(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 September 2019 (19.09.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/177465 A1

(51) International Patent Classification:
F24H 1/06 (2006.01)

(21) International Application Number:
PCT/NO2019/050055

(22) International Filing Date:
12 March 2019 (12.03.2019)

(25) Filing Language: Norwegian

(26) Publication Language: English

(30) Priority Data:
20180357 13 March 2018 (13.03.2018) NO

(71) Applicant: **ROMY CLIMA AS** [NO/NO]; Prestmovegen 7, 7514 Stjørdal (NO).

(72) Inventor: **MYHRE, Roar**; Dyvasåsen 13, 7517 Hell (NO).

(74) Agent: **ACAPO AS**; P.O. Box 1880 Nordnes, 5817 Bergen (NO).

(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, 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, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, 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, 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))*
— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

(54) Title: MOBILE HEATING STATION

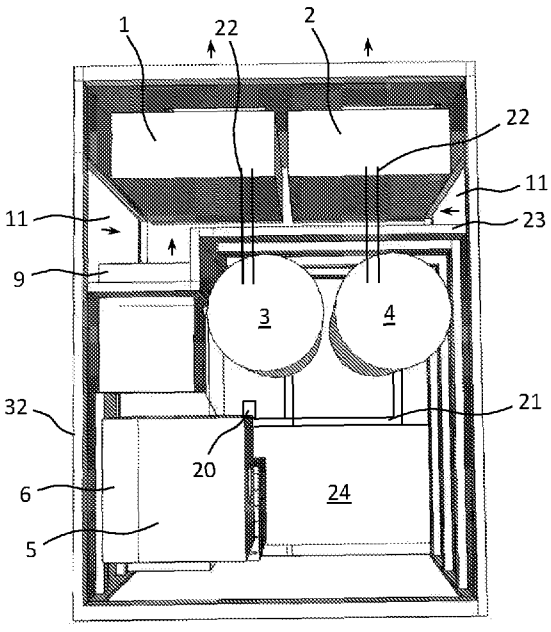


Fig. 5

(57) Abstract: Mobile heating station (30), characterised in that it comprises a container (32) equipped with one or more air-water heat pumps (1,2) collecting energy from external air and/or recirculated air and to exchange for heating of a water-glycol mixture to one or more water tanks (3,4), for intermediate storage of thermal energy, in which the heated water-glycol mixture from said water tanks (3,4) is circulated in a conduit circuit (21) to exchange thermal energy further to a thermal battery (6) for heating of air that shall be supplied to a building and/or to a heat exchanger of an external heating installation.

WO 2019/177465 A1

Mobile heating station

Field of the invention

The present invention relates to a mobile heating station for heating and/or drying of buildings, comprising a container equipped with one or more heat pumps.

Background to the invention

Building driers are used, as the name implies, for heating and drying of buildings, and buildings under construction in particular. These normally use diesel or gas/propane as the energy source for heating and drying, but electric building driers are also known.

Description of prior art

NO20130573 A1 relates to a ventilation installation with a heat pump that gets energy from both the air outside and ventilation air. The amounts of air from the outside, supplied air, ventilation air and circulation air are controlled with the help of mass regulators in an automatic control system. The document shows how a heat pump is used but there is no storage of heat in the fluid filled intermediate storage tanks.

US5249430 A describes control of the state of the air in a closed room, such as a greenhouse and which comprises a brine reservoir.

JP2007218462 A describes a heat pump with heat storage.

EP0693660 A2 describes a ventilator/drier assembly for very damp rooms.

Furthermore, reference is made to WO 2013026588 A1 which relates to a mobile water heater device comprising a carrier frame, a housing provided on the carrier frame, a first fluid flow system where a first fluid can flow and a second fluid flow system in which water can flow. A heat exchanger is connected between the first fluid flow system and the second fluid flow system for heat exchange between the first fluid and the water. The first fluid flow system is comprising a first fluid duct connected between the heat exchanger, a fluid heating device, a first pumping device, a first fluid container and further back to the heat exchanger again. The second fluid flow system is comprising a second fluid duct connected between a

circulation water inlet connector, a second pumping device, the heat exchanger and further to a water outlet connector.

Objects of the present invention

An object of the invention is to provide a mobile station (container) for heating of a building where energy is taken from the outside air with an air-water heat pump that exchanges to heat up water/glycol which is stored intermediately in tanks and which is further exchanged to a channel heat battery for heating of the air that enters into an air installation or to a water heat exchanger connected to a heating installation.

Furthermore, an object is to provide a release-free mobile heating station with ventilation channel spigots for the air supply and exhaust air channels that use the energy from the exhaust air and external air at the same time to the external part of the heat pump for optimal energy uptake and COP.

Furthermore, an object is to provide a release-free mobile heating station for the construction industry to stop the use of fossil energy for heating and drying of new and existing buildings.

An object is also to provide a mobile heating station for the heating of spaces that shall be heated and dried. The air that is treated can be filtered in the mobile heating station for a cleaner internal environment.

Furthermore, an object is to provide a heating station with control via dampeners for continuous fresh air/recirculated air to spaces that shall be heated to optimise the need for and use of energy, and which can be controlled automatically with temperature and moisture sensors in the space that shall be treated.

Summary of the invention

The above mentioned objects are obtained with a mobile heating station comprising a container equipped with one or more air-water heat pumps adapted to recover energy from the outside air and/or recirculated air and to exchange for heating of a water-glycol mixture to one or more water tanks for intermediate storage of thermal energy, in which the heated water-glycol mixture from said water tanks is circulated in a conduit circuit to exchange thermal energy further to a thermal battery for the heating of air that shall be supplied to a building, and/or to a heat exchanger of an external heating installation.

The container can comprise a control unit for control of the heated water-glycol mixture from the water tanks to the thermal battery for heating of the air that shall be supplied to the building or to the heat exchanger of the external heating installation.

In one embodiment, the control unit can comprise a pump and a shunt valve that are both connected into the conduit circuit for the water-glycol mixture.

It is preferred that the thermal battery is connected to a ventilation fan in the form of an air supply fan set up to blow heated air through a supply line outlet and to the building via one supply air channel.

Furthermore, the container can comprise a fresh-air dampener and one or more air circulation/return dampeners for the control of the air to said one or more air-water heat pumps.

Furthermore, said one or more water tanks can be filled with water mixed with monoethylene glycol-based industrial glycol for heat transfer in circulation systems, such as Termfluid MEG5™.

Furthermore, the mobile heating station can be equipped with an automatic control system set up to be controlled by temperature and moisture sensors placed in the building that is to be heated.

The container can comprise one or more air filters for the cleaning of the air that circulates in the container and to the building.

The container is preferably a closed container built in steel or aluminium which is adapted to tolerate being loaded, transported, hoisted, and moved by a car, crane or truck.

The container can comprise an air supply fan set up to blow heated air out through a supply pipe and to the building, and also one or more extraction fans that collect hot air from the building for further distribution to the supply air fan or the external part of the heat pumps.

Description of the figures

Preferred embodiments of the invention shall be described in the following in more detail with reference to the enclosed figures, in which:

Figure 1 shows a perspective drawing of a mobile heating station according to the invention.

Figure 2 shows a perspective drawing of the mobile heating station according to the invention.

Figure 3 shows a perspective drawing of the mobile heating station according to the invention.

Figure 4 shows a perspective drawing of the mobile heating station according to the invention.

Figure 5 shows the mobile heating station according to the invention seen from above.

Figure 6 shows a perspective drawing of the mobile heating station according to the invention.

Figure 7 shows a schematic diagram of components in the mobile heating station according to the invention.

Description of preferred embodiments of the invention

The mobile heating station 30 according to the invention can be built as a closed container 32 in steel or aluminium, in a reinforced construction and adapted for fastening of heat pumps, water tanks and equipment that tolerates up-loading, being transported, being hoisted up, and moved by a car, crane or a truck.

The mobile heating station can be built in a version for heating of ventilation air to a building in connection with heating and drying of the building, and in a second version for the heating of the water/glycol mixture to a heating station/district heating source. Alternatively, both versions can be integrated into the mobile heating station 30 and be controlled with respect to the desired function.

Firstly, the hot air function of heating and drying of a building shall be described. The mobile heating station 30 comprises a container 32 equipped with one or more air-water heat pumps1,2 that utilise external air and exhaust air from the building to take up energy and which heats a cooling medium for exchange to a water-glycol mixture that is stored in one or more water tanks 3,4. In the water tanks 3,4 water can be mixed with monoethylene glycol-based industrial glycol for heat transfer in circulation

systems, such as Termfluid MEG5™, so that it does not freeze down to -20 °C by the storing in the heat station 30, and in use when it is freezing.

The heat pump(s) 1,2 heat the water-glycol mixture in the water tanks 3,4 and a pump 20b pumps water-glycol in a conduit circuit 21 to a shunt valve 20a, in a control unit 20 that has a connection to a water thermal battery 5 in a ventilation channel internally in the heating station 30, and which in turn is connected to a ventilation channel in the building to lead dry, hot air, with the help of an air supply fan 5a, to areas in the building that shall be heated/dried.

The control unit 20, with the shunt valve 20a and pump 20b, is shown in more detail in figure 7. The shunt valve 20a will be able to exchange between the heat exchanger 26 air-water and water-water. Furthermore, there can be an exchange between water/water-glycol from the tanks 3,4 in the internal circuit.

Air is brought from the outside air and recirculated air (returned air from areas that are heated) can be adjusted according to need using a fresh-air dampener 7 and one or more recirculation dampeners/return dampeners 9 from 0-100% fresh air/recirculated air. Temperature, with heating supply to the shunt valve 20a, thermal battery 6 and the dampeners 7,9 for fresh air/recirculated air can be regulated by the control system. The installation can be controlled based on a timer, or according to need with moisture and temperature sensors in the areas that shall be heated/dried for optimal operation and saving of energy.

Hot air is moved by an air supply fan 5a in to the areas that shall be heated/dried and returned air from the areas is coupled to the heating station 30 to be used for recirculated air or be discarded.

The air supply fan 5a and the exhaust fan 5b can be adjusted with individual rpm/speed/amount of air independent of each other to compensate for channel resistance and the amount of air needed in the supply air and exhaust.

To regulate the moisture two individual set points relating to the fan speed can be used for both the supplied air and exhaust fan. At a moisture above the set point the fans 5a,5b can be adjusted to a rpm/set point (for example with an increased amount of air) of the supply air and exhaust fan and when the desired or lower moisture is

reached, the set point of the fans can be reset to a different (for example a decreased amount of air) rpm/set point.

The regulation of the temperature can be carried out by choosing between supplied air regulation, i.e. at a set temperature on the air supply, independent of other temperatures or exhaust regulation with a desired exhaust temperature with maximum-minimum supply air temperature set points that can be adjusted. For example, if 15 °C is wanted in the exhaust, the supply air can be adjusted to, for example, between 12 °C and 30 °C to get 15 °C in the exhaust. However, all temperatures are adjusted individually.

In particular, figures 5 and 7 show the layout of the components in the container 32. In the specific and shown embodiment the air-water heat pumps1,2 are placed at one end of the container 32 that is connected to the water tanks 3,4 for the heating of the water-glycol mixture. The conduit circuit 21 connects the water tanks 3,4 with the thermal battery 6 or to an external heat exchanger, where the control is carried out with a shunt valve 20a and the pump 20b. The supply air fan 5a is placed adjoining the thermal battery 6 and blows heated air out through the supply air line 10 and further in the supply air channel (not shown) to the building that shall be heated or dried.

In addition to the supply air fan 5a which ensures that the heated air is blown out through the supply outlet 10, the container 32 also comprises one or more exhaust fans 5b in connection to the shown air recirculation dampener/return air dampener 9 that collects warm air from the building. The exhaust fan 5b transports air internally in the container 32 to the supply air fan 5a or to the outside part of the heat pumps1,2, with regard to the control by the dampener of fresh air/recirculated air and the dampener for the external air.

In the second embodiment the mobile heating station 30 is set up for heating of hot water and is constructed as described previously and shown. The mobile heating station with air-water heat pumps 1,2 uses external air to take up energy that heats the cooling medium for exchange to water-glycol that is stored in water tanks 3,4. In the water tanks 3,4 water can be mixed with Termfluid MEG5™ to avoid freezing, all the way down to -20 °C, by storing in the heating station and in use when it is freezing.

The heat pump 1,2 heats water/glycol in the water tanks 3,4 and the pump 20b pumps water-glycol in the conduit circuit 21 to the shunt valve 20a that supplies the heat exchanger to heat up a water circuit which is connected to an exchanger that is external to the heating station 30, for example from a distant heating installation or other water heating installation water or water/glycol.

The energy is taken from the outside air, which is heated by the cooling medium in the air-water heat pump 1,2 that exchanges to heat up the water/glycol in the water tanks 3,4, which is further exchanged according to need to the thermal battery air/water for heating of the air or to a water heat exchanger for the heating of water heat (district heating, etc.).

With the invention, one achieves a smart CO_2-free heating station which is mobile, and which can start to produce energy from air to air or water by simply being connected to the electricity grid and starting the station. The system will be able to start and operate with the external temperature from -20 °C to +35 °C. The automatic regulation with the control as needed fresh air/recirculation air function, temperature and moisture sensors for optimal and control as needed of the heating and drying process and minimal use of energy.

The COP (coefficient of performance) of a heating station can, for example, be 4.1 for heat pumps at 7 °C outside and gradually lower down to 2.85 at -15 °C, this is the case for both versions.

Smart CO_2-free heating stations as described can be supplied with performances from 9kW to 180 kW with an alternative number of heat pumps.

<u>Components</u>

1. Heat pump 1 external part
2. Heat pump 2 external part
3. Water/glycol tank
4. Water/glycol tank
5. Ventilation fans, supply air fan 5a and exhaust fan 5b
6. Water/glycol thermal battery air
7. Fresh-air dampener
8. Air filter
9. Recirculated air dampener/returned air dampener

10. Supply air heated to the ventilation channel
11. Air inlet external air to heat pumps and supply air
12. Waste external air after uptake of energy in the heat pumps
13. Chanel spigot recirculated air/returned air
14. Channel spigot supply air to heating
16. Drainage of condensed water (in the draining a heating cable may be used to avoid ice when it is freezing)
17. Automation cupboard placing
18. Connection of electricity
19. Water/glycol filling
20. Control station with shunt valve 20a and pump 20b
21. Water/glycol pipe
22. Cooling pipe
23. Dividing wall
24. Mixing room air, external air and exhaust air before filtration in a filter.
26. Heat exchanger
32. Container, impenetrable in use, only openings that are shown in drawings with air in and out

Claims

1. Mobile heating station (30), characterised in that it comprises a container (32) equipped with one or more air-water heat pumps (1,2) collecting energy from external air and/or recirculated air and to exchange for heating of a water-glycol mixture to one or more water tanks (3,4), for intermediate storage of thermal energy, in which the heated water-glycol mixture from said water tanks (3,4) is circulated in a conduit circuit (21) to exchange thermal energy further to a thermal battery (6) for heating of the air that shall be supplied to a building and/or to a heat exchanger of an external heating installation.

2. Mobile heating station (30) according to claim 1, characterised in that the container (32) comprises a control station (20) for control of the heated air-glycol mixture from the water tanks (3,4) to the thermal battery (6) for heating of air that shall be supplied to the building or to the heat exchanger of the external heating installation.

3. Mobile heating station (30) according to claim 2, characterised in that the control station (20) is comprising a pump (20b) and a shunt valve (20a) that are both coupled to the conduit circuit (21) for the water-glycol mixture.

4. Mobile heating station (30) according to claim 1, characterised in that the thermal battery (6) is connected to a ventilation fan (5) blowing heated air through a supply air outlet (10) and to the building via a supply air channel.

5. Mobile heating station (30) according to claim 1, characterised in that the container (32) comprises a fresh-air dampener (7) and one or more recycled air/return dampeners (9) for control of the air to said one or more air-water heat pumps (1,2).

6. Mobile heating station (30) according to claim 1, characterised in that said one or more water tanks (3,4) are filled with water mixed with monoethylene glycol-based industrial glycol for the transfer of heat in circulation systems.

7. Mobile heating station (30) according to claim 1, characterised in that the mobile heating station (30) is equipped with an automatic control system (17)

controlled by temperature and moisture sensors placed in the building that is to be heated.

8. Mobile heating station (30) according to claim 1, characterised in that the container (32) comprises one or more air filters (8) for cleaning of the air that circulates in the container (32) and to the building.

9. Mobile heating station (30) according to claim 1, characterised in that the container (32) is a closed container built in steel or aluminium and adapted to tolerate being uploaded, transported, hoisted up and moved by car, crane or truck.

10. Mobile heating station (30) according to claim 1, characterised in that the container (32) comprises a supply air fan (5a) blowing heated air out through a supply air outlet (10) to the building, and also one or more exhaust fans (5b) collecting warm air from the building for further transport to the supply air fan (5) or to an external part of the heat pumps (1,2).

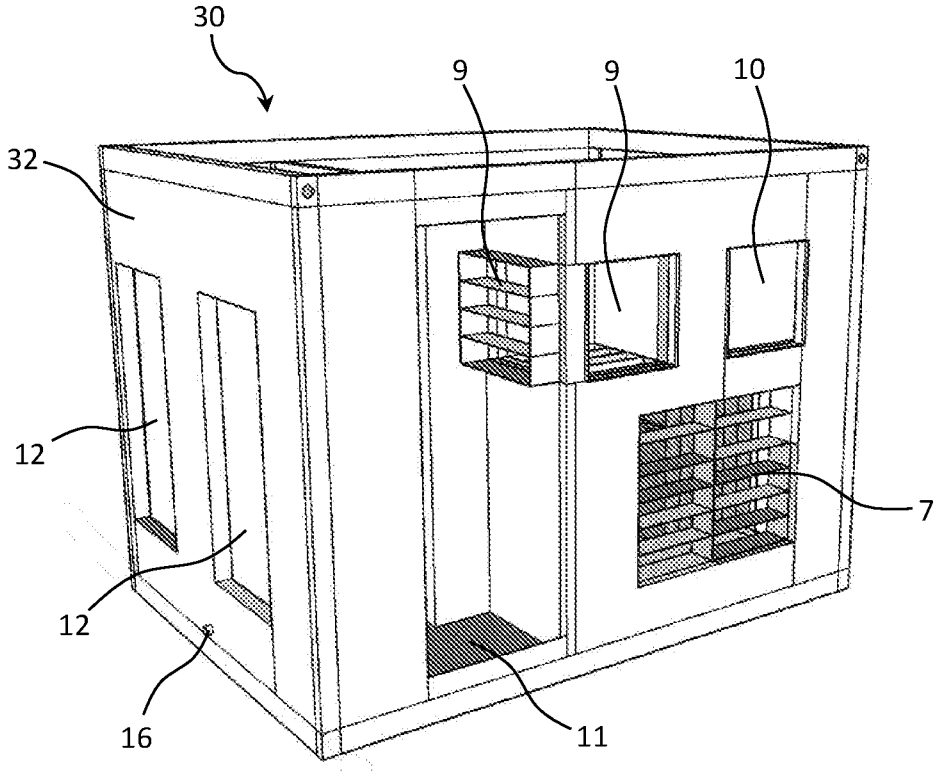


Fig. 1

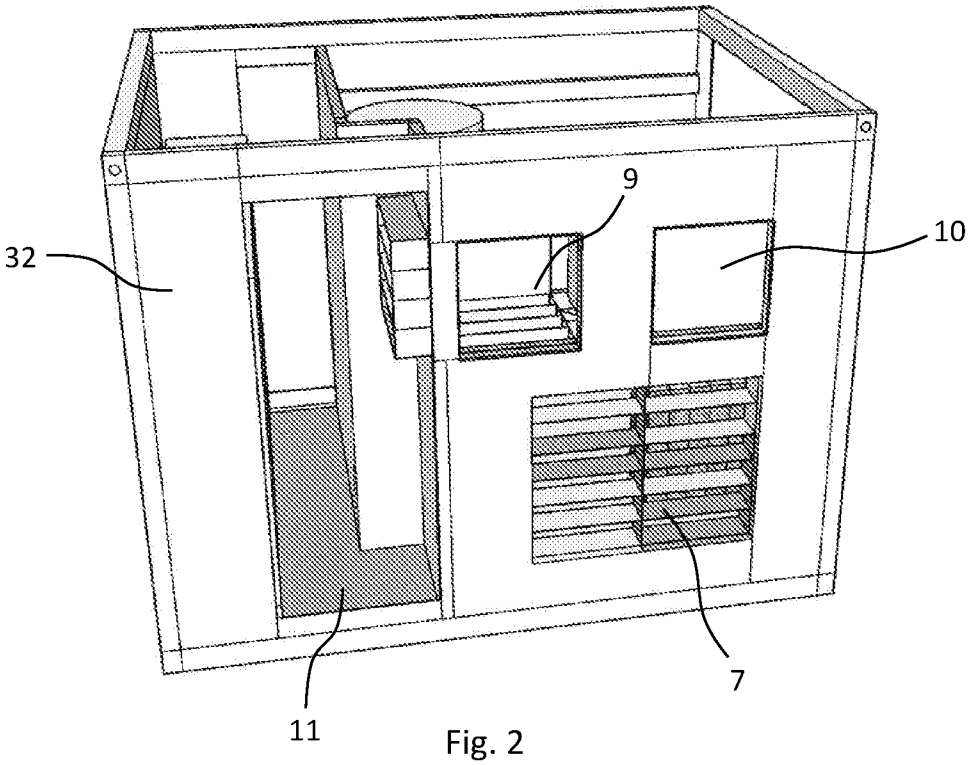


Fig. 2

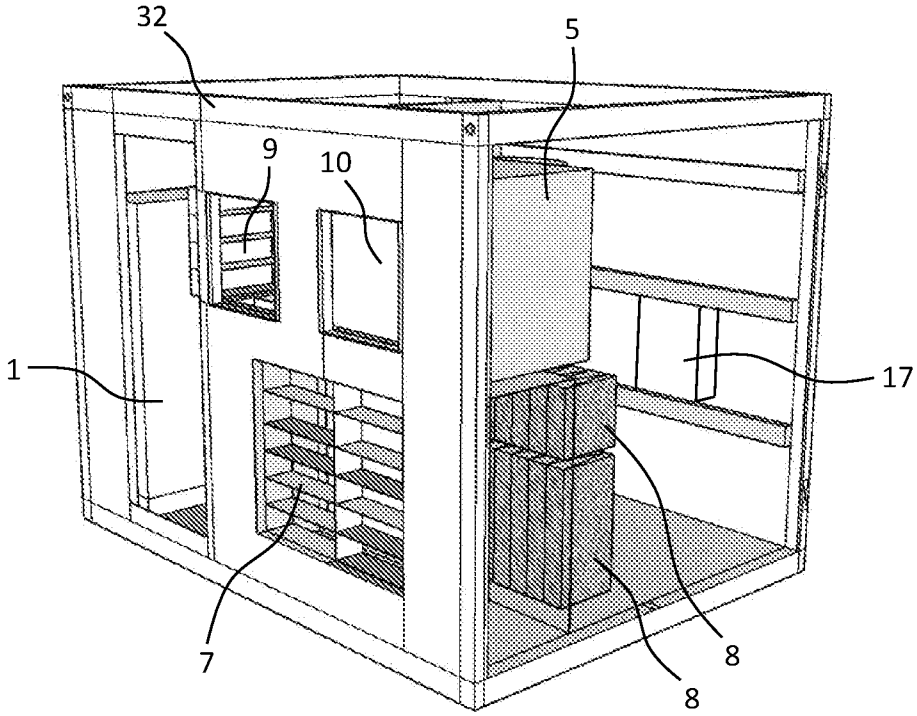


Fig. 3

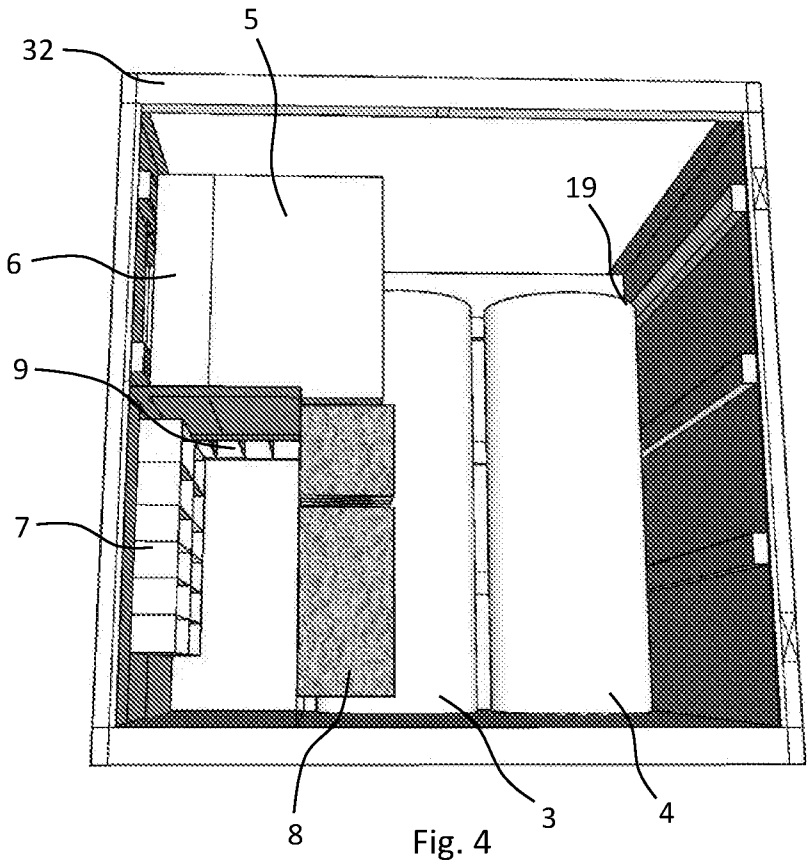


Fig. 4

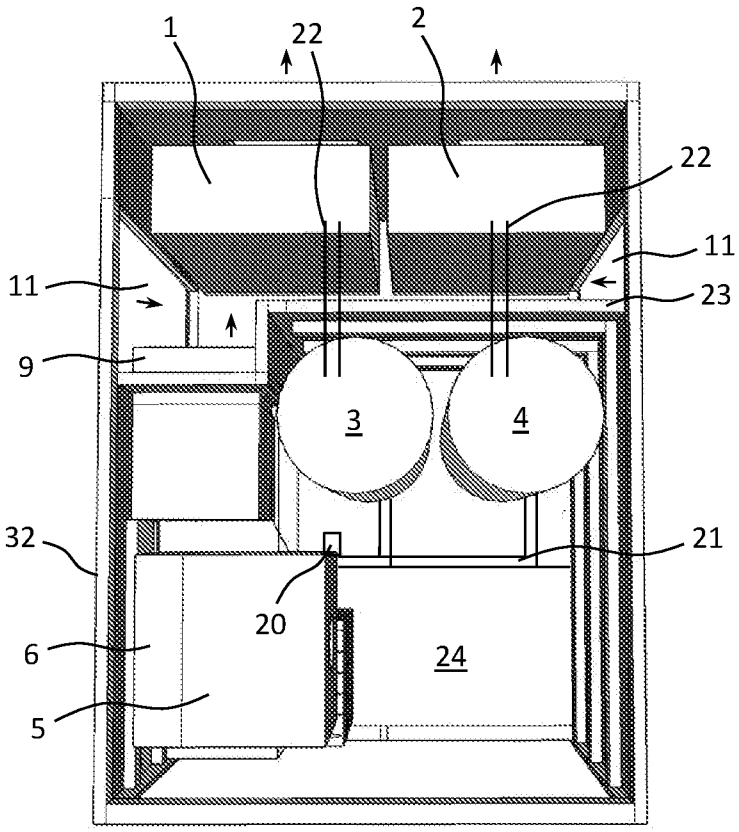


Fig. 5

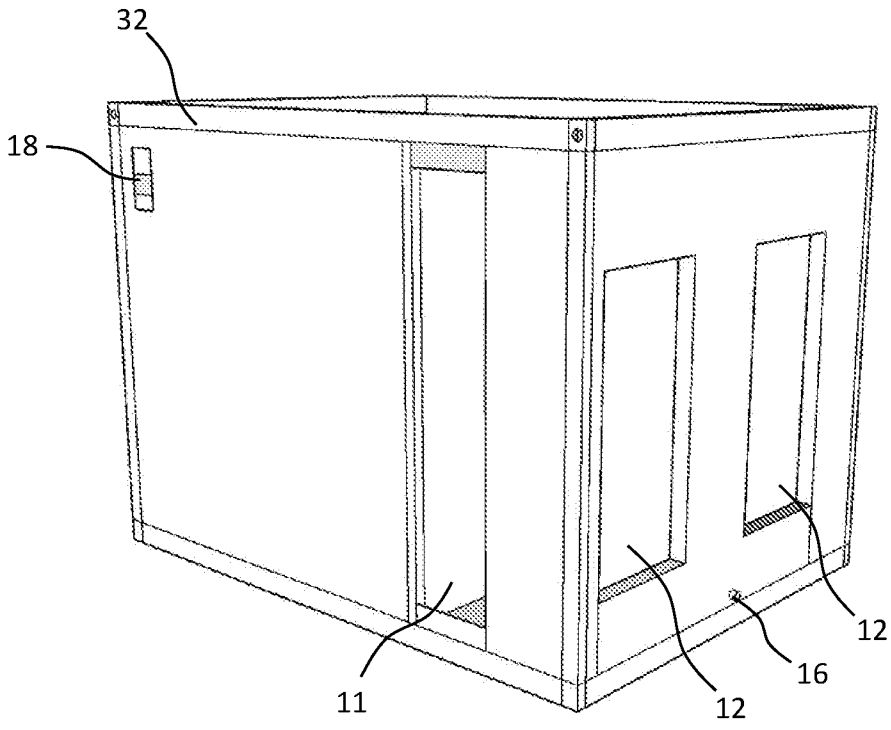


Fig. 6

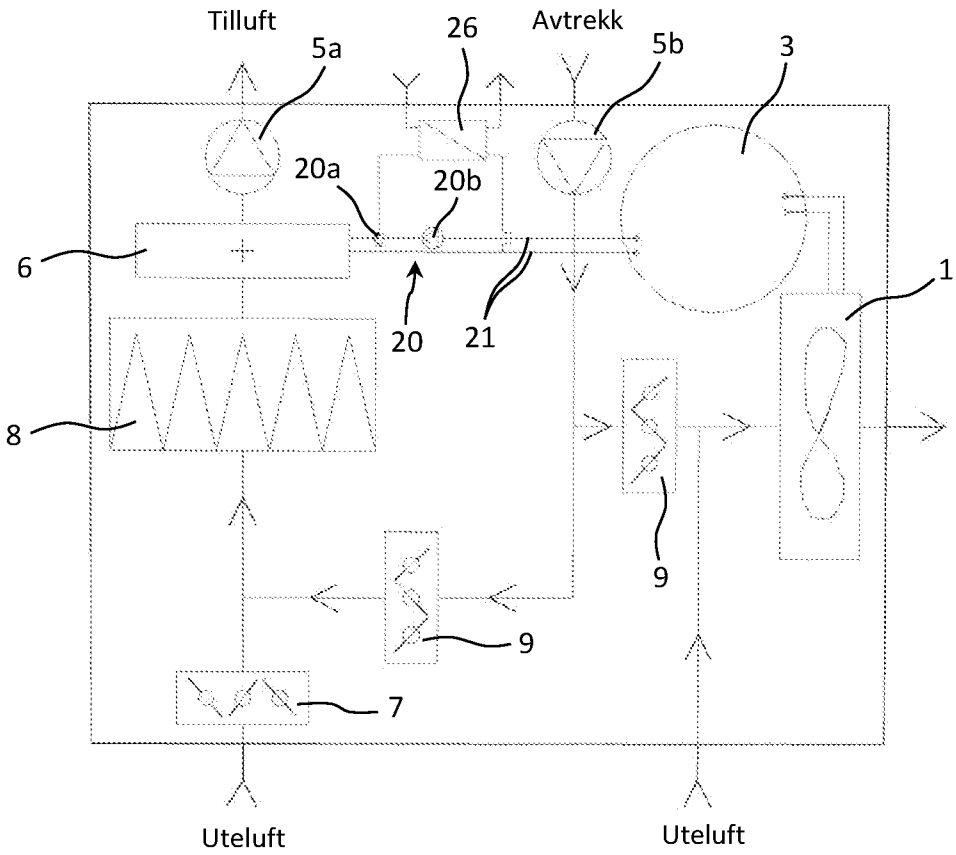

Tilluft
5a
26
Avtrekk
5b
3
20a
20b
6
1
20
21
8
9
9
7
Uteluft
Uteluft

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO2019/050055

A. CLASSIFICATION OF SUBJECT MATTER

F24H 1/06 (2017.04)

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)

F24H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

DK, NO, SE, FI: Classes as above.

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, FULL TEXT: ENGLISH, GERMAN, FRENCH

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2013026588 A1 (HEATHWORK AS) 2013.02.28 The whole document	1-10

☐ 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	Date of mailing of the international search report
13/05/2019	14/05/2019
Name and mailing address of the ISA Nordic Patent Institute Helgeshøj Allé 81 DK - 2630 Taastrup, Denmark. Facsimile No. + 45 43 50 80 08	Authorized officer Nebojsa Markovic Telephone No. +47 22 38 76 22

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NO2019/050055

Patent document cited in search report / Publication date		Patent family member(s) / Publication date	
WO 2013026588 A1	2013.02.28	NO 20111141 A1	2013.02.20
		NO 333494 B1	2013.06.40