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

(11) **EP 4 286 755 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
06.12.2023 Bulletin 2023/49

(21) Application number: **23169922.4**

(22) Date of filing: **25.04.2023**

(51) International Patent Classification (IPC):
F24F 1/52 *(2011.01)* ***F24F 1/54*** *(2011.01)*
F24F 1/60 *(2011.01)*

(52) Cooperative Patent Classification (CPC):
F24F 1/52; F24F 1/54; F24F 1/60

(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

(30) Priority: **30.05.2022 NL 2032021**

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(54) **HEAT PUMP HOUSING**

(57) The invention relates to a heat pump housing (100) for housing an outdoor unit (41) of a heat pump (40) heating a building (10), comprising: an installation surface (110) for installing the outdoor unit, wherein the installation surface is arranged on an inside (11) of the building; an air inlet grille (120) arranged for allowing air (121) outside of the building to flow towards the outdoor unit; and an air outlet grille (130) arranged for allowing air (131) to flow from the outdoor unit to the outside of the building; wherein the air inlet grille and/or the air outlet grille are arranged to a side (20) of the building.

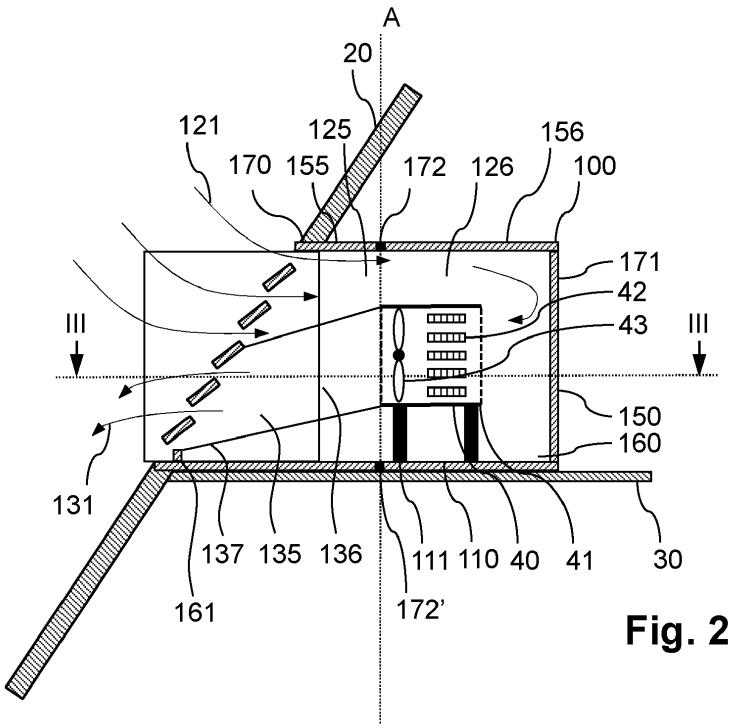

Fig. 2

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a heat pump housing for housing an outdoor unit of a heat pump heating a building.

BACKGROUND OF THE INVENTION

[0002] A heat pump transfers thermal energy between an inner space of a building and the outdoors. When used to heat a building, the energy is transferred from the outside into the building. A heat pump comprises an outdoor unit picking up the energy from the outdoors, and an indoor unit releasing the energy to the indoors of the building. The distance between the outdoor unit and the indoor unit of the heat pump is preferably kept as short as possible. In some embodiments the indoor unit and the outdoor unit may even be partly integrated.

[0003] For buildings, such as houses, the outdoor placement of the outdoor unit of the heat pump may be hampered due to lack of space. Often it is not possible to place the outdoor unit on the ground. In other instances, the indoor unit of the heat pump is located on another level than ground level. The outdoor unit is therefore often located on a wall at height or on the roof. A disadvantage of these outdoor units is that servicing and maintenance, such as regular servicing, requires additional materials to access these outdoor units, such as a ladder or construction lift, and possibly additional precautionary measures, such as a construction climbing harness, all hampering servicing and maintenance of the outdoor unit.

SUMMARY OF THE INVENTION

[0004] An object of the invention is to overcome one or more of the disadvantages mentioned above. According to a first aspect of the invention, a heat pump housing for housing an outdoor unit of a heat pump heating a building, comprising: a rectangular cuboid-shaped section comprising: an installation surface for installing the outdoor unit, wherein the installation surface is arranged on an inside of the building; and a wedge-shaped section comprising: an air inlet grille arranged for allowing air outside of the building to flow towards the outdoor unit; and an air outlet grille arranged for allowing air to flow from the outdoor unit to the outside of the building; wherein the air inlet grille and/or the air outlet grille are arranged to a slanted roof of the building; and wherein the rectangular cuboid-shaped section and the wedge-shaped section are produced as separate parts.

[0005] The heat pump comprises an outdoor unit typically for exchanging heat between the outdoors and a heat transporting fluid, preferably compressible heat transporting fluid. The heat transporting fluid transports the energy between the outside and inside of the building, such as an office or house for living. The heat pump is typically arranged for heating the building. The heat pump may also be used to cool the building.

[0006] The heat pump housing comprises an installation surface. The installation surface is arranged for installing the outdoor unit. The installation surface is arranged on an inside of the building. Arranging the installation surface on an inside of the building arranges the heat pump at least partly inside the building.

[0007] The heat pump housing comprises an air inlet grille. the air inlet grille is arranged for allowing air outside of the building to flow towards the outdoor unit. The air inlet grille is typically arranged for keeping rain out, while allowing air to flow through. The air inlet grille may comprise a mesh. The air inlet grille may comprise openings arranged for allowing the air to flow through, while preferably keeping rain and other weather influences out. The heat pump comprises an air outlet grille. The air outlet grille is arranged for allowing air to flow from the outdoor unit to the outside of the building. The air outlet grille may comprise a mesh. The air outlet grille may comprise openings arranged for allowing the air to flow through, while preferably keeping rain and other weather influences out. The air outlet grille and the air inlet grille allow an air flow through the outdoor unit for preserving the COP - coefficient of performance - or at least minimizing the reduction of the COP of the heat pump due to the heat pump housing.

[0008] The air inlet grille and/or the air outlet grille are arranged to a side of the building. As the air inlet grille and/or the air outlet grille are arranged to a side of the building, as a consequence, the installation surface is arranged on an inside of the building. As a further consequence, the outdoor unit is at least partly arranged on the inside of the building. Arranging the outdoor unit at least partly on the inside of the building allows servicing from the inside of the building of the outdoor unit. Servicing the outdoor unit from the inside of the building provides the technical effect of simplifying servicing and maintenance. Furthermore, this simplification of servicing and maintenance is provided while preserving the COP or at least minimizing reduction of the COP of the heat pump.

[0009] The heat pump housing is shaped to be arranged in a slanted roof and/or angled side of the building. A slanted roof is a roof having an angle different from horizontal and vertical. A slanted roof preferably has an angle, relative to horizontal, in the range between 10°-80°, more preferably 20°-75°, more preferably 30°-80°, most preferably 40°-70°. The room under the slanted roof is typically an attic or loft advantageously providing the space for arranging the heat

pump housing. In a further embodiment, the roof is sloped or angled. A sloped roof typically results in some unusable indoor space, such as close to the floor under the slanted roof. Arranging the heat pump housing on the floor under the slanted roof allows this unusable space to be advantageously used by the heat pump housing.

[0010] This heat pump housing advantageously uses the unusable space in a building as described in the previous paragraph. Furthermore, the wedge-shaped section is typically custom made for adapting the wedge-shaped section to the angle of the slanted roof. The rectangular cuboid-shaped section may advantageously be adapted to the different types of heat pumps. Compartmentalizing the heat pump housing in these sections allows for advantageously simple adaptation to roof angle and/or heat pump type. The compartmentalizing advantageously allows reuse of sections and provides freedom of combination of sections.

[0011] A further advantage of the heat pump housing according to the invention may be that the distance between the indoor and the outdoor unit of the heat pump may be reduced for decreasing transportation losses and thus increasing the efficiency of the heat pump. A further advantage of the heat pump housing according to the invention may be that the cold air is not directly blown into e.g. a garden area causing for example discomfort to anyone in the garden in the form of noise and/or temperature. A further advantage may be that the heat pump housing arranged in a roof is less prone to street dirt and mechanical destructive actions, such as vandalism.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0012] In an embodiment of the heat pump housing, the angle of the wedge-shaped section matches the angle of the slanted roof of the building. The wedge-shaped section side facing the slanted roof is placed against or in contact with the slanted roof for advantageously an airtight or almost airtight connection such that the air circulating in the heat pump housing comes from the outside and is blown to the outside and not from or to the interior of the building.

[0013] Furthermore, the wedge-shaped section side facing the slanted roof is placed against or in contact with the slanted roof for advantageously minimizing the chance on leakage between the housing and the roof. In a further embodiment, the wedge-shaped section side facing the slanted roof is placed flush with the slanted roof for advantageously allowing at least partly PV panels to be placed over the wedge-shaped section side facing the slanted roof, preferably not over one or more of the air openings.

[0014] In an embodiment of the heat pump housing, the rectangular cuboid-shaped section and the wedge-shaped section are shaped to form one housing advantageously stipulating the cooperation between the sections of the housing.

[0015] In an embodiment of the heat pump housing, the wedge-shaped section has a truncated wedge shape, preferably forming a wedge-shaped cuboid. The truncated wedge shape separates the connection between the grille part and the cuboid-shaped section for advantageously simplifying both connections.

[0016] In an embodiment of the heat pump housing, the air inlet grille and/or the air outlet grille are arranged in a side of the building providing further detailing the arranging of the installation surface on an inside of the building for reaching the technical effect and advantages mentioned.

[0017] In an embodiment of the heat pump housing, the air inlet grille and/or the air outlet grille are arranged flush in a side of the building providing further detailing the arranging of the installation surface on an inside of the building for reaching the technical effect. Conventional heat pumps such as arranged on a roof typically cause swirls in the wind having the disadvantage of generating noise and rain to be able to enter the building in an unexpected direction. Thus, apart from further detailing the technical effect, one or more grilles, preferably both, flush with the building advantageously minimizes the weather influence, such as wind around the building, to be changed by the heat pump housing. As a further advantage, rain, snow and drizzle is less likely to enter the building through one or more of the grilles of the heat pump housing.

[0018] In an embodiment of the heat pump housing, the heat pump comprises a service hatch. The service hatch is arranged for advantageously accessing the outdoor unit from inside the building for example for servicing and maintenance.

[0019] In an embodiment of the heat pump housing, the outdoor unit comprises an air input opening and an air output opening; and the heat pump housing comprises: an inlet channel for fluidly, preferably air impermeable, coupling the air inlet grille and the air input opening; and an outlet channel for fluidly, preferably air impermeable, coupling the air outlet grille and the air output opening. The inlet channel guides air inflow from the outdoors to the outdoor unit. The outlet channel guides air outflow from the outdoor unit to the outdoors. The air flowing in typically has a different temperature from the air flowing out. If the heat pump is heating the house, the air flowing in has a higher temperature compared to the air flowing out due to that energy is extracted from the air flow by the outdoor unit for heating the building. The inlet channel and the outlet channel separate the inflow and outflow of air of the outdoor unit. Separating the air flows provides the advantage of reducing the heat exchange between the inflow and outflow of air for preserving the temperature difference for allowing the outdoor unit to function and preserving the COP or at least minimizing the reduction of the COP of the heat pump.

[0020] In a further embodiment of the heat pump housing, the inlet channel and the air inlet grille are arranged for

drafting air from the outdoors in a direction perpendicular to the building. Typically, the building comprises a side wherein the heat pump housing is arranged or placed, wherein the grille is preferably parallel, more preferably flush, with that side of the building. Recirculation of air through multiple units has the disadvantage of greatly reducing the COP of the heat pump. Drafting air from the outdoors in a direction perpendicular provides the advantage of drafting in air that previously not circulated through the outdoor unit of the heat pump. Furthermore, outdoor units of coupled buildings, such as terraced houses or row houses, have outdoor units often placed in each other's vicinity. Drafting air in a perpendicular direction provides the advantage of preventing or at least reducing the change of air circulating through two outdoor units.

[0021] In a further embodiment of the heat pump housing, the outlet channel and the air outlet grille are arranged for expelling air to the outdoors in a direction perpendicular to the building. Typically, the building comprises a side wherein the heat pump housing is placed, wherein the grille is preferably parallel, more preferably flush, with that side of the building. Recirculation of air through multiple units has the disadvantage of greatly reducing the COP of the heat pump. Expelling air to the outdoors in a direction perpendicular provides the advantage of expelling air that is prevented or at least the change is reduced that the expelled air is recirculated through the outdoor unit of the heat pump. Furthermore, outdoor units of coupled buildings, such as terraced houses or row houses, have outdoor units often placed in each other's vicinity. Expelling air in a perpendicular direction provides the advantage of preventing or at least reducing the change of air circulating through two outdoor units.

[0022] In a further preferred embodiment of the heat pump housing, both air flows are perpendicular to the building for further reducing the change of recirculating the air through the heat pump.

[0023] In an embodiment of the heat pump housing, either the inlet channel or the outlet channel is an outer channel; and the other of the inlet channel or the outlet channel is an inner channel for spatially efficiently arranging the channels for advantageously minimizing the space occupied by the heat pump housing. In a further embodiment of the heat pump housing, the outer channel envelops the inner channel. for even further optimizing the spatial efficiency.

[0024] In an embodiment of the heat pump housing, either the inlet channel or the outlet channel is shaped to accelerate the air either at the inlet grille or at the outlet grille, respectively. Shaping the outlet channel is a preferred embodiment. The advantage of accelerating the air at the grille is that the mixing of the air at the outside of building is reduced for advantageously reducing the recirculation of air through the outdoor unit. As an exemplary embodiment, the shape of the channel may be a tapered channel tapered towards the associated grille.

[0025] In an embodiment of the heat pump housing, the installation surface is arranged to the outer channel providing a combination of the two features for advantageously providing an additional function to the outer channel. The outer channel may comprise installation means for arranging the outer channel to a surface of the building. The installation means may be such as suspension means for suspending the outer channel from a surface of the building and/or support means such that a surface of the building can support the outer channel.

[0026] In an embodiment of the heat pump housing, the service hatch is arranged to the outer channel. The service hatch advantageously provides direct access to the outdoor unit for servicing and maintenance. The outer channel may advantageously envelop the inner channel as well as the outdoor unit providing a spatially efficient design.

[0027] In an embodiment of the heat pump housing, the heat pump comprises an outer shell, wherein the outer shell envelops the outdoor unit; and wherein the outer shell comprises the air inlet grille, the air outlet grille and the outer channel. This embodiment advantageously provides a spatially efficient design.

[0028] In an embodiment of the heat pump housing, the outer shell also comprises the service hatch. The service hatch advantageously provides direct access to the outdoor unit for servicing and maintenance. The outer shell may advantageously envelop the inner channel as well as the outdoor unit providing a spatially efficient design.

[0029] In an embodiment of the heat pump housing, the outer shell comprises a first part, a second part and separation means, such as hinges, or wheels and rails, for separably coupling the first part and the second part; in a first position of the separation means the first part and the second part contact each other for forming the outer channel; and in a second position of the separation means the first part and the second part are arranged such that the outdoor unit is advantageously accessible for maintenance. Separation means, such as the hinges, or wheels and rails provide the advantage that separation and/or coupling may be done manually with light labour. Furthermore, hinges provide the advantage of rotating the second part relative to the first part, and rails and wheels provide the advantage of translating the second part relative to the first part. Depending on the shape and volume of the space inside the building wherein the heat pump housing is installed, either example of separation means may provide benefits of easier placing the first part and the second part in the second position, and/or easier transitioning between the first and the second position. The installation surface may be arranged to the first part or the second part. In a further embodiment, the service hatch may be arranged to the first part or the second part.

[0030] In an embodiment of the heat pump housing, the outlet grille is arranged below the inlet grille. The air drafted in by the inlet grille is typically warmer compared to the air expelled from the outlet grille. As cold air falls or floats to the ground and warm air rises, the air is separated at the outside of the heat pump housing. This separation advantageously prevents or at least reduces the change of recirculation of the air through the outdoor unit. In a further preferred embod-

iment, the arrangement of the grilles on top of each other is combined with the air flows perpendicular to the building. This provides the advantage of preventing or at least minimizing the reduction of the COP.

[0031] In an embodiment of the heat pump housing, the heat pump comprises a condense receptacle for collecting condense from the outdoor unit, wherein the condense receptacle comprises raised sides, wherein a raised side (161) of the raised sides arranged to the air outlet grille or the air inlet grille is lower compared to other raised sides. Arranging the raised side to the air outlet grille or the air inlet grille involves creating a fluidly, preferably air, impermeable surface between the condense receptacle and the respective grille. Typically, the grille is selected that is arranged lowest of the two grilles. This embodiment provides the advantage that if the condense receptacle overflows, such as with condense or incoming rain through the grille, the overflow is expelled via the respective grille to the outside of the building. Any water damage to the inside of the building is advantageously prevented or at least reduced with this embodiment.

[0032] In an embodiment of the heat pump housing, the installation surface is a support surface for arranging the outdoor unit on. In a further embodiment, the support surface is part of the outer channel and/or the outer shell. In an embodiment of the heat pump housing, the installation surface is a suspension surface for suspending the outdoor unit from. In a further embodiment, the suspension surface is part of the outer channel and/or the outer shell.

[0033] In an embodiment of the heat pump housing, the heat pump housing is built up from modular parts having a size; and the size of all the modular parts is such that these modular parts fit through the stairwell of a standard house. This embodiment provides the advantage that the installation of the heat pump housing and most likely also the heat pump itself, may be done without providing means, such as a ladder, construction lift or scaffold, for accessing the outside of the building from outdoors. Thus, this embodiment provides the advantage of simplified installation of at least the heat pump housing. In a further embodiment, the size of the modular parts having a plate shape is smaller than 2.5 metres by 2 metres, preferably 2 metres by 1.5 metres, more preferably 1.80 metres by 1.40 metres. The heat pump housing preferably mainly and/or substantially by weight and/or volume consists of plate shaped parts, typically making up the grilles and/or the channels. The heat pump housing may further comprise corner posts for linking all the plates shaped parts. The heat pump housing may further comprise smaller parts typically easily transported through stairwells.

[0034] In an embodiment of the heat pump housing, the air inlet grille and/or the air outlet grille comprise a frame and noise damping and/or noise protecting material arranged to the frame. Heat pumps, especially the outdoor unit, are known for generating noise, such as a low zooming and/or humming noise. Arranging the outdoor unit in the heat pump housing already reduces the noise on the outside of the building as well as on the inside of the building. Furthermore, the noise damping and/or noise protecting measures of this embodiment further advantageously reduces the outside noise coming from the outdoor unit. The noise damping and/or noise protecting measures are preferably arranged around the slits or openings where the air flows through the grille. In another embodiment, the air inlet grille and/or the air outlet grille comprise a frame and fire retarding and/or resisting material arranged to the frame for advantageously delaying or preventing the spread of fire. Furthermore, the materials may advantageously be periodically checked by separating the two sections.

[0035] In an embodiment of the heat pump housing, the rectangular cuboid-shaped section and the wedge-shaped section in use are substantially air tight; the rectangular cuboid-shaped section and the wedge-shaped section in use form a substantially airtight seal; and the wedge-shaped section in use forms a substantially airtight seal with the slanted roof. The heat pump typically uses volatile substances and/or fluids also typically under high pressure, which substances and/or fluids are typically hazardous to living creatures, such as humans. A leak such as in pipes and/or conduits of the heat pump may occur. The current embodiment ensures that any leakage of the outdoor unit, and/or conduits and/or pipes arranged inside the heat pump housing will spill the substance and/or fluid substantially or in whole to the outside of the building. The spilling to the outside is typically via the air outlet grille and/or air inlet grille. The current heat pump housing therefore advantageously enhances the safety. According to another aspect of the invention, a heat pump housing (100) for housing an outdoor unit (41) of a heat pump (40) heating a building (10), comprising: a section (170) arranged on an inside (11) of the building; an air inlet grille (120) arranged for allowing air (121) outside of the building to flow towards the outdoor unit; and an air outlet grille (130) arranged for allowing air (131) to flow from the outdoor unit to the outside of the building; wherein the air inlet grille and/or the air outlet grille are arranged to a side of the building; wherein the section in use is substantially or fully air tight; and wherein the section in use forms a substantially or fully airtight seal with the side of the building. The current embodiment ensures that any leakage of the outdoor unit, and/or conduits and/or pipes arranged inside the heat pump housing will spill the substance and/or fluid substantially or in whole to the outside of the building. The spilling to the outside is typically via the air outlet grille and/or air inlet grille. The current heat pump housing therefore advantageously enhances the safety.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] The invention will be apparent from and elucidated further with reference to the embodiments described by way of example in the following description and with reference to the accompanying drawings, in which:

Figure 1 schematically shows front view of a heat pump housing;
Figure 2 schematically shows a cross-section of a heat pump housing; and
Figure 3 schematically shows a cross-section of a heat pump housing.

[0037] The figures are purely diagrammatic and not drawn to scale. In the figures, elements which correspond to elements already described may have the same reference numerals.

LIST OF REFERENCE NUMERALS

[0038]

10	building
11	inside building
12	outside building
20	side of building
30	floor
40	heat pump
41	outdoor unit
42	heat exchanger
43	ventilator
100	heat pump housing
110	installation surface
111	heat pump support
120	air inlet grille
121	air taken in
125	air inlet channel
126	outer channel
130	air outlet grille
131	air expelled
135	air outlet channel
136	inner channel
137	inner channel wall
150	outer shell
151	service hatch
155	first part of outer shell
156	second part of outer shell
157	hinges
158	first position
159	second position
160	condense receptacle
161	lower side condense receptacle
170	wedge-shaped section
171	rectangular cuboid-shaped section

(continued)

172, 172'	section contact surface
A	line separating first part or section, and second part or section
B	rotation second part
II	indication of cross section Figure 2
III	indication of cross section Figure 3

DETAILED DESCRIPTION OF THE FIGURES

[0039] The following figures may detail different embodiments. Embodiments can be combined to reach an enhanced or improved technical effect. These combined embodiments may be mentioned explicitly throughout the text, may be hint upon in the text or may be implicit.

[0040] Figure 1 schematically shows front view of a heat pump housing 100. Figure 1 further schematically shows a building 20, such as a house. The building comprises sides 20, such as a roof or a wall. The heat pump housing is arranged to or in the side of the building. Figure 1 further shows a line II and a viewing direction shown by the arrow providing an indication of the cross section shown in Figure 2.

[0041] Figure 2 schematically shows a cross-section of a heat pump housing 100. The cross-section may be of the heat pump housing also shown in Figures 1 and/or 3 along line II and a viewing direction shown by the arrow. Figure 2 further shows a line III and a viewing direction shown by the arrow providing an indication of the cross section shown in Figure 3.

[0042] The building 10 comprises an inside 11 of the building, an outside 12 of the building, a side 20 of the building, and a floor 20 of the building. The heat pump housing is arranged to, through, or in the side of the building. The side of the building may be a roof of a house. The heat pump housing is arranged for housing an outdoor unit 41 of a heat pump 40.

[0043] The heat pump housing comprises an installation surface 110, an air inlet grille 120, and an air outlet grille 130. The installation surface is arranged for installing the outdoor unit. The outdoor unit may be supported by the installation surface. The heat pump housing may comprise heat pump supports 111 arranged between the outdoor unit and the installation surface for supporting the outdoor unit. The outdoor unit may be suspended from the installation surface. The installation surface is arranged to an inside of the building. The air inlet grille is arranged for allowing air (121) outside of the building to flow towards the outdoor unit. The air inlet grille may comprise horizontal strips spaced from each other for allowing the air to pass through the space between the horizontal strips. The air inlet grille may comprise a mesh having through holes for allowing air to pass through the through holes of the mesh. The air outlet grille is arranged for allowing air (131) to flow from the outdoor unit to the outside of the building. The air outlet grille may comprise horizontal strips spaced from each other for allowing the air to pass through the space between the horizontal strips. The air outlet grille may comprise a mesh having through holes for allowing air to pass through the through holes of the mesh.

[0044] The grilles separate the inside and the outside of the building. Arranging the installation surface on an inside of the building arranges at least a part of the heat pump, preferably the larger part of the heat pump, more preferably substantially the whole heat pump, most preferably the whole the heat pump, on the inside of the building. This has the effect that the heat pump is available for servicing, maintenance and/or replacement from inside of the building simplifying this servicing, maintenance and/or replacement.

[0045] The heat pump housing may comprise and air inlet channel 125, and an air outlet channel 135. The air inlet channel guides the air flow from the air inlet grille to the outdoor unit. The air outlet channel guides the air flow from the outdoor unit to the air outlet grille. Figure 2 shows the air outlet channel coupling and/or joining with an outflow opening of the heat pump. Figure 2 further shows that the air inlet channel loosely couples with the air inlet opening of the heat pump. The channels advantageously separate the air flows from each other. Separation of the air flows advantageously prevent or reduce the exchange of energy between the two air flows outside of the outdoor unit.

[0046] In Figure 2 the air inlet channel forms an outer channel 126, and the air outlet channel forms an inner channel 136. Further, the outer channel may envelop the inner channel as shown in Figure 2. The inner channel comprises a channel 137, according to this embodiment separating the two air flows. This construction provides the advantage of simplifying construction and/or maintaining the COP as well as possible. From the combination of Figures 2 and 3 it may be deduced that the inner channel wall has a truncated pyramid shape, a frustum pyramid shape, a square frustum, or quadrilateral frustum.

[0047] The heat pump housing may comprise an outer shell 150. The outer shell may comprise a first part 155, and a second part 156. The outer shell may further comprise hinges for hinging the first part relative to the second part as shown in Figure 3 and not shown in Figure 2. The separation between the first part and the second part may be shown with line A.

[0048] Figure 2 shows the air inlet grille arranged above the air outlet grille. The air drafted from the outside typically has a higher temperature compared to the air expelled to the outside. The cold air expelled may therefore fall down from the air outlet grille and is prevented from, or at least a reduced change of, mixing with air drafted from the outside and/or from recirculating through the outdoor unit. Thus, the arrangement of grilles relative to each other provides the advantage of maintaining or at least minimizing the reduction of the COP of the heat pump.

[0049] The heat pump housing may comprise a wedge-shaped section 170 and a rectangular cuboid shaped section 171. The separation between the wedge-shaped section and the rectangular cuboid shaped section may be shown with line A, further elucidated with specifying the section contact surface 172, 172'. The section contact surfaces of the wedge-shaped section and the rectangular cuboid shaped section are shaped to cooperate for forming a continuous housing for preventing air to flow between the sections. The section contact surfaces of the wedge-shaped section and the rectangular cuboid shaped section typically line openings of each section having similar shaped for cooperating with each other. The wedge-shaped section adapts the angle of for example the slanted roof to the uniform and/or rectangular shape of the rectangular cuboid shaped section. Furthermore, typically the inner channel wall is arranged in this section. The rectangular cuboid shaped section is adapted to facilitate different types of heat pumps. The rectangular cuboid shaped section typically comprises the installation surface and optionally heat pump supports for arranging the outdoor unit at the appropriate height such that the inner channel wall couples and/or joins well with the outdoor unit. The arrangement in sections advantageously provides a simplification of the adaptation of the heat pump housing to different angled or slanted roofs as well as different types of heat pumps, more specifically outdoor units. In the shown example the first part and the wedge-shaped section may substantially be the same over even identical. In the shown example the second part and the rectangular cuboid shaped section may substantially be the same or even identical.

[0050] The heat pump housing may comprise a condense receptacle 160. The condense receptacle typically comprises sides. The sides of the condense receptacle may be integrated with the outer shell. The integration may comprise providing a fluid impermeable layer on the inside of the outer shell for forming the condense receptacle. The condense receptacle may comprise a lower side 161 compared to the other sides of the receptacle. The lower side is arranged to one of the grilles, typically the air outlet grille. In case the condense receptacle is not emptied in time, the overflow of the receptacle is at least going to an outside of the building and leakage in the inside of the building is prevented or the change is minimized.

[0051] It may be noted that the outdoor unit 41 comprises a heat exchanger 42 and a ventilator 43. The ventilator is typically arranged downstream of the heat exchanger as shown in Figures 2 and 3. Drawing air through the heat exchanger is typically more efficient than blowing air through the heat exchanger. Thus, this typical arrangement provides the advantage of reduced energy consumption of the ventilator for the same amount of air. Furthermore, the air flowing from the air inlet grille towards the outdoor unit is curved up to 180 degrees, while the air flowing from the outdoor unit towards the air outlet grille has a straight or substantially straight path towards the outdoors. This arrangement follows the technical effect described for the outdoor unit: drawing air around a corner costs less energy compared from blowing air around a corner. Thus, the current arrangement provides the advantage reduced drag of the airflow, the heat pump reduction in COP due to the heat pump housing is limited or almost absent, and/or the heat pump uses almost the same energy compared to a situation having no heat pump housing.

[0052] Figure 3 schematically shows a cross-section of a heat pump housing 100. The cross-section may be of the heat pump housing also shown in Figure 2 along line III and a viewing direction shown by the arrow. Figure 3 further shows a line II and a viewing direction shown by the arrow providing an indication of the cross section shown in Figure 2.

[0053] The heat pump housing may comprise an outer shell 150. The outer shell may comprise a first part 155, and a second part 156. The outer shell may further comprise hinges 157 for hinging the first part relative to the second part. In an alternative embodiment, the hinges may be absent allowing the second part to separate from the first part to provide the same advantage. In a further alternative embodiment, the first and second part remain joined or coupled in a second position providing access to the outdoor unit with the same advantage.

[0054] The second part of the outer shell is shown in a first position with solid lines. The second part of the outer shell is shown in a second position with dotted lines. The second part of the outer shell may traverse between the first and the second position according to arrow B. The outdoor unit is typically attached to the second part of the outer shell for rotating together with the second part of the outer shell. For clarity, the outdoor unit is only shown in the first position and not in the second position. In the first position the outer shell is closed and outdoor unit may be operational. In the second position the outer shell is open and provides access, typically all-around access to the outdoor unit. The access to the outdoor unit provides the advantage of servicing, maintenance and/or replacing the outdoor unit of the heat pump from inside of the building. This greatly simplifies servicing, maintenance and/or replacing. In an alternative embodiment, the outdoor unit may be attached to the first part of the outer shell and the second part rotates away in the second position for providing the same advantages as mentioned.

[0055] The outer shell may comprise a service hatch 151. The service hatch may be arranged to the second part of the outer shell. The service hatch provides access to the outdoor unit for servicing the outdoor unit. Servicing may comprise for example checking a control unit, such as a display unit on the outdoor unit. Servicing may comprise removing

condense from the condense receptacle. Servicing via the service hatch typically comprises less servicing compared to servicing in the second position of the second part of the outer shell. The service hatch provides the advantage of fast and easy access to the outdoor unit.

[0056] Figure 3 further shows the air expelled from the air outlet grille to be substantially perpendicular in the plane of the cross-section, which typically is a horizontal plane. It is clear to the skilled person that the drafted air into the air inlet grille is substantially perpendicular in a comparable way as for the expelled air only in a reverse direction. In the context of this embodiment, perpendicular is thus perpendicular to the side of the building in the cross-section as shown in Figure 3.

[0057] The heat pump housing may be sold in the future under the brand name Matt-Lee Box. The heat pump housing, and especially the outer channel and/or the outer shell may form an airtight and/or air impermeable layer between the inside and outside of the building. The heat pump housing, and especially the outer channel and/or the outer shell may provide a high insulation between the inside and outside of the building, which is advantageous typically for houses applying heat pumps as these are typically houses with reduced energy consumption.

[0058] According to another aspect of the invention, a heat pump housing (100) for housing an outdoor unit (41) of a heat pump (40) heating a building (10), comprising: a rectangular cuboid-shaped section (170) comprising: an installation surface (110) for installing the outdoor unit, wherein the installation surface is arranged on an inside (11) of the building; and a wedge-shaped section (171) comprising: an air inlet grille (120) arranged for allowing air (121) outside of the building to flow towards the outdoor unit; and an air outlet grille (130) arranged for allowing air (131) to flow from the outdoor unit to the outside of the building; wherein the air inlet grille and/or the air outlet grille are arranged to a slanted roof (20) of the building; and wherein the rectangular cuboid-shaped section and the wedge-shaped section are produced as an integral part. The outdoor unit of the heat pump typically produces noise, such as a humming sound, at a level that is audible to a person next to the outdoor unit one the inside or outside of the building. Damping this noise may be an objective of the housing. The wedge shape of one side of the housing, while the other side of the housing is vertical causes sound waves of the noise to be deflected to the bottom of the housing. The technical effect is that the arrangement of the sides of the housing provides a reduction of the audible noise outside the housing. This effect may be apparent inside and/or outside of the building.

[0059] According to another aspect of the invention, a heat pump housing (100) for housing an outdoor unit (41) of a heat pump (40) heating a building (10), comprising: an installation surface (110) for installing the outdoor unit, wherein the installation surface is arranged on an inside (11) of the building; an air inlet grille (120) arranged for allowing air (121) outside of the building to flow towards the outdoor unit; an air outlet grille (130) arranged for allowing air (131) to flow from the outdoor unit to the outside of the building; a slanted side wherein the air inlet grille and/or the air outlet grille are arranged to the slanted side; and wherein the slanted side is arranged to fit into a slanted roof (20) of the building; a vertical side arranged opposite to the slanted side, and with the outdoor unit arranged between the slanted side and the vertical side. The outdoor unit of the heat pump typically produces noise, such as a humming sound, at a level that is audible to a person next to the outdoor unit one the inside or outside of the building. Damping this noise may be an objective of the housing. The wedge shape of one side of the housing, while the other side of the housing is vertical causes sound waves of the noise to be deflected to the bottom of the housing. The technical effect is that the arrangement of the sides of the housing provides a reduction of the audible noise outside the housing. This effect may be apparent inside and/or outside of the building.

[0060] It will also be clear that the above description and drawings are included to illustrate some embodiments of the invention, and not to limit the scope of protection. Starting from this disclosure, many more embodiments will be evident to a skilled person without departing from the scope of the invention as set forth in the appended claims. These embodiments are within the scope of protection and the essence of this invention and are obvious combinations of prior art techniques and the disclosure of this patent. Devices functionally forming separate devices may be integrated in a single physical device.

[0061] The term "substantially" herein, such as in "substantially all emission" or in "substantially consists", will be understood by the person skilled in the art. The term "substantially" may also include embodiments with "entirely", "completely", "all", etc. Hence, in embodiments the adjective substantially may also be removed. Where applicable, the term "substantially" may also relate to 90% or higher, such as 95% or higher, especially 99% or higher, even more especially 99.5% or higher, including 100%. The term "comprise" also includes embodiments wherein the term "comprises" means "consists of'.

[0062] The term "functionally" will be understood by, and be clear to, a person skilled in the art. The term "substantially" as well as "functionally" may also include embodiments with "entirely", "completely", "all", etc. Hence, in embodiments the adjective functionally may also be removed. When used, for instance in "functionally parallel", a skilled person will understand that the adjective "functionally" includes the term substantially as explained above. Functionally in particular is to be understood to include a configuration of features that allows these features to function as if the adjective "functionally" was not present. The term "functionally" is intended to cover variations in the feature to which it refers, and which variations are such that in the functional use of the feature, possibly in combination with other features it relates

to in the invention, that combination of features is able to operate or function. For instance, if an antenna is functionally coupled or functionally connected to a communication device, received electromagnetic signals that are receives by the antenna can be used by the communication device. The word "functionally" as for instance used in "functionally parallel" is used to cover exactly parallel, but also the embodiments that are covered by the word "substantially" explained above. For instance, "functionally parallel" relates to embodiments that in operation function as if the parts are for instance parallel. This covers embodiments for which it is clear to a skilled person that it operates within its intended field of use as if it were parallel.

[0063] Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein. Thus, these terms are not necessarily intended to indicate temporal or other prioritization of such elements.

[0064] The devices or apparatus herein are amongst others described during operation. As will be clear to the person skilled in the art, the invention is not limited to methods of operation or devices in operation.

[0065] It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "to comprise" and "to include", and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. Also, the use of introductory phrases such as "at least one" and "one or more" in the claims should not be construed to imply that the introduction of another claim element by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim element to inventions containing only one such element, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an." The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

[0066] The invention may be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device or apparatus claims enumerating several means, several of these means may be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

[0067] The invention further applies to an apparatus or device comprising one or more of the characterising features described in the description and/or shown in the attached drawings. The invention further pertains to a method or process comprising one or more of the characterising features described in the description and/or shown in the attached drawings.

[0068] The various aspects discussed in this patent can be combined in order to provide additional advantages. The mere fact that certain measures are recited in mutually different claims does not indicate that a combination of these measures cannot be used to advantage. Furthermore, some of the features can form the basis for one or more divisional applications.

EMBODIMENTS

[0069]

1. Heat pump housing (100) for housing an outdoor unit (41) of a heat pump (40) heating a building (10), comprising:

- an installation surface (110) for installing the outdoor unit, wherein the installation surface is arranged on an inside (11) of the building;
- an air inlet grille (120) arranged for allowing air (121) outside of the building to flow towards the outdoor unit; and
- an air outlet grille (130) arranged for allowing air (131) to flow from the outdoor unit to the outside of the building;

wherein the air inlet grille and/or the air outlet grille are arranged to a side (20) of the building.

2. Heat pump housing according to the preceding embodiment, wherein the air inlet grille and/or the air outlet grille are arranged in a side of the building.

3. Heat pump housing according to any of the preceding embodiments, wherein the air inlet grille and/or the air outlet grille are arranged flush in a side of the building.

4. Heat pump housing according to any of the preceding embodiments, comprising a service hatch (151) arranged for accessing the outdoor unit from inside the building.

5. Heat pump housing according to any of the preceding embodiments,

wherein the outdoor unit comprises an air input opening and an air output opening; and
wherein the heat pump housing comprises:

- an inlet channel (125) for fluidly coupling the air inlet grille and the air input opening; and
- an outlet channel (135) for fluidly coupling the air outlet grille and the air output opening.

6. Heat pump housing according to the preceding embodiment,

wherein the inlet channel and the air inlet grille are arranged for drafting air from the outdoors in a direction perpendicular to the side of the building; and/or
wherein the outlet channel and the air outlet grille are arranged for expelling air to the outdoors in a direction perpendicular to the side of the building.

7. Heat pump housing according to any of the preceding embodiments 5-6,

wherein either the inlet channel or the outlet channel is an outer channel (126); and
wherein the other of the inlet channel or the outlet channel is an inner channel (136).

8. Heat pump housing according to the preceding embodiment, wherein the outer channel envelops the inner channel.
9. Heat pump housing according to any of the preceding embodiments 7-8, wherein the installation surface is arranged to the outer channel.
10. Heat pump housing according to any of the preceding embodiments 7-9, also depending on embodiment 4, wherein the service hatch is arranged to the outer channel.
11. Heat pump housing according to any of the preceding embodiments 7-10, comprising an outer shell (150),

wherein the outer shell envelops the outdoor unit; and
wherein the outer shell comprises the air inlet grille, the air outlet grille and the outer channel.

12. Heat pump housing according to the preceding embodiment, also depending on embodiment 4, wherein the outer shell also comprises the service hatch.
13. Heat pump housing according to any of the preceding embodiments 7-12,

wherein the outer shell comprises a first part (155), a second part (156) and separation means (157) , such as hinges, or wheels and rails, for separably coupling the first part and the second part;
wherein in a first position (158) of the separation means the first part and the second part contact each other for forming the outer channel; and
wherein in a second position (159) of the separation means the first part and the second part are arranged such that the outdoor unit is accessible for maintenance.

14. Heat pump housing according to any of the preceding embodiments, wherein the outlet grille is arranged below the inlet grille.
15. Heat pump housing according to any of the preceding embodiments, comprising a condense receptacle (160) for collecting condense from the outdoor unit, wherein the condense receptacle comprises raised sides, wherein a raised side (161) of the raised sides arranged to the air outlet grille or the air inlet grille is lower compared to other raised sides.
16. Heat pump housing according to any of the preceding embodiments, wherein the installation surface is a support surface for arranging the outdoor unit on, or a suspension surface for suspending the outdoor unit from.
17. Heat pump housing according to any of the preceding embodiments,

wherein the heat pump housing is built up from modular parts having a size;
wherein the size of all the modular parts is such that these modular parts fit through the stairwell of a standard house; and
wherein preferably the size of all the modular parts having a plate shape is smaller than 2.5 metres by 2 metres, preferably 2 metres by 1.5 metres, more preferably 1.80 metres by 1.40 metres.

18. Heat pump housing according to any of the preceding embodiments, wherein the air inlet grille and/or the air outlet grille comprise a frame and noise damping material arranged to the frame.
19. Heat pump housing according to any of the preceding embodiments, wherein the heat pump housing is shaped to be arranged in a roof of the building.
20. Heat pump housing according to the preceding embodiment, comprising a wedge-shaped section (170) and a rectangular cuboid shaped section (171);

wherein the rectangular cuboid-shaped section comprises an inner side configured for installing the outdoor unit; and
wherein the wedge-shaped section is shaped to couple the roof to the rectangular cuboid-shaped section.

21. Heat pump housing according to the preceding embodiment, wherein the wedge-shaped section has a truncated wedge shape, preferably forming a wedge-shaped cuboid.

Claims

1. Heat pump housing (100) for housing an outdoor unit (41) of a heat pump (40) heating a building (10), comprising:

- a rectangular cuboid-shaped section (170) comprising:

  - an installation surface (110) for installing the outdoor unit, wherein the installation surface is arranged on an inside (11) of the building; and

- a wedge-shaped section (171) comprising:

  - an air inlet grille (120) arranged for allowing air (121) outside of the building to flow towards the outdoor unit; and
  - an air outlet grille (130) arranged for allowing air (131) to flow from the outdoor unit to the outside of the building;

wherein the air inlet grille and/or the air outlet grille are arranged to a slanted roof (20) of the building; and
wherein the rectangular cuboid-shaped section and the wedge-shaped section are produced as separate parts.

2. Heat pump housing according to the preceding claim, wherein the slanted roof of the building is an angled side of the building.

3. Heat pump housing according to any of the preceding claims, wherein the angle of the wedge-shaped section matches the angle of the slanted roof of the building.

4. Heat pump housing according to any of the preceding claims, wherein the rectangular cuboid-shaped section and the wedge-shaped section are shaped to form one housing.

5. Heat pump housing according to any of the preceding claims, wherein the wedge-shaped section has a truncated wedge shape, preferably forming a wedge-shaped cuboid.

6. Heat pump housing according to any of the preceding claims, wherein either the inlet channel or the outlet channel is shaped to accelerate the air either at the inlet grille or at the outlet grille, respectively.

7. Heat pump housing according to the preceding claim,

wherein the air inlet grille and/or the air outlet grille are arranged in a side of the building;
wherein the air inlet grille and/or the air outlet grille are arranged flush in a side of the building; and/or
wherein the heat pump housing comprises a service hatch (151) arranged for accessing the outdoor unit from inside the building.

8. Heat pump housing according to any of the preceding claims,

wherein the outdoor unit comprises an air input opening and an air output opening; and
wherein the heat pump housing comprises:

- an inlet channel (125) for fluidly coupling the air inlet grille and the air input opening;
- an outlet channel (135) for fluidly coupling the air outlet grille and the air output opening; wherein preferably the inlet channel and the air inlet grille are arranged for drafting air from the outdoors in a direction perpendicular to the side of the building; and

wherein preferably the outlet channel and the air outlet grille are arranged for expelling air to the outdoors in a direction perpendicular to the side of the building.

9. Heat pump housing according to preceding claim,

wherein either the inlet channel or the outlet channel is an outer channel (126); and
wherein the other of the inlet channel or the outlet channel is an inner channel (136);
wherein preferably the outer channel envelops the inner channel;
wherein preferably the installation surface is arranged to the outer channel;
wherein preferably, when also depending on claim 5, the service hatch is arranged to the outer channel;
wherein preferably the heat pump housing comprises an outer shell (150),

wherein the outer shell envelops the outdoor unit; and
wherein the outer shell comprises the air inlet grille, the air outlet grille and the outer channel;

wherein preferably, when also depending on claim 5, the outer shell also comprises the service hatch;
wherein preferably the outer shell comprises a first part (155), a second part (156) and separation means (157) , such as hinges, or wheels and rails, for separably coupling the first part and the second part;
wherein preferably in a first position (158) of the separation means the first part and the second part contact each other for forming the outer channel; and/or
wherein preferably in a second position (159) of the separation means the first part and the second part are arranged such that the outdoor unit is accessible for maintenance.

10. Heat pump housing according to any of the preceding claims, wherein the outlet grille is arranged below the inlet grille.

11. Heat pump housing according to any of the preceding claims, comprising a condense receptacle (160) for collecting condense from the outdoor unit, wherein the condense receptacle comprises raised sides, wherein a raised side (161) of the raised sides arranged to the air outlet grille or the air inlet grille is lower compared to other raised sides.

12. Heat pump housing according to any of the preceding claims, wherein the installation surface is a support surface for arranging the outdoor unit on, or a suspension surface for suspending the outdoor unit from.

13. Heat pump housing according to any of the preceding claims,

wherein the heat pump housing is built up from modular parts having a size;
wherein the size of all the modular parts is such that these modular parts fit through the stairwell of a standard house; and
wherein preferably the size of all the modular parts having a plate shape is smaller than 2.5 metres by 2 metres, preferably 2 metres by 1.5 metres, more preferably 1.80 metres by 1.40 metres.

14. Heat pump housing according to any of the preceding claims, wherein the air inlet grille and/or the air outlet grille comprise a frame and noise damping and/or noise protecting material arranged to the frame.

15. Heat pump housing according to any of the preceding claims,

wherein the rectangular cuboid-shaped section and the wedge-shaped section in use are substantially air tight;
wherein the rectangular cuboid-shaped section and the wedge-shaped section in use form a substantially airtight seal; and
wherein the wedge-shaped section in use forms a substantially airtight seal with the slanted roof.

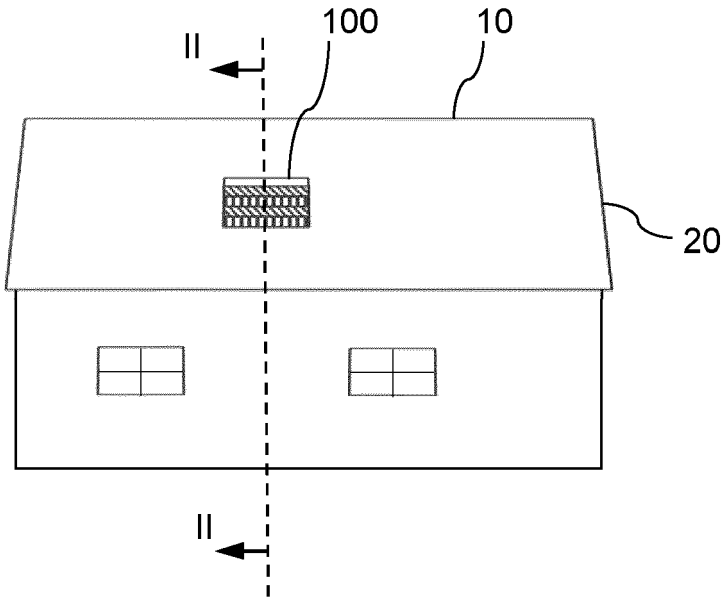
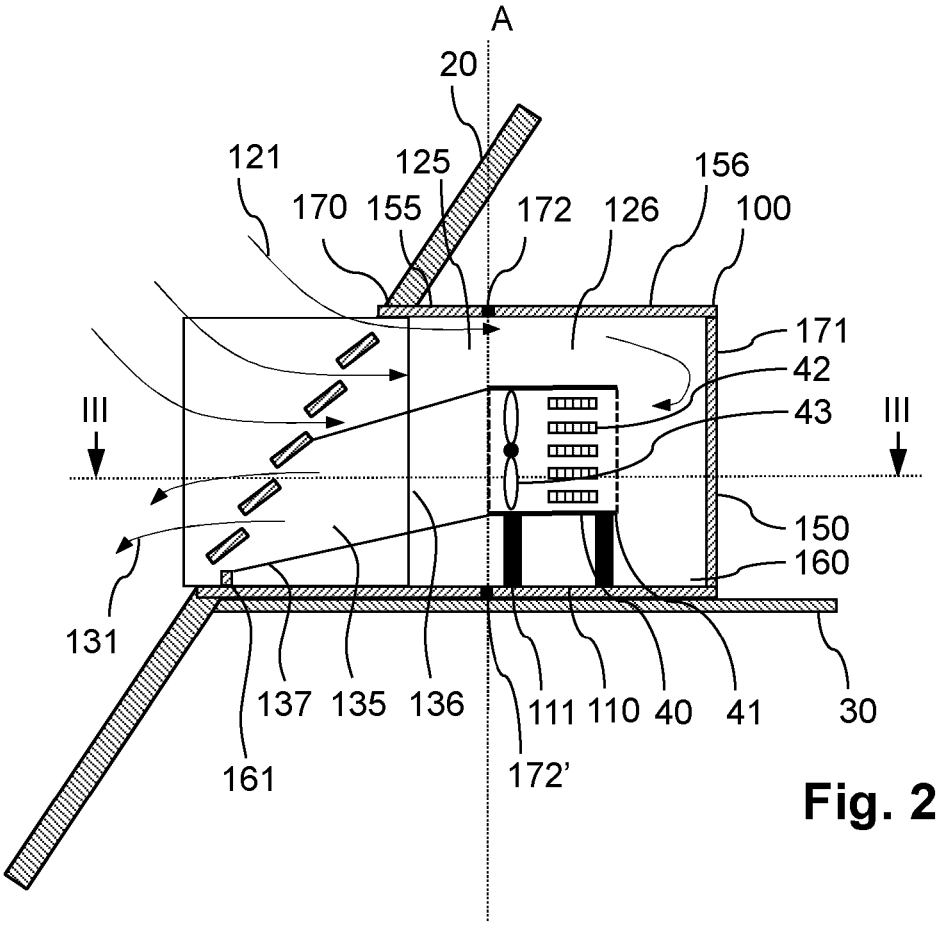


Fig. 1


A
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110
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161
172'

Fig. 2

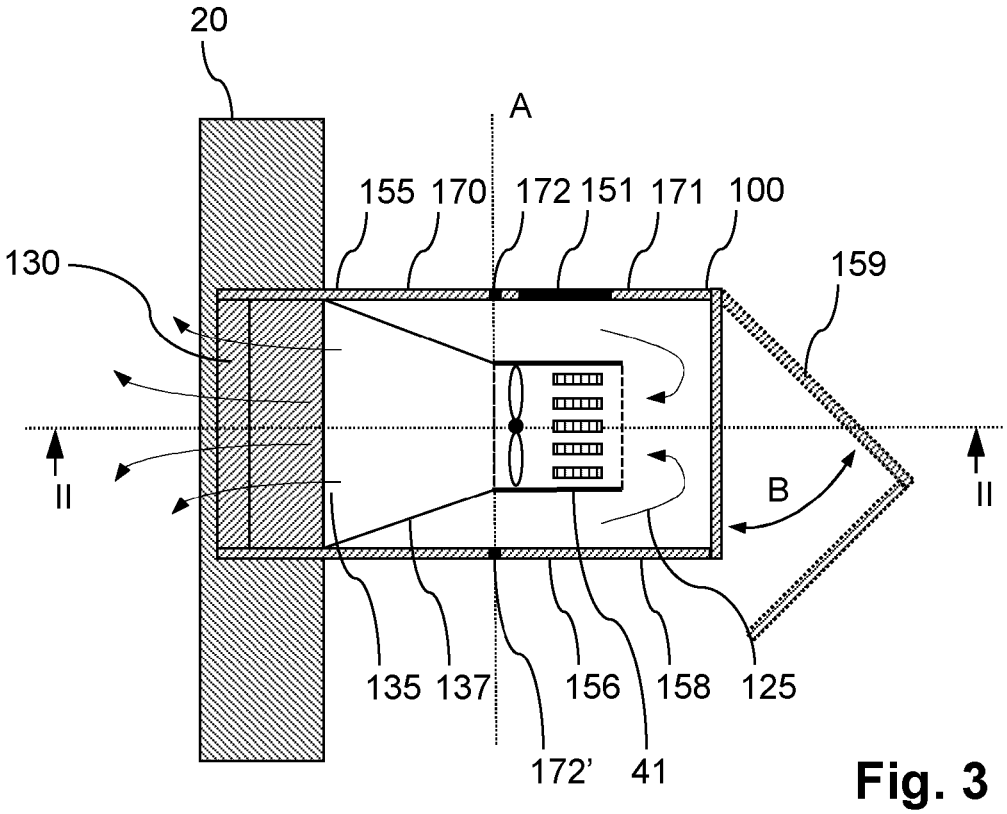
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Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 23 16 9922

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Place of search	Date of completion of the search	Examiner
Munich	28 May 2023	Mattias Grenbäck

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X : particularly relevant if taken alone
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