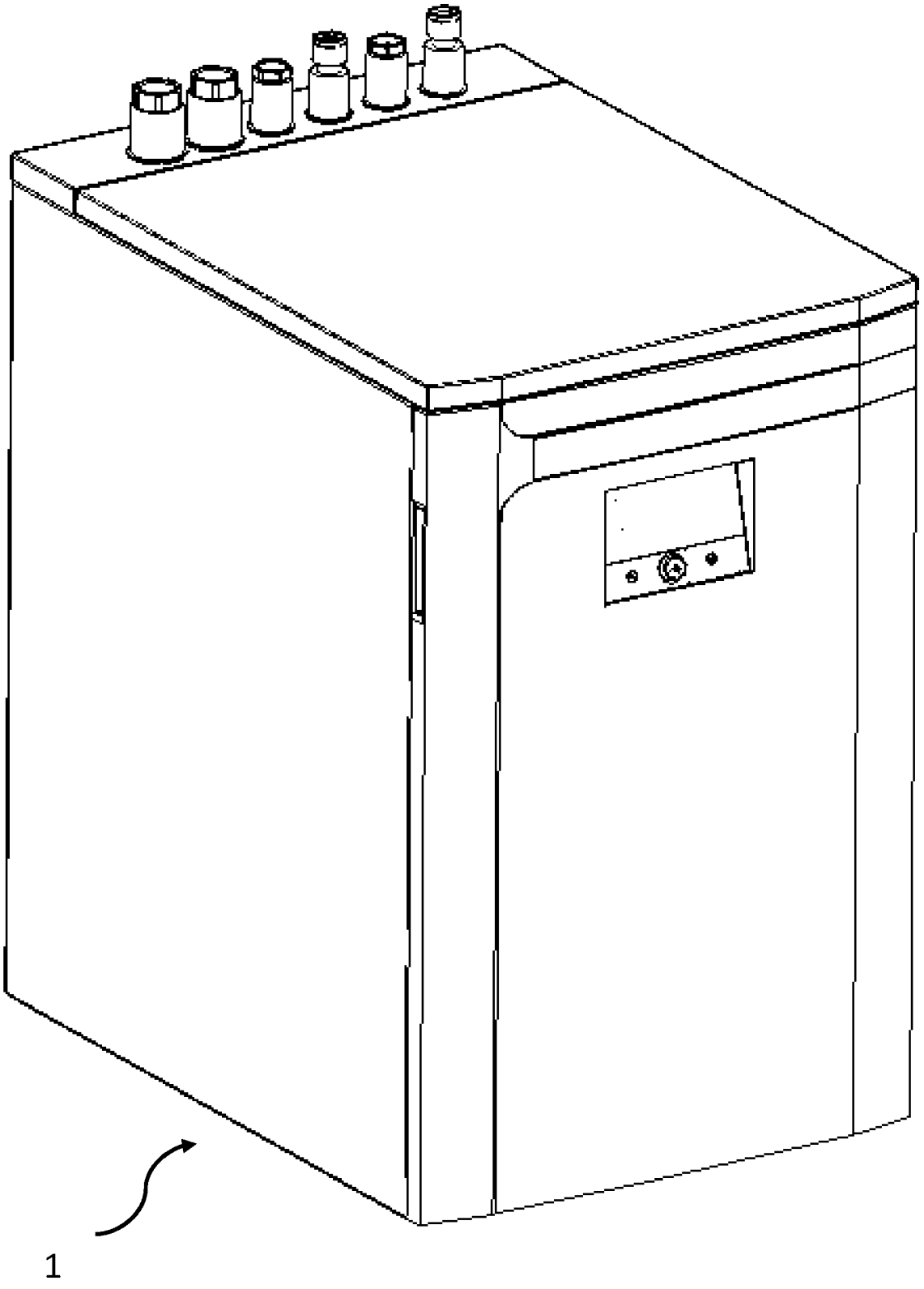


Fig. 3

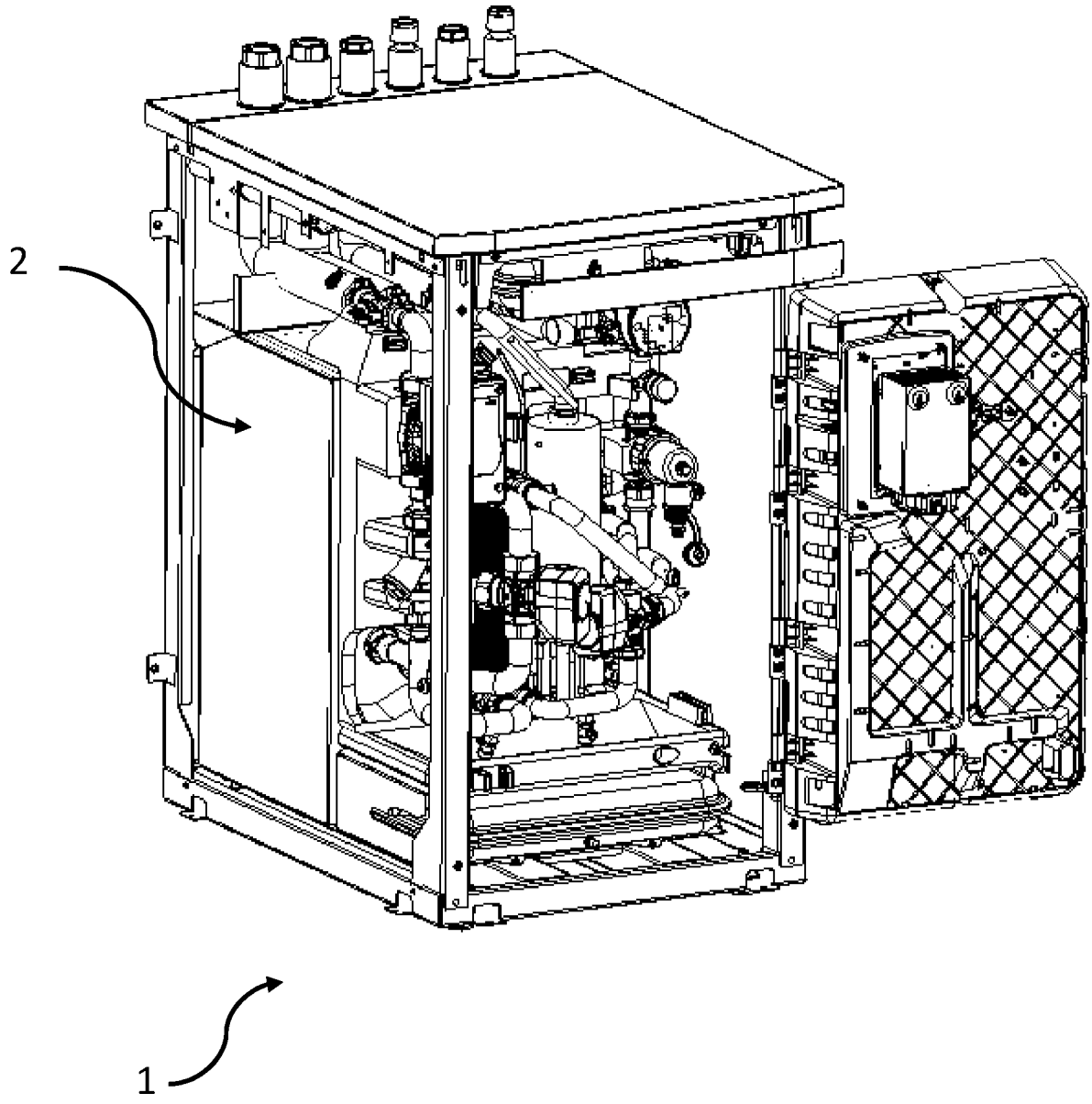


Fig. 4

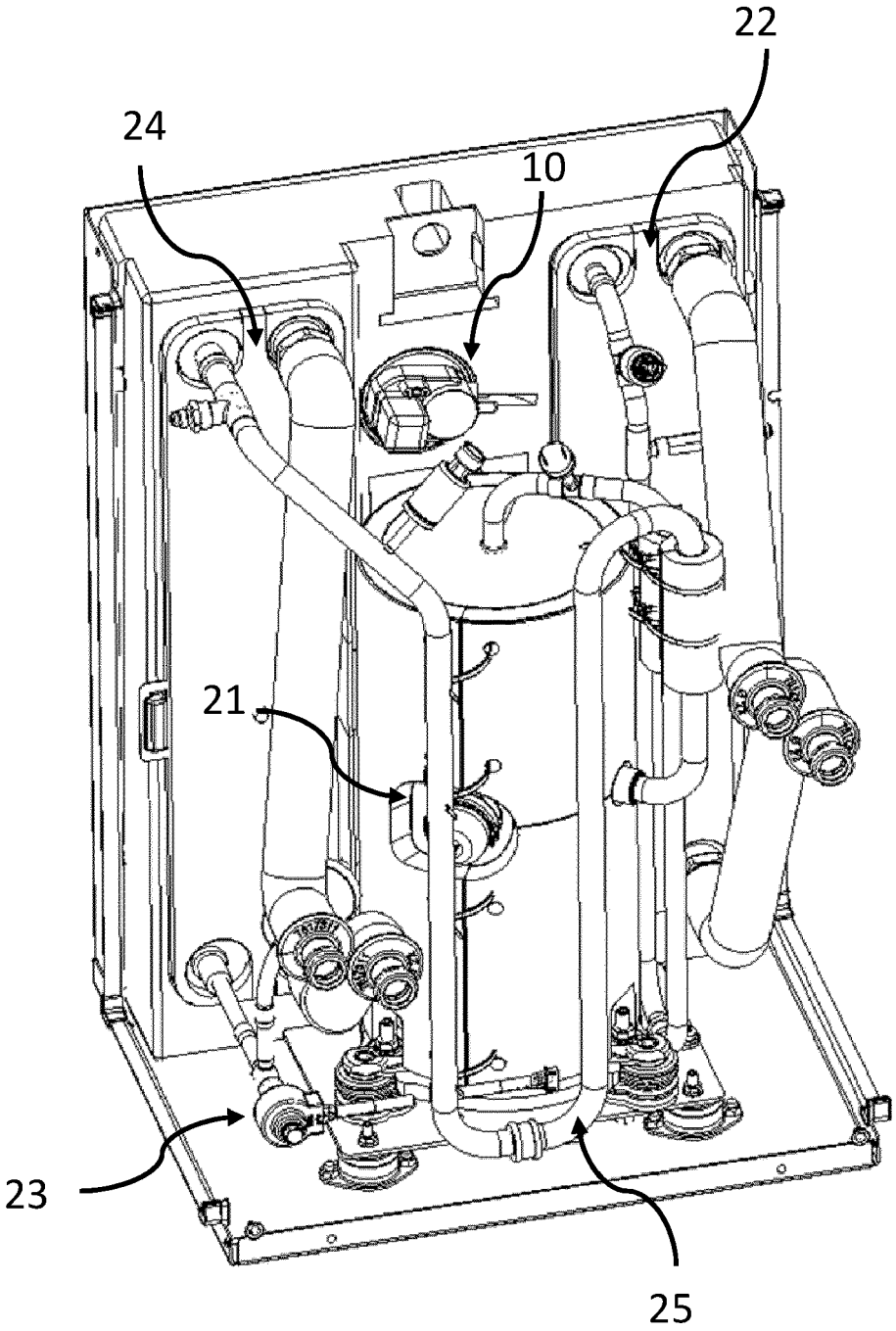
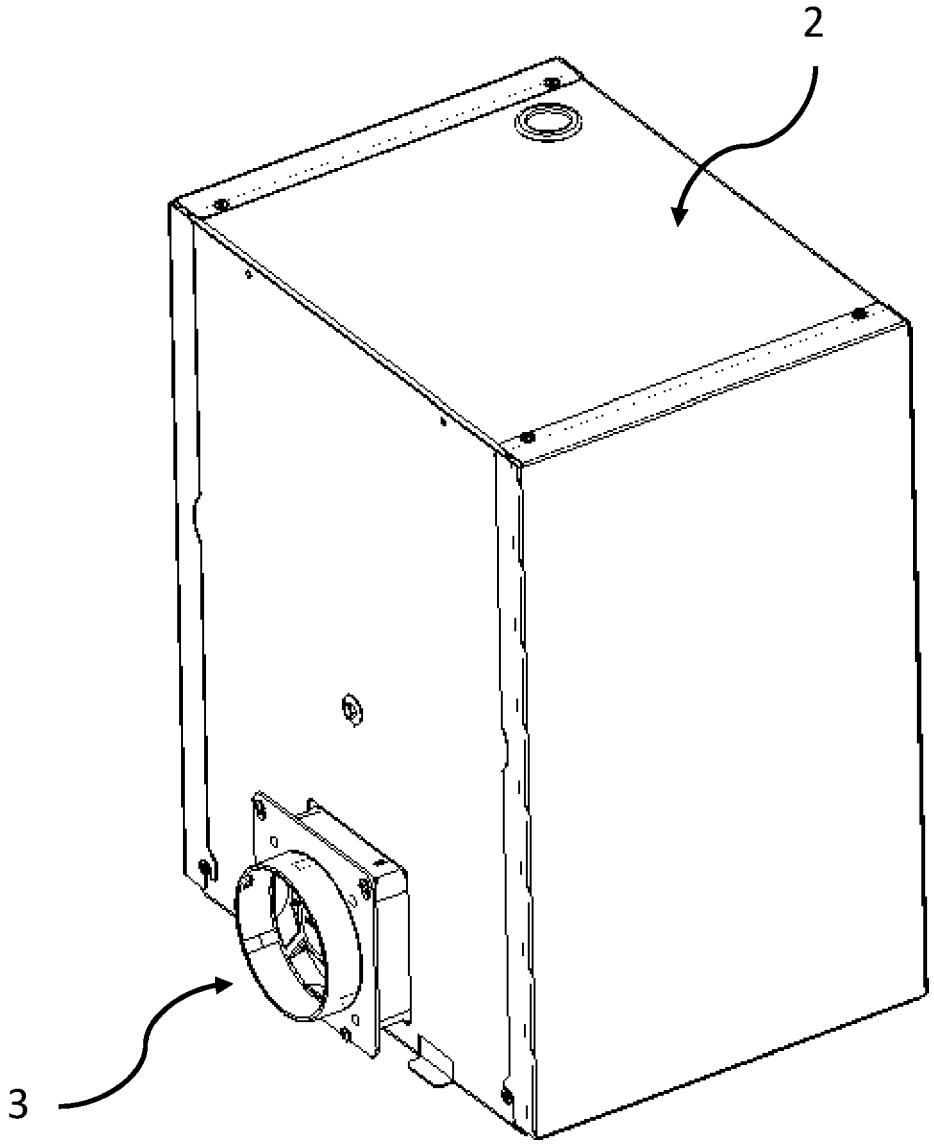


Fig. 5



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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 March 2023	Ast, Gabor

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