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

(11) **EP 4 442 885 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.10.2024 Bulletin 2024/41

(21) Application number: **24163147.2**

(22) Date of filing: **13.03.2024**

(51) International Patent Classification (IPC):
D06F 25/00 *(2006.01)* ***D06F 58/20*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
D06F 25/00; D06F 58/206

(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:
GE KH MA MD TN

(30) Priority: **04.04.2023 CN 202310350818**

(71) Applicant: **BSH Hausgeräte GmbH**
81739 München (DE)

(72) Inventors:
- **Lu, Jin**
  Nanjing 210046 (CN)
- **Wang, Fei**
  Nanjing 210046 (CN)
- **Zhu, Zesen**
  Nanjing 210046 (CN)

(54) LAUNDRY TREATMENT APPARATUS

(57) The invention relates to the technical field of laundry treatment apparatuses, and more particularly to a laundry treatment apparatus (1000), comprising: a box (900); a clothes accommodating cavity (800) provided in the box (900); and a heat pump module assembly (700) provided in the box (900) and positioned above the clothes accommodating cavity (800), the heat pump module assembly (700) comprising: a heat pump system (100) configured to be connected with the clothes accommodating cavity (800) to form a drying circulation loop, the heat pump system (100) comprising a compressor (20), a condenser (30), and an evaporator (40) connected in a closed loop via a coolant pipeline (10); and an air-cooling device (200) configured to cool the compressor (20), the air-cooling device (200) having an airflow generating mechanism (210) adapted to rotate about a rotation axis (L1) to generate an airflow, wherein the air-cooling device (200) is configured to discharge air in a direction different from the rotation axis (L1). Through embodiments of the invention, by enabling the air-cooling device to discharge the air in a direction different from the rotation axis, it is unnecessary to leave a design space that is too high for this air-cooling device, which has the advantage of a compact design, particularly in the area above the clothes accommodating cavity with limited height space, and also ensures the necessary heat dissipation effect required by the compressor.

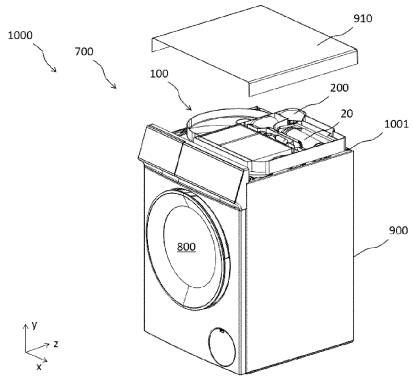

Fig. 1

EP 4 442 885 A1

Description

Technical Field

[0001] The invention relates to the technical field of laundry treatment apparatuses, and more particularly to a laundry treatment apparatus.

Background Art

[0002] Nowadays, with the development of the economy and the improvement of people's living standards, laundry treatment apparatuses (e.g. clothes dryers, wash-dryers, and the like) have entered millions of households. In order to provide the drying function, a laundry treatment apparatus is typically equipped with a heat pump system, which typically includes a compressor. Since the compressor releases a large amount of heat during operation, the compressor typically needs to be cooled down. However, when the compressor or even the entire heat pump system is provided in the area above the clothes accommodating cavity of a laundry treatment apparatus, since the space in this area is relatively limited, especially in height, additional height is required for the laundry treatment apparatus itself if a conventional cooling device is used, which is unfavorable for a compact design.

Summary of the Invention

[0003] In view of this, it is an object of embodiments of the invention to provide an improved laundry treatment apparatus to overcome at least one of the above disadvantages and/or other possible disadvantages not mentioned herein.

[0004] According to an embodiment of the invention, a laundry treatment apparatus is provided. The laundry treatment apparatus includes: a box; a clothes accommodating cavity provided in the box; and a heat pump module assembly provided in the box and positioned above the clothes accommodating cavity. The heat pump module assembly includes a heat pump system configured to be connected with the clothes accommodating cavity to form a drying circulation loop. The heat pump system includes a compressor, a condenser, and an evaporator connected in a closed loop via a coolant pipeline. The heat pump module assembly further includes an air-cooling device configured to cool the compressor. The air-cooling device has an airflow generating mechanism adapted to rotate about a rotation axis to generate an air flow. The air-cooling device is configured to discharge the air in a direction different from the rotation axis. As such, by enabling the air-cooling device to discharge the air in a direction different from the rotation axis, it is unnecessary to leave a design space that is too high for this air-cooling device, which has the advantage of a compact design, especially in the area above the clothes accommodating cavity with limited height space, and also ensures the necessary heat dissipation effect required by the compressor.

[0005] According to an optional embodiment of the invention, the compressor is configured as a horizontal compressor arranged between the clothes accommodating cavity and the top cover of the box. As such, in the case where the compressor is arranged between the clothes accommodating cavity and the top cover of the box, the space in the height direction is particularly likely to be limited. However, the cooling air volume can be ensured even in such a limited space with the air-cooling device of the embodiment of the invention. If other forms of air-cooling devices other than that of the invention are used, the distance between the clothes accommodating cavity and the top cover of the box needs to be additionally increased if a sufficient cooling air volume is to be ensured, which results in waste of space and resultant additional manufacturing costs.

[0006] According to an optional embodiment of the invention, the compressor includes a high-heat portion with high temperature and a low-heat portion with low temperature during operation, where the air-cooling device is configured to discharge the air toward the high-heat portion, and the discharged airflow preferably leaves the compressor from the low-heat portion. As such, the cooling airflow generated by the air-cooling device flows from the high-heat portion to the low-heat portion of the compressor and leaves. This can effectively cool the most heated portion of the compressor and beneficially take away the heat generated by the compressor during operation, and can prevent the hot air from accumulating inside the box, thereby further improving the heat dissipation effect.

[0007] According to an optional embodiment of the invention, the compressor includes a head and a motor assembly provided close to the head, wherein the high-heat portion is close to the head, the compressor includes a tail opposite to the head, the low-heat portion is close to the tail, and the air-cooling device is configured to enable the discharged airflow to flow from the head to the tail. As such, in the case where the compressor includes a motor assembly, the area of the motor assembly typically forms a high-heat portion. In the case where the motor assembly is close to the head of the compressor, heat generation is particularly severe at the head of the compressor. Therefore, by enabling the discharged airflow of the air-cooling device to flow from the head to the tail of the compressor, the heat generated by the compressor during operation can be taken away effectively, thereby achieving the purpose of cooling.

[0008] According to an optional embodiment of the invention, the compressor forms an installation inclination angle

of about 3° with the horizontal plane. As such, when the air-cooling device discharges the air to cool down the compressor, this further facilitates the discharged airflow to further flow through the compressor due to gravity, thereby achieving the purpose of effective cooling.

[0009] According to an optional embodiment of the invention, the rotation axis of the air-cooling device is arranged substantially vertically relative to the horizontal plane. As such, in the case where the rotation axis of the air-cooling device is arranged substantially vertically relative to the horizontal plane, and the air discharge direction of the air-cooling device is different from the direction of the rotation axis, this means that the air is discharged from the air-cooling device at least not vertically relative to the horizontal plane. That is, the air-cooling device itself does not need to occupy too much height space, thus achieving the purpose of saving installation space.

[0010] According to an optional embodiment of the invention, the air-cooling device is arranged higher than or above the installation position of the compressor. As such, it can be ensured that the cooling air flows through the compressor in a predetermined path due to gravity, for example, thereby achieving the purpose of effective cooling.

[0011] According to an optional embodiment of the invention, the air-cooling device includes a casing, the height of the casing being at most one half, particularly at most one third, of the diameter of the compressor. As such, an air-cooling device that is much smaller than the compressor in height is sufficient to cool down the compressor, thereby achieving the purpose of saving installation space.

[0012] According to an optional embodiment of the invention, the air-cooling device is configured as a centrifugal fan. As such, the purpose of cooling the compressor can be achieved by using a conventional centrifugal fan without additional design, thereby saving manufacturing costs.

[0013] According to an optional embodiment of the invention, the air-cooling device is closer to a peripheral wall of the box than the compressor. As such, the path for introducing the air from outside the box to the air-cooling device is shorter, which not only strengthens the cooling airflow to avoid additional airflow loss, but also allows the components of the heat pump module assembly to be installed more compactly.

[0014] According to an optional embodiment of the invention, when viewed from above, the air-cooling device discharges the air in a direction at an included angle in the range of 0° to 90° relative to the compressor shaft of the compressor, and particularly obliquely toward the compressor. As such, the air-cooling device discharges the air toward the compressor obliquely relative to the compressor shaft of the compressor, making the spatial arrangement more flexible. Particularly in the case where the air is discharged at a directional included angle of 0°to 90°, the cooling airflow experiences smaller air resistance from the end face of the compressor head and the airflow can circulate more easily, thereby providing better heat dissipation effect.

[0015] According to an optional embodiment of the invention, the laundry treatment apparatus includes an inlet air guide mechanism connected with the air-cooling device in the air inlet direction of the air-cooling device. The inlet air guide mechanism includes: a first air guide port positioned at the bottom of the air-cooling device; a second air guide port provided on the back wall of the box; and a connector (particularly a connecting hose) communicating the first air guide port with the second air guide port, the second air guide port being positioned lower than the first air guide port. As such, cool air is introduced from the outside through the connector of the inlet air guide mechanism, while the air inlet hole, such as the second air guide port, on the box can be provided at a lower position that does not interfere with the heat pump system, thereby making the spatial layout less cramped.

[0016] According to an optional embodiment of the invention, the laundry treatment apparatus includes a first accommodating housing in which the compressor is positioned, and the first accommodating housing has an airflow outlet close to the low-heat portion of the compressor. As such, by simply providing the airflow outlet close to the low-heat portion of the compressor in the first accommodating housing adapted to accommodate the compressor, it is particularly possible to realize guidance of the cooling airflow without an excessively complicated design of the first accommodating housing, thereby achieving the purpose of heat dissipation while effectively reducing manufacturing costs.

[0017] According to an optional embodiment of the invention, the first accommodating housing includes a flow guide side wall that is close to the air outlet of the air-cooling device and configured to have a curvature. As such, even if the air-cooling device is arranged in a position relative to the compressor that is not suitable for discharging the air directly toward the compressor, the cooling airflow can still be guided through the compressor via the flow guide side wall to achieve the purpose of cooling while reducing the dissipation of cooling air volume.

[0018] According to an optional embodiment of the invention, the laundry treatment apparatus includes a second accommodating housing in which the air-cooling device is positioned, and the second accommodating housing is integrally formed with the first accommodating housing. As such, the first and second accommodating housings can be manufactured particularly easily as a whole, thereby reducing unnecessary additional manufacturing processes.

[0019] According to an optional embodiment of the invention, the air-cooling device is installed horizontally in the box. As such, in the case where the heat pump module assembly is arranged in an area above the clothes accommodating cavity, installing the air-cooling device horizontally can particularly save unnecessary height space.

[0020] According to an optional embodiment of the invention, the air-cooling device is installed obliquely downwards in the box. As such, even if the compressor has a larger size than the air-cooling device, the air-cooling device can still

discharge the air obliquely downwards, so that the cooling airflow can flow through the compressor evenly, thereby achieving the purpose of cooling.

[0021] According to an optional embodiment of the invention, the air-cooling device forms a second included angle of at least 10°, preferably at least 15°, relative to the horizontal plane. As such, by forming a limited included angle between the air-cooling device and the horizontal plane, the air-cooling device is enabled to discharge the air obliquely downwards, thereby achieving the purpose of cooling the compressor, simply by adjusting the placement angle of the air-cooling device without too much additional design of the air-cooling device.

Description of the Drawings

[0022] The more detailed description below of the invention with reference to the accompanying drawings can provide better understanding of the principles, features, and advantages of the invention. In the accompanying drawings:

Fig. 1 shows a laundry treatment apparatus according to an exemplary embodiment of the invention, particularly a heat pump module assembly of the laundry treatment apparatus;
Fig. 2 shows a top view of a laundry treatment apparatus according to an exemplary embodiment of the invention, particularly a heat pump module assembly of the laundry treatment apparatus viewed from above;
Fig. 3 shows the positional relationship between an air-cooling device and a compressor of a laundry treatment apparatus according to another exemplary embodiment of the invention viewed from above;
Fig. 4 shows a rear view of a laundry treatment apparatus according to an exemplary embodiment of the invention;
Fig. 5 shows a separate perspective view of an air-cooling device of a laundry treatment apparatus according to an exemplary embodiment of the invention;
Fig. 6 shows an exploded view of the air-cooling device shown in Fig. 5;
Fig. 7 shows an axial fan that is different from the air-cooling device of the embodiments of the invention by comparison;
Fig. 8 shows a partial enlarged view of Fig. 2;
Fig. 9 shows a partial enlarged view of Fig. 4;
Fig. 10 shows a separate perspective view of a heat pump module assembly of a laundry treatment apparatus according to an exemplary embodiment of the invention;
Fig. 11 shows a partial top view of a base for a heat pump module assembly of a laundry treatment apparatus according to an exemplary embodiment of the invention, with components mounted thereon not shown;
Fig. 12 shows the positional relationship between an air-cooling device and a compressor of a laundry treatment apparatus according to an exemplary embodiment of the invention in a simplified side view;
Fig. 13 shows the positional relationship between an air-cooling device and a compressor of a laundry treatment apparatus according to another exemplary embodiment of the invention in a simplified side view; and
Fig. 14 shows the positional relationship between an air-cooling device and a compressor of a laundry treatment apparatus according to yet another exemplary embodiment of the invention in a simplified side view.

Detailed Description of Embodiments

[0023] In order to make the technical problems to be solved, technical solutions, and beneficial technical effects of the invention clearer, the invention will be further described in detail below with reference to the accompanying drawings and several exemplary embodiments. It should be understood that the specific embodiments described here are only intended to explain the invention and not to limit the scope of protection of the invention. Embodiments may share the same view or multiple views for description, but not all the features appearing in the same figure should be construed as essential features of an embodiment.

[0024] Before starting the description, it should be noted that for the sake of convenience, this document may use orientational terms or directional terms for description. The orientational terms or directional terms are relative to the conventional use state of the laundry treatment apparatus. This is clear for a person skilled in the art from the description of the invention without causing any confusion. In this case, these orientational terms and directional terms should not be construed simply as orientations or directions in any state. In other words, orientational or directional relations indicated by the terms "upper," "lower," "front," "rear," "left," "right," "vertical," "horizontal," "top," "bottom," "inside," "outside," "longitudinal," "transverse," "high," "front," "back," and the like in the description of the invention are based on the orientational or directional relations shown in the accompanying drawings, are only intended to facilitate description of the invention and simplification of the description, are not intended to indicate or imply that the device or element referred to must have a specific direction or be constructed and operated in a specific orientation, and therefore should not be understood as a limitation of the invention.

[0025] In addition, in the description of the invention, the expression "A and/or B" indicates all possible combinations

of A and B, such as A alone, B alone, or A and B. The terms "first" and "second" are used only for the purpose of description and should not be understood as indicating or implying relative importance or implicitly indicating the number of technical features indicated. Thus, a feature defined by "first" or "second" may explicitly or implicitly include one or more of the features.

[0026] First, for ease of understanding, the description in the background art section of the invention may be reviewed or recalled. One of the objects of the invention is to provide an improved laundry treatment apparatus. The laundry treatment apparatus includes: a box; a clothes accommodating cavity provided in the box; and a heat pump module assembly provided in the box and positioned above the clothes accommodating cavity. The heat pump module assembly includes: a heat pump system configured to be connected with the clothes accommodating cavity to form a drying circulation loop, the heat pump system including a compressor, a condenser, and an evaporator connected in a closed loop via a coolant pipeline; and an air-cooling device configured to cool the compressor, the air-cooling device having an airflow generating mechanism adapted to rotate about a rotation axis to generate an airflow, where the air-cooling device is configured to discharge the air in a direction different from the rotation axis. As such, by enabling the air-cooling device to discharge the air in a direction different from the rotation axis, it is unnecessary to leave too much height design space for this air-cooling device, which has the advantage of compact design, particularly in the area above the clothes accommodating cavity with limited height space, and also ensures the necessary heat dissipation effect required by the compressor.

[0027] Exemplary embodiments of the invention will be described below with reference to the accompanying drawings.

[0028] Fig. 1 shows a laundry treatment apparatus 1000 according to an exemplary embodiment of the invention, particularly a heat pump module assembly 700 of the laundry treatment apparatus 1000. Fig. 1 schematically shows the xyz coordinate system of the laundry treatment apparatus 1000, where x represents the width direction of the laundry treatment apparatus 1000, y represents the height direction of the laundry treatment apparatus 1000, and z represents the depth direction of extension from the outside to the inside of the laundry treatment apparatus 1000. For the sake of clarity, some of the accompany drawings are shown and described substantially with reference to this xyz coordinate system.

[0029] As shown in Fig. 1, the clothes treatment apparatus 1000 according to an exemplary embodiment of the invention includes a box 900 and a clothes accommodating cavity 800 provided in the box 900. Here, for example, for a drum-type laundry treatment apparatus 1000, the clothes accommodating cavity 800 should be particularly understood as, for example, an outer tub of a wash-dryer, and typically a rotatable inner tub is further provided inside the outer tub to directly accommodate clothes to be washed or dried. For other non-drum type laundry treatment apparatuses 1000, the clothes accommodating cavity 800 can be understood as a space for accommodating clothes to be dried or a container with such a space. By way of example, the laundry treatment apparatus 1000 may be configured as a heat pump dryer or a heat pump wash-dryer. As such, the laundry treatment apparatus 1000 may further include a heat pump module assembly 700 provided in the box 900 and above the clothes accommodating cavity 800. Optionally, the box 900 may further include a particularly detachable top cover 910, and Fig. 1 exemplarily shows a scene in which the heat pump module assembly 700 is exposed after the top cover 910 is removed.

[0030] Fig. 2 shows a top view of the laundry treatment apparatus 1000 according to an exemplary embodiment of the invention, particularly the heat pump module assembly 700 of the laundry treatment apparatus 1000 when viewed from above.

[0031] As shown in Fig. 2, the heat pump module assembly 700 includes a heat pump system 100 configured to be connected with the clothes accommodating cavity 800 to form a drying circulation loop. The heat pump system 100 includes a compressor 20, a condenser 30, an evaporator 40, and optionally a throttle 50 connected in a closed loop via a coolant pipeline 10. By way of example, such a drying circulation loop as an internal circulation loop of a heat pump dryer or a heat pump wash-dryer can operate as follows: a gaseous coolant (e.g. a gaseous refrigerant) is transformed from low-pressure gas into high-pressure gas by the compressor 20 and enters the condenser 30 through the coolant pipeline 10. Here, the gas releases heat and is liquefied into high-pressure liquid and enters the throttle 50, and then is optionally depressurized into low-pressure liquid by the throttle 50 and enters the evaporator 40, where the liquid absorbs heat and evaporates into low-pressure gas, and re-enters the compressor 20 for the next cycle therefrom. In this process, the compressor 20 generates heat due to its own high-power operation. Here, excessive heat will not only affect the operation of the compressor 20 itself, but also adversely affect the operation of the entire laundry treatment apparatus 1000.

[0032] As shown in Fig. 2 in conjunction with Fig. 1, the compressor 20 is preferably constructed as a horizontal compressor, and optionally has a metal surface that is heat conductive and a compressor shaft L2. This horizontal compressor is particularly suitable to be arranged between the clothes accommodating cavity 800 and the top cover 910 of the box 900.

[0033] As schematically shown in Fig. 2, the compressor 20 includes a high-heat portion 201 with high temperature and a low-heat portion 202 with low temperature during operation. By way of example, the high-heat portion 201 is one end of the compressor 20, and the low-heat portion 202 is the other end of the compressor 20. However, it should be

understood that the high-heat portion 201 or the low-heat portion 202 may also be some middle section of the compressor 20, respectively.

[0034] In order to cool the compressor 20, the heat pump module assembly 700 further includes an air-cooling device 200 fixed thereon by, for example, screws or buckles. The air-cooling device 200 preferably generates an airflow under the action of centrifugal force, so it is especially constructed as a centrifugal fan, so that the air volume can be increased by centrifugal force to achieve the purpose of cooling. Therefore, the air-cooling device 200 is preferably configured to discharge the air toward the high-heat portion 201, and the discharged airflow leaves the compressor 20 particularly from the low-heat portion 202 after absorbing the heat from the compressor 20.

[0035] Optionally, the air-cooling device 200 may be configured as a cooling fan with adjustable air volume and/or air pressure. For example, the laundry treatment apparatus 1000 may include a control unit (not shown) for the heat pump module assembly 700, which is adapted for, for example, DC power supply and control of the air-cooling device 200, and in particular, for adjustment of the air volume and/or air pressure of the air-cooling device 200 through current control. By way of example, the rotational speed of the air-cooling device 200 can be 4300rpm and the air volume can be $0.67m^3$/min when the power supply current is 0.4A, and the rotational speed can be 5500rpm and the air volume can be $0.86m^3$/min when the power supply current is 0.8A. Further, the laundry treatment apparatus 1000 may further include a detection unit (not shown) adapted to detect the temperature of the compressor 20. The control unit may also be configured to control the air volume and/or air pressure of the air-cooling device 200 based on the temperature detected by the detection unit, so as to be adapted for targeted cooling of the compressor 20 in different operating conditions.

[0036] As shown in Fig. 2 in conjunction with Fig. 1, the air-cooling device 200 is closer to the peripheral wall of the box 900 than the compressor 20. In Fig. 4, which is to be described next, the air-cooling device 200 is closer to the back plate or back wall 901 of the box 900 than the compressor 20. In other embodiments, however, the air-cooling device 200 may be closer to the side plate or side wall of the box 900 than the compressor 20.

[0037] Fig. 3 shows the positional relationship between the air-cooling device 200 and the compressor 20 of the laundry treatment apparatus 1000 according to another exemplary embodiment of the invention viewed from above.

[0038] As shown in Figs. 2 and 3, when viewed from above, the air-cooling device 200 discharges the air toward the compressor 20 at a directional included angle a0 in the range of 0° to 90° relative to the compressor shaft L2 of the compressor 20. Here, the directional included angle a0 in this angular range particularly ensures the necessary radiation area of the air-cooling device 200 to the compressor 20 to avoid excessive loss of the heat-dissipation air volume. In the example given in Fig. 2, the air-cooling device 200 discharges air toward the compressor 20 at a directional included angle a0 of about 50° relative to the compressor shaft L2 of the compressor 20, which is particularly applicable in the case where the top of the laundry treatment apparatus 1000 has limited installation space without occupying an excessively long installation space. Optionally, as shown in Fig. 3, the directional included angle a0 may also be, for example, 0°. That is, the air outlet 220 of the air-cooling device 200 discharges the air directly to the compressor 20, which is particularly applicable when the top of the laundry treatment apparatus 1000 has horizontally long and narrow installation space.

[0039] Fig. 4 shows a rear view of the laundry treatment apparatus 1000 according to an exemplary embodiment of the invention; Fig. 5 shows a separate perspective view of the air-cooling device 200 of the laundry treatment apparatus 1000 according to an exemplary embodiment of the invention; and Fig. 6 shows an exploded view of the air-cooling device 200 shown in Fig. 5.

[0040] As shown in Fig. 4 in conjunction with Figs. 5 and 6, the air-cooling device 200 has an airflow generating mechanism 210 adapted to rotate about the rotation axis L1 to generate an airflow. The airflow generating mechanism 210 may be configured to have at least one blade adapted to rotate about the rotation axis L1. Here, the air-cooling device 200 is configured to discharge the air in a direction different from the rotation axis L1, especially toward the compressor 20 (particularly toward the high-heat portion 201 of the compressor 20). Preferably, the air discharge direction of the air-cooling device 200 forms an angle of about 90° with the rotation axis L1. Here, for example, the air from the outside can be sucked in through the first air guide port 231 positioned at the bottom of the air-cooling device 200 along the axial direction with reference to the air-cooling device 200 itself (i.e. the direction of the rotation axis L1), compressed and transported through the blade or impeller of the airflow generating mechanism 210, and finally blown out from the air outlet 220 along the radial direction (here, e.g. the direction perpendicular to the rotation axis L1) for cooling the compressor 20.

[0041] As shown in Figs. 5 and 6, the air-cooling device 200 includes a casing 240 having a height H1, and the casing 240 is composed of a first casing member 241 and a second casing member 242, especially as shown in Fig. 6.

[0042] Fig. 7 shows an axial fan 200' that is different from the air-cooling device 200 of the embodiments of the invention as comparison.

[0043] As shown in Fig. 7, this axial fan 200' has a plurality of blades that rotate about a rotation axis L' to generate an airflow and has a height H'. It is clear from the figure that the air discharge direction of this axial fan 200' is the same as its rotation axis L'.

[0044] For reference, the comparison data of the axial fan 200' and the air-cooling device 200 configured as a centrifugal

fan of the laundry treatment apparatus 1000 according to an exemplary embodiment of the invention is given in the following table.

Table 1

	Axial fan 200'	Air-cooling device 200 configured as a centrifugal fan
Height	H'=60mm	H1=33mm
Rated voltage	DC24V	DC24V
Rated current	0.12A±10%	0.4A±10%
Rotational speed	4200±10%RPM	4200±10%RPM
Air volume	0.7m^3/min	0.67m^3/min

[0045] As can be clear from the above table, for the same heat-dissipation air volume to be obtained, the air-cooling device 200 constructed as a centrifugal fan of the laundry treatment apparatus 1000 according to an exemplary embodiment of the invention is only about half of the height H' of the axial fan 200'.

[0046] Even if other relevant data is taken into account, in the condition of the same installation space, the air-cooling device 200 constructed as a centrifugal fan of the laundry treatment apparatus 1000 according to an exemplary embodiment of the invention still has obvious advantages in terms of air volume.

[0047] Fig. 8 shows a partial enlarged view of Fig. 2.

[0048] As shown in Fig. 8 in conjunction with Fig. 2, the compressor 20 includes a head 22 and a tail 23 opposite to the head 22. For the sake of work efficiency of the compressor 20 itself, the compressor 20 may have a motor assembly 21 close to the head 22, so the temperature is high at this position, that is, the high-heat portion 201 is close to the head 22. The low-heat portion 202 is close to the tail 23, so the air-cooling device 200 is preferably configured to enable the discharged airflow to flow from the head 22 to the tail 23. As can be understood, the compressor 20 can be driven by other driving means than the motor assembly 21, such as hydraulic driving or other hybrid driving means. Any of these driving means may cause the temperature of the compressor 20 to be too high, which requires cooling, but the heating issue is particularly serious for the compressor 20 driven by the motor assembly 21, so it is particularly suitable to use the air-cooling device 200 provided by the embodiment of the invention for cooling. Exemplary data is given here for reference. For example, for a compressor with power of 500W, cooling down can be realized only by using an air-cooling device with power of 10W provided by the embodiment of the invention, and the cooling effect can probably reduce the surface temperature of the compressor by about 10°C.

[0049] Fig. 9 shows a partial enlarged view of Fig. 4; and Fig. 10 shows a separate perspective view of a heat pump module assembly 700 of a laundry treatment apparatus 1000 according to an exemplary embodiment of the invention.

[0050] As shown in Fig. 10, the laundry treatment apparatus 1000 includes an inlet air guide mechanism 230 connected to the air-cooling device 200 in the air inlet direction of the air-cooling device 200. Here, especially as shown in conjunction with Figs. 6 and 9, the inlet air guide mechanism 230 includes: a first air guide port 231 positioned at the bottom of the air-cooling device 200; a second air guide port 232, exemplified by a plurality of air inlets, provided on the back wall 901 of the box 900; and a connector 233 communicating the first air guide port 231 with the second air guide port 232, the position of the second air guide port 232 being lower than the first air guide port 231. Particularly in the case where a connecting hose is used as the connector 233 as shown in Fig. 10, this can be more advantageously adapted to different heights between the first air guide port 231 and the second air guide port 232, and hence adapted to different installation conditions of the laundry treatment apparatus 1000.

[0051] Fig. 11 shows a partial top view of a base for the heat pump module assembly 700 of the laundry treatment apparatus 1000 according to an exemplary embodiment of the invention, with various components installed thereon not shown.

[0052] As shown in Fig. 11 in conjunction with Fig. 8, the laundry treatment apparatus 1000 includes a first accommodating housing 101 in which the compressor 20 is positioned, and the first accommodating housing 101 has an airflow outlet 303 close to the low-heat portion 202 (the right side in the drawing, by way of example) of the compressor 20. As such, the cooling airflow from the air-cooling device 200 can particularly be guided to leave at the airflow outlet 303 due to gravity after absorbing the heat of the compressor 20. Preferably, the first accommodating housing 101 includes a guide side wall 301, which is close to the air outlet 220 of the air-cooling device 200 and is configured to have a curvature (here, for example, configured as a curved surface). This is particularly adapted to enable the cooling air to flow over the compressor surface in a more targeted manner for the purpose of heat dissipation.

[0053] As shown in Fig. 11, the laundry treatment apparatus 1000 further includes a second accommodating housing 102 in which the air-cooling device 200 is positioned, and the second accommodating housing 102 and the first accom-

modating housing 101 are preferably integrally formed. Here, "integrally formed" should be particularly understood as two parts being formed into one piece in one manufacturing process instead of combining multiple pieces by subsequent processing. Of course, alternatively, the second accommodating housing 102 and the first accommodating housing 101 may also be combined by subsequent processing, such as welding or bonding.

[0054] Fig. 12 shows the positional relationship between the air-cooling device 200 and the compressor 20 of the laundry treatment apparatus 1000 according to an exemplary embodiment of the invention in a simplified side view; Fig. 13 shows the positional relationship between the air-cooling device 200 and the compressor 20 of the laundry treatment apparatus 1000 according to another exemplary embodiment of the invention in a simplified side view; and Fig. 14 shows the positional relationship between the air-cooling device 200 and the compressor 20 of the laundry treatment apparatus 1000 according to yet another exemplary embodiment of the invention in a simplified side view. In Figs. 13 and 14, the discharged airflow of the air-cooling device 200 is also exemplarily shown by dotted arrows.

[0055] As can be seen from Figs. 12 to 14 in conjunction with the aforementioned drawings, since the space above the clothes accommodating cavity 800 of the laundry treatment apparatus 1000 for installing the heat pump module assembly 700 is extremely limited, and the installation height depends on the height of the compressor 20 itself as exemplarily shown in Figs. 12 to 14 in some cases, the air-cooling device 200 provided by the embodiment of the invention is adapted to change the wind direction in this limited space, so it is not necessary to deliberately choose an axial fan with an excessively large size, and the positional relationship of the air-cooling device 200 relative to the compressor 20 can be set more flexibly through the arrangement as shown by way of example in Figs. 12 to 14, so as to adapt to the laundry treatment apparatuses 1000 with different installation spaces.

[0056] As shown in Fig. 12, the compressor 20 forms an installation inclination angle b0 of about 3° with the horizontal plane 1001, particularly toward the air-cooling device 200. Here, the horizontal plane 1001 can also be understood as the reference horizontal plane where the laundry treatment apparatus 1000 or the heat pump system 100 is positioned (for example, referring to Fig. 1, and it can also be understood as the xz plane).

[0057] As shown in Fig. 12, the air outlet 220 of the air-cooling device 200 is substantially at a distance d0 of 35mm from the compressor 20. For the laundry treatment apparatus 1000 with a conventional size, this particularly ensures the compactness of various components while advantageous air circulation can be achieved.

[0058] As shown in Figs. 12 to 14, the rotation axis L1 of the air-cooling device 200 is arranged substantially vertically relative to the horizontal plane 1001. Here, particularly within the scope of the invention, the term "substantially" should be understood as not exceeding 20%, particularly 15%, and preferably 10% from the exact value. Therefore, for example, the term "arranged substantially vertically" can be understood as the included angle of the rotation axis L1 of the air-cooling device 200 relative to the horizontal plane 1001 is between 72° and 108°, preferably 90°.

[0059] As shown in Figs. 12 to 14, the height H1 of the air-cooling device 200 itself or the height H1 of the casing 240 is at most one half, particularly at most one third, of the diameter d1 of the compressor 20. Here, as an example, the height H1 of the casing 240 is about 33mm, for example, and the diameter d1 of the compressor 20 is about 100mm, for example. As shown in the figures, the air-cooling device 200 is arranged higher than or above the installation position of the compressor 20. This particularly means here that the horizontal axis (not shown here) of the air-cooling device 200 is arranged higher than the compressor shaft L2 of the compressor 20.

[0060] In Figs. 12 and 13, it is schematically shown that the air-cooling device 200 is horizontally installed in the box 900. In particular, the rotation axis L1 of the air-cooling device 200 is perpendicular to the horizontal plane 1001.

[0061] In Fig. 14, it is schematically shown that the air-cooling device 200 is installed obliquely downwards in the box 900. Specifically, the air-cooling device 200 forms a second included angle a2 with the horizontal plane 1001. Here, the second included angle a2 is optionally about 15°, for example, preferably at least 10°, or preferably at least 15°.

[0062] As shown in Fig. 13, the air outlet 220 of the air-cooling device 200 may include a guide bottom wall 223 extending obliquely downwards (particularly gently). Preferably, the guide bottom wall 223 forms a first included angle a1 between 5° and 15°, particularly about 10°, with the horizontal plane 1001. Since the air-cooling device 200 configured as a centrifugal fan, for example, has a higher air pressure than a conventional axial fan, the smooth transition is more favorable for maintaining the air pressure. However, in order to ensure the compactness of the heat pump module assembly 700, the guide bottom wall 223 can preferably be gently inclined downwards to ensure that the downward inclination angle is not too large, which is particularly favorable for ensuring the air pressure required for heat dissipation of the compressor 20.

[0063] Although specific implementations of the invention have been described in detail here, they are only given for the purpose of explanation and should not be considered as limiting the scope of the invention. Various substitutions, changes, and modifications can be conceived without departing from the spirit and scope of the invention.

Claims

1. A laundry treatment apparatus (1000), comprising:

a box (900);
a clothes accommodating cavity (800) provided in the box (900); and
a heat pump module assembly (700) provided in the box (900) and positioned above the clothes accommodating cavity (800), the heat pump module assembly (700) comprising:

a heat pump system (100) configured to be connected with the clothes accommodating cavity (800) to form a drying circulation loop, the heat pump system (100) comprising a compressor (20), a condenser (30), and an evaporator (40) connected in a closed loop via a coolant pipeline (10); and
an air-cooling device (200) configured to cool the compressor (20), the air-cooling device (200) having an airflow generating mechanism (210) adapted to rotate about a rotation axis (L1) to generate an airflow, wherein the air-cooling device (200) is configured to discharge air in a direction different from the rotation axis (L1).

2. The laundry treatment apparatus (1000) as claimed in claim 1, wherein

the compressor (20) is configured as a horizontal compressor arranged between the clothes accommodating cavity (800) and a top cover (910) of the box (900); and/or
the compressor (20) comprises a high-heat portion (201) with high temperature and a low-heat portion (202) with low temperature during operation, wherein the air-cooling device (200) is configured to discharge air toward the high-heat portion (201), and the discharged airflow preferably leaves the compressor (20) from the low-heat portion (202).

3. The laundry treatment apparatus (1000) as claimed in claim 2, wherein

the compressor (20) comprises a head (22) and a motor assembly (21) provided close to the head (22), wherein the high-heat portion (201) is close to the head (22), the compressor (20) comprises a tail (23) opposite to the head (22), the low-heat portion (202) is close to the tail (23), and the air-cooling device (200) is configured to enable the discharged airflow to flow from the head (22) to the tail (23); and/or
the compressor (20) forms an installation inclination angle (b0) of about 3° with the horizontal plane (1001).

4. The laundry treatment apparatus (1000) as claimed in any of claims 1 to 3, wherein

the rotation axis (L1) of the air-cooling device (200) is arranged substantially vertically relative to the horizontal plane (1001); and/or
the air-cooling device (200) is arranged higher than or above the installation position of the compressor (20); and/or
the air-cooling device (200) comprises a casing (240), the height (H1) of the casing (240) being at most one half, particularly at most one third, of the diameter (d1) of the compressor (20); and/or
the air-cooling device (200) is configured as a centrifugal fan.

5. The laundry treatment apparatus (1000) as claimed in claim 4, wherein
the air-cooling device (200) is closer to a peripheral wall of the box (900) than the compressor (20); and when viewed from above, the air-cooling device (200) preferably discharges the air at a directional included angle (a0) in the range of 0° to 90° relative to the compressor shaft (L2) of the compressor (20), and particularly obliquely toward the compressor (20).

6. The laundry treatment apparatus (1000) as claimed in any of claims 1 to 5, wherein
the laundry treatment apparatus (1000) comprises an inlet air guide mechanism (230) connected with the air-cooling device (200) in the air inlet direction of the air-cooling device (200), the inlet air guide mechanism (230) comprising:

a first air guide port (231) positioned at the bottom of the air-cooling device (200);
a second air guide port (232) provided on a back wall (901) of the box (900); and
a connector (233), particularly a connecting hose, communicating the first air guide port (231) with the second air guide port (232),
wherein the position of the second air guide port (232) is lower than the first air guide port (231).

7. The laundry treatment apparatus (1000) as claimed in any of claims 2 to 6, wherein
the laundry treatment apparatus (1000) comprises a first accommodating housing (101) in which the compressor

(20) is positioned, and the first accommodating housing (101) has an airflow outlet (303) close to the low-heat portion (202) of the compressor (20).

8. The laundry treatment apparatus (1000) as claimed in claim 7, wherein the first accommodating housing (101) comprises a flow guide side wall (301) close to the air outlet (220) of the air-cooling device (200) and configured to have a curvature.

9. The laundry treatment apparatus (1000) as claimed in claim 7 or 8, wherein the laundry treatment apparatus (1000) comprises a second accommodating housing (102) in which the air-cooling device (200) is positioned, and the second accommodating housing (102) and the first accommodating housing (101) are integrally formed.

10. The laundry treatment apparatus (1000) as claimed in any of claims 1 to 9, wherein the air-cooling device (200) is horizontally installed in the box (900).

11. The laundry treatment apparatus (1000) as claimed in any of claims 1 to 9, wherein the air-cooling device (200) is installed obliquely downwards in the box (900).

12. The laundry treatment apparatus (1000) as claimed in claim 11, wherein the air-cooling device (200) forms a second included angle (a2) of at least 10°, preferably at least 15°, with the horizontal plane (1001).

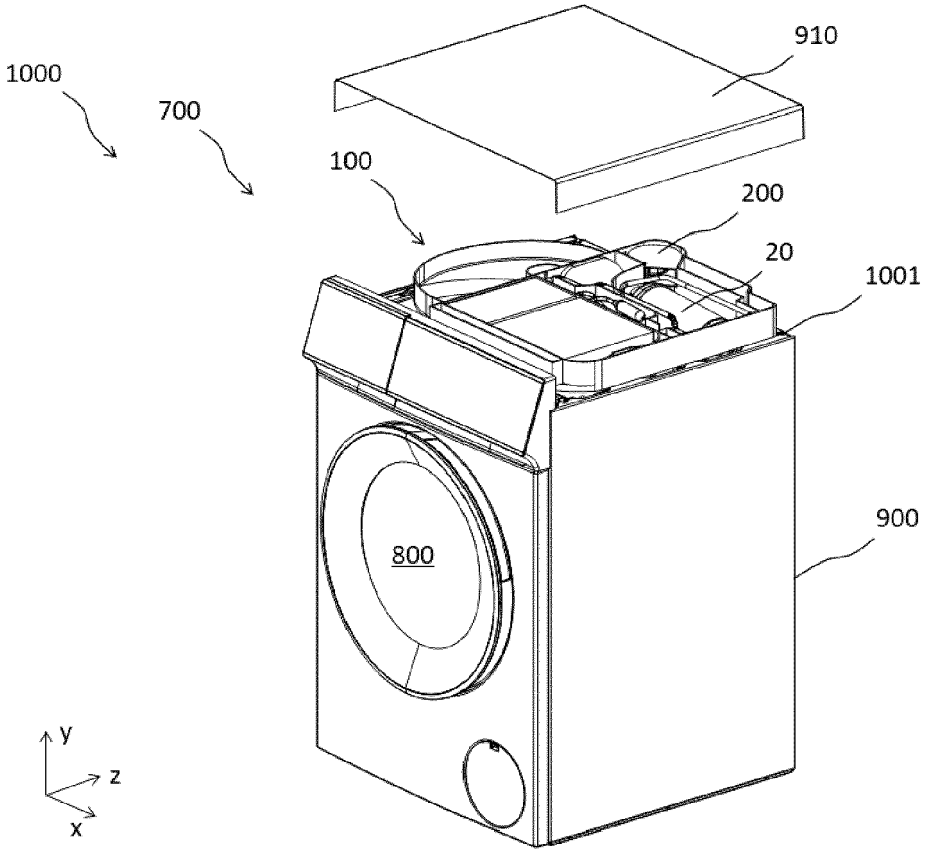

Fig. 1

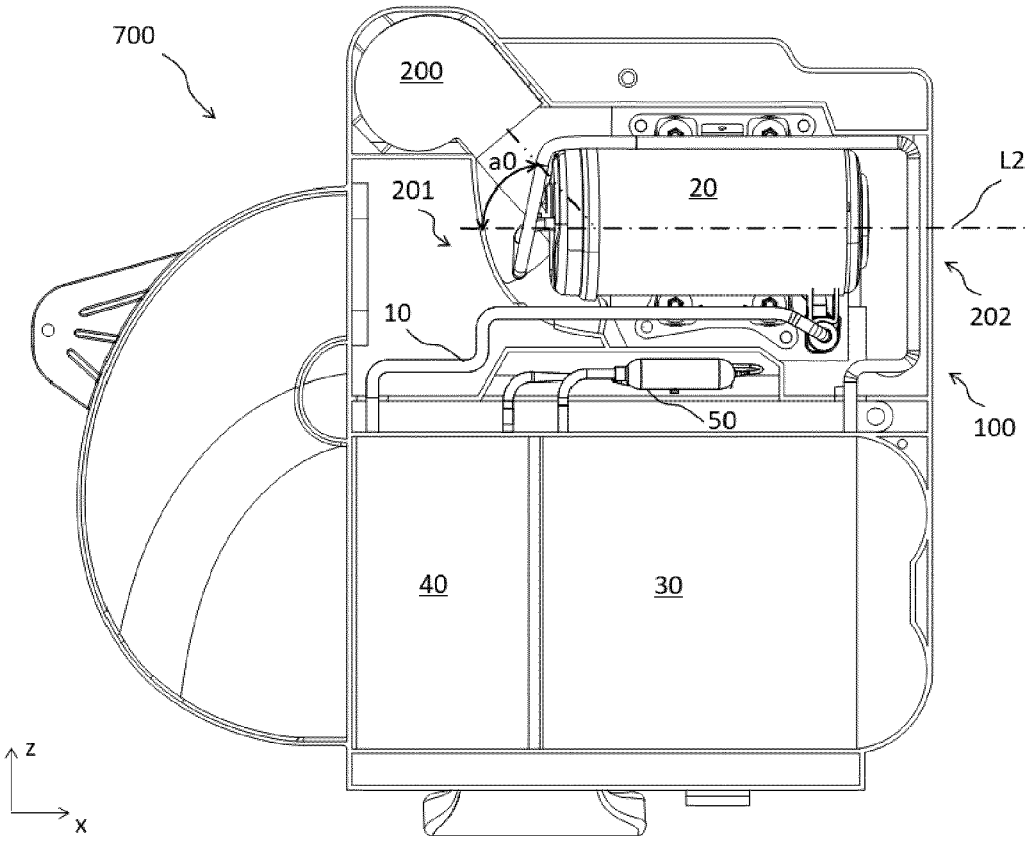

Fig. 2

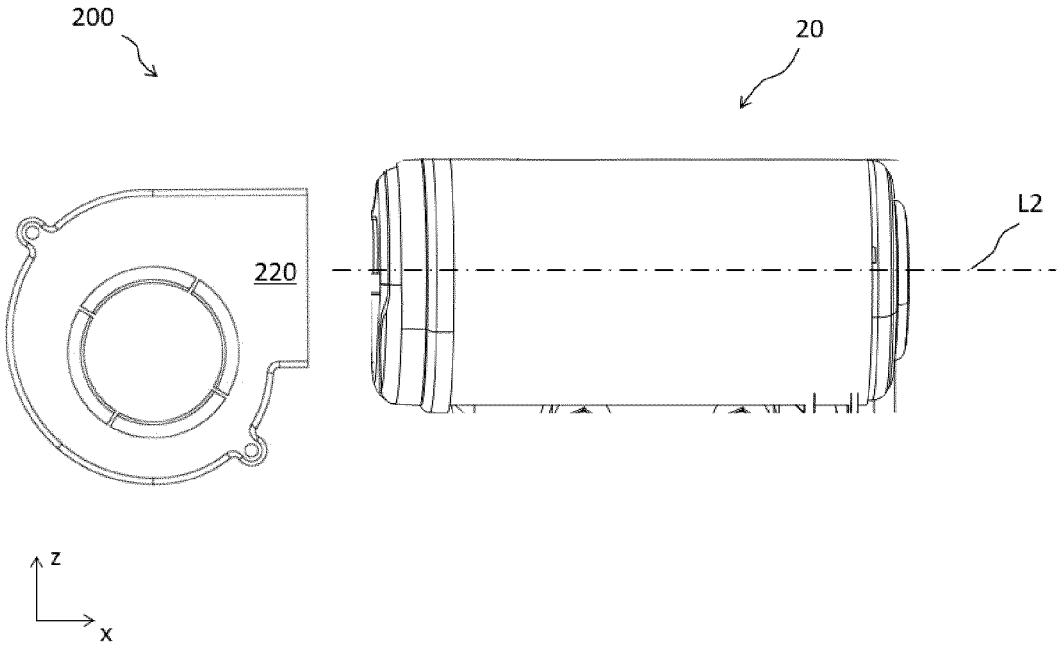

Fig. 3

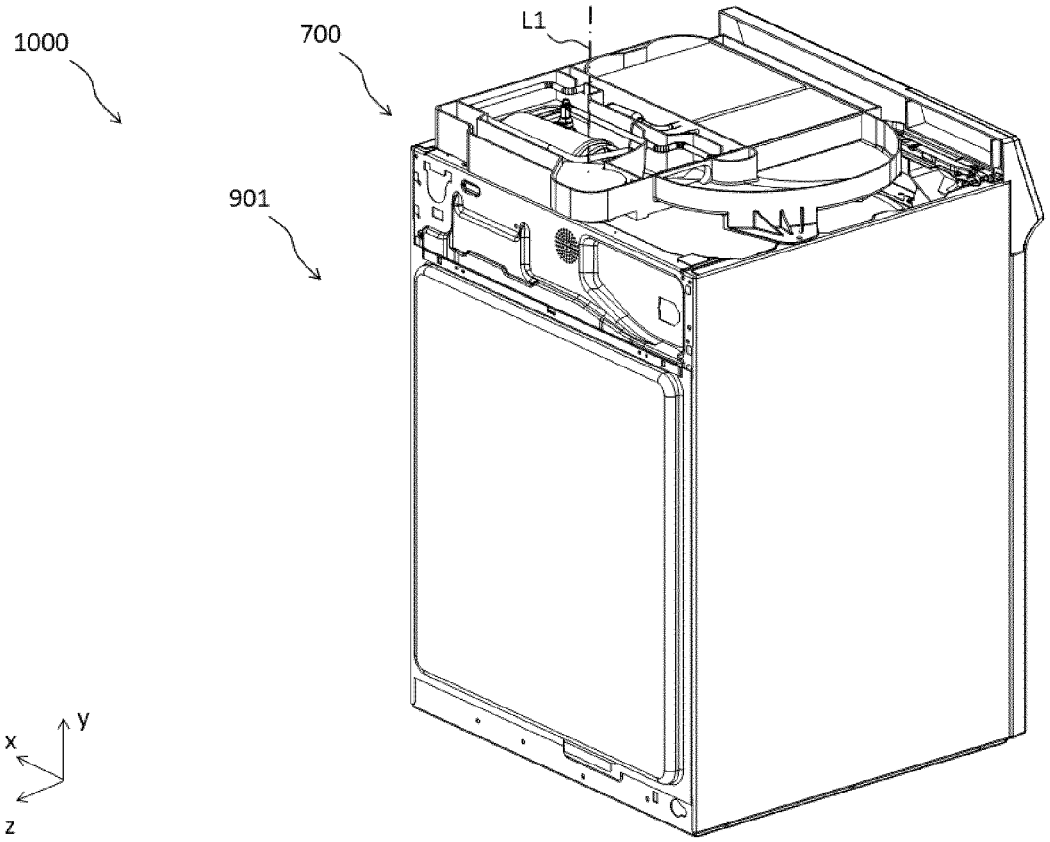

Fig. 4

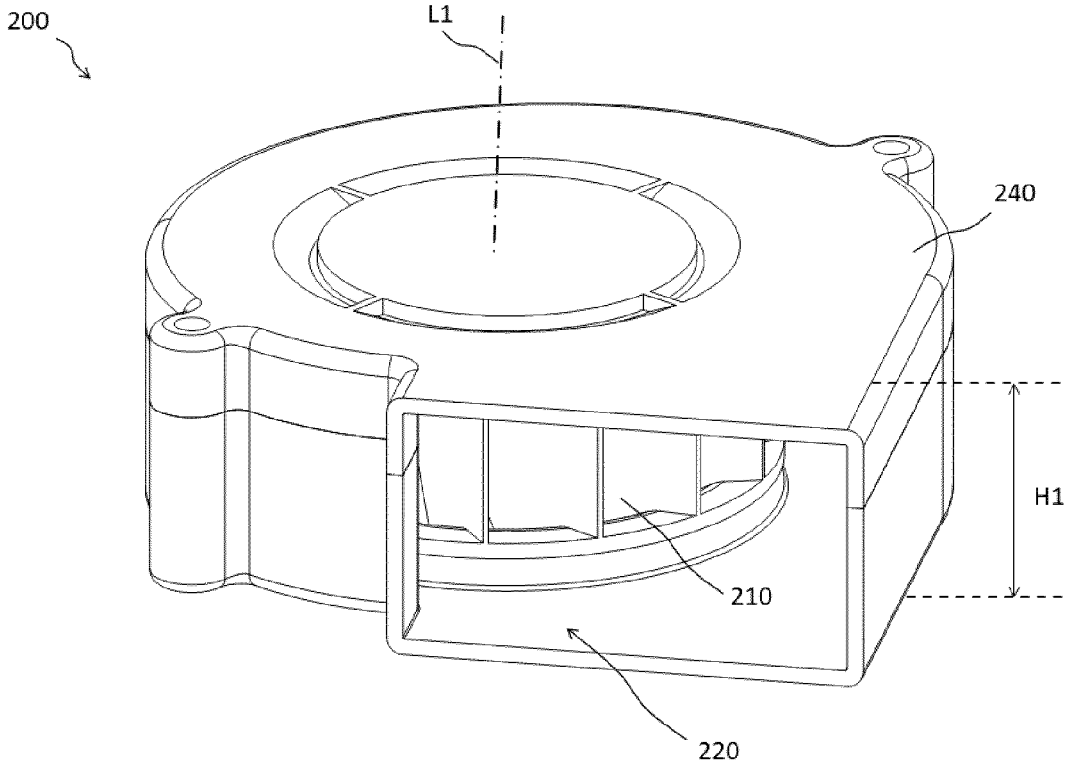

Fig. 5

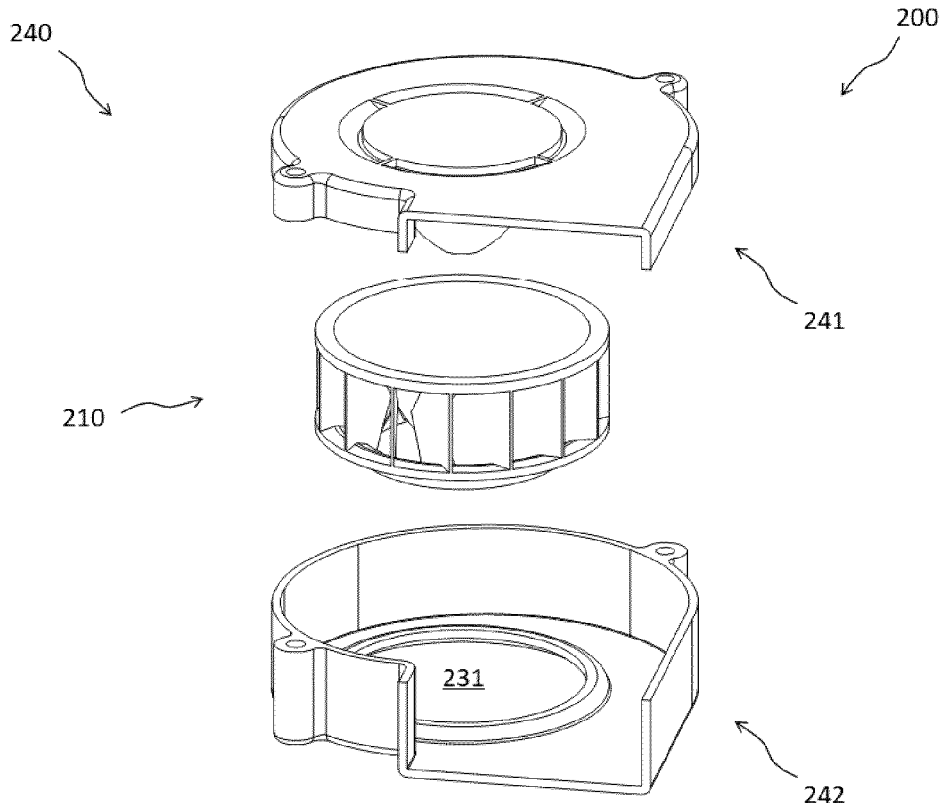

Fig. 6

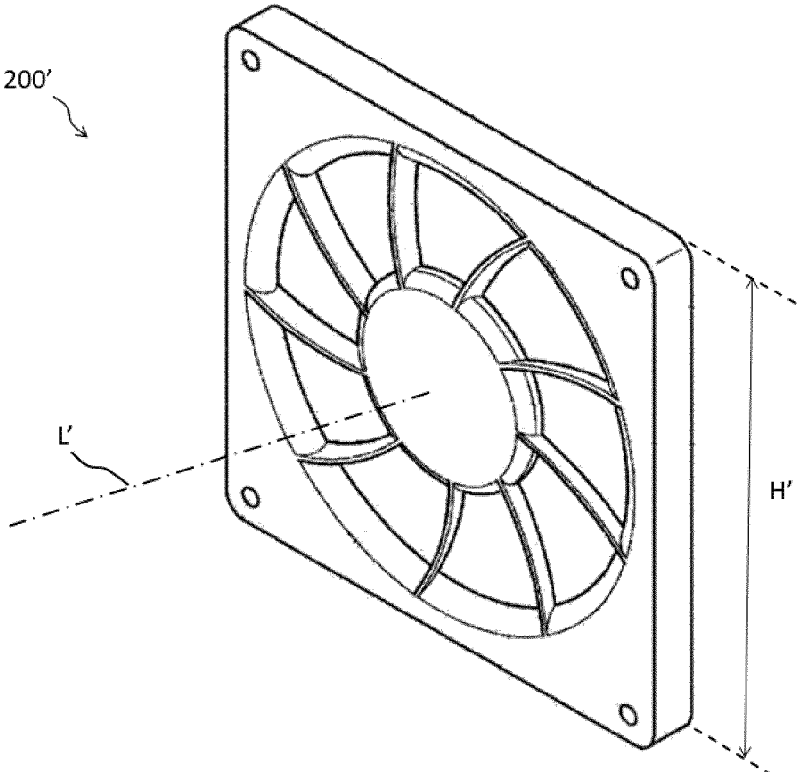

Fig. 7

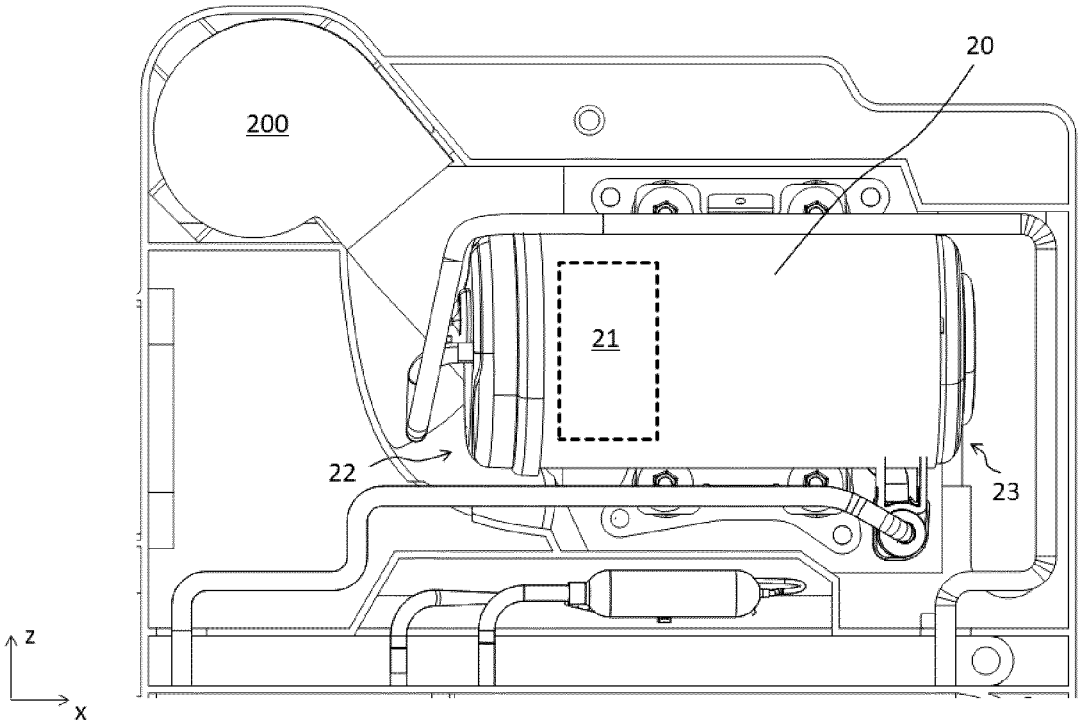

Fig. 8

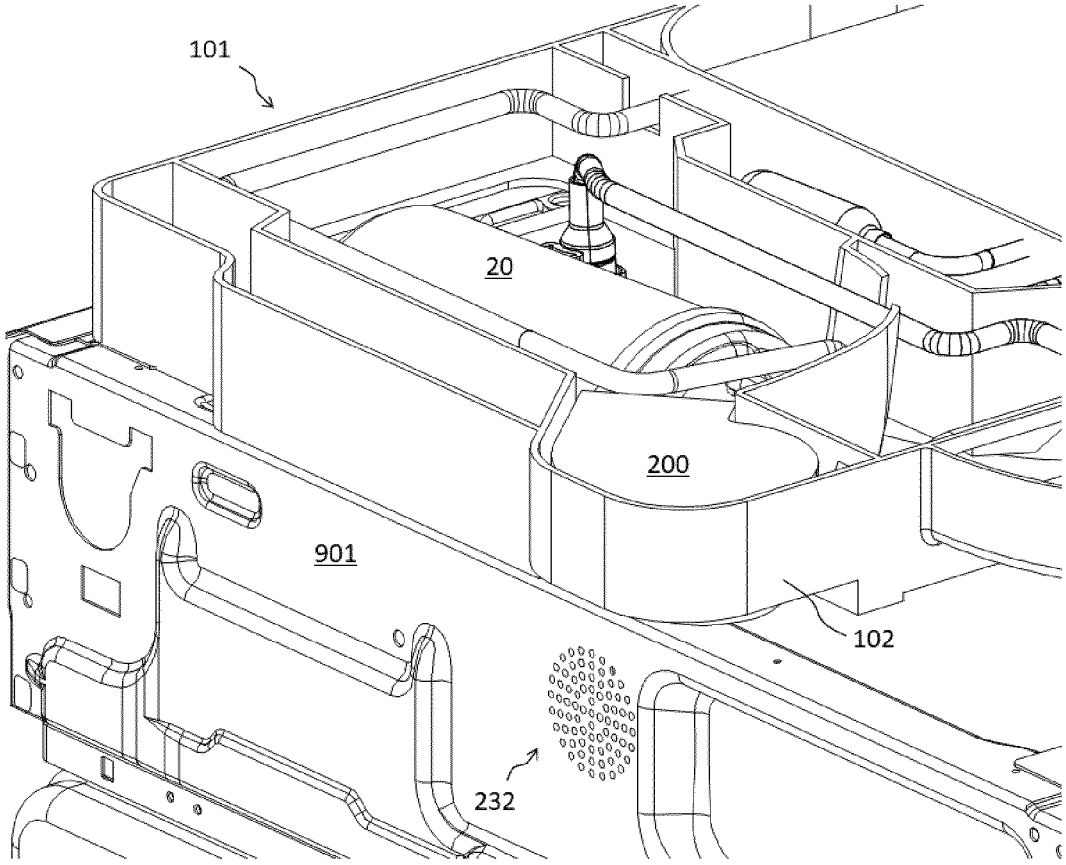

Fig. 9

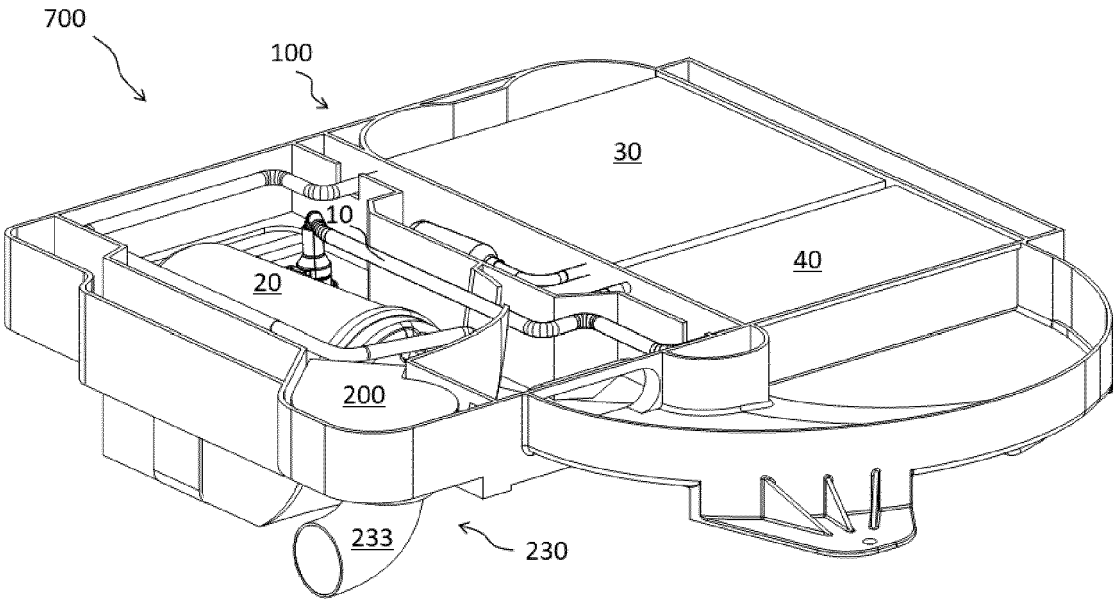

Fig. 10

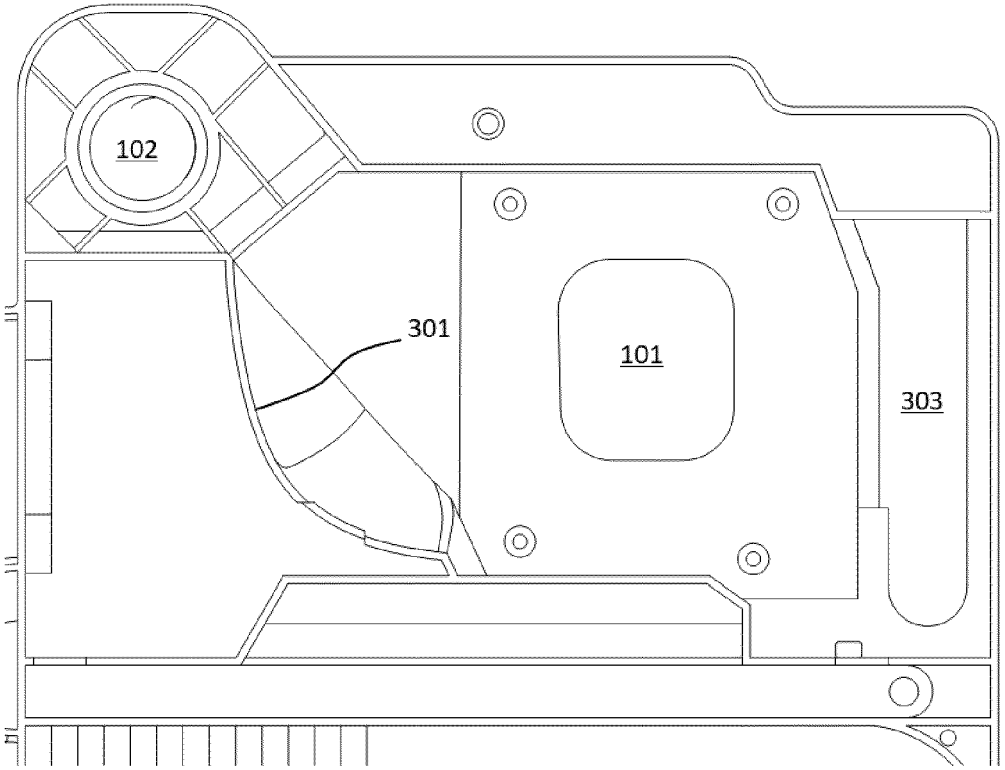

Fig. 11

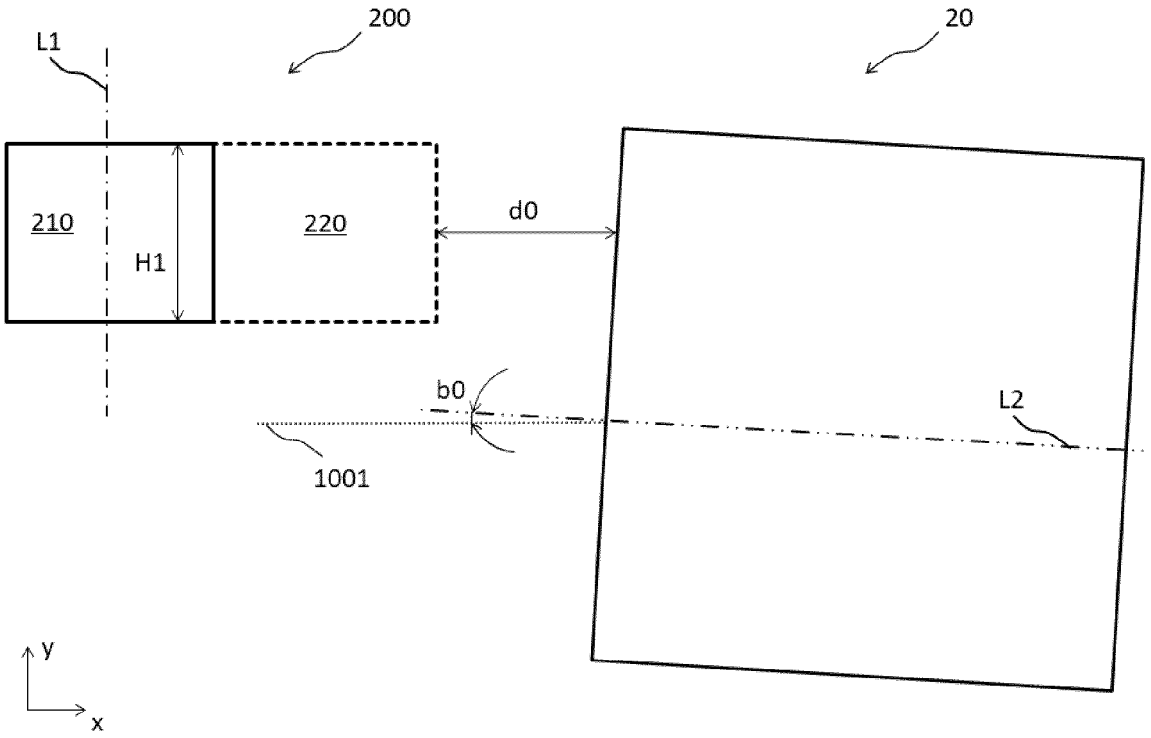
L1
200
20
210
H1
220
d0
b0
L2
1001
y
x

Fig. 12

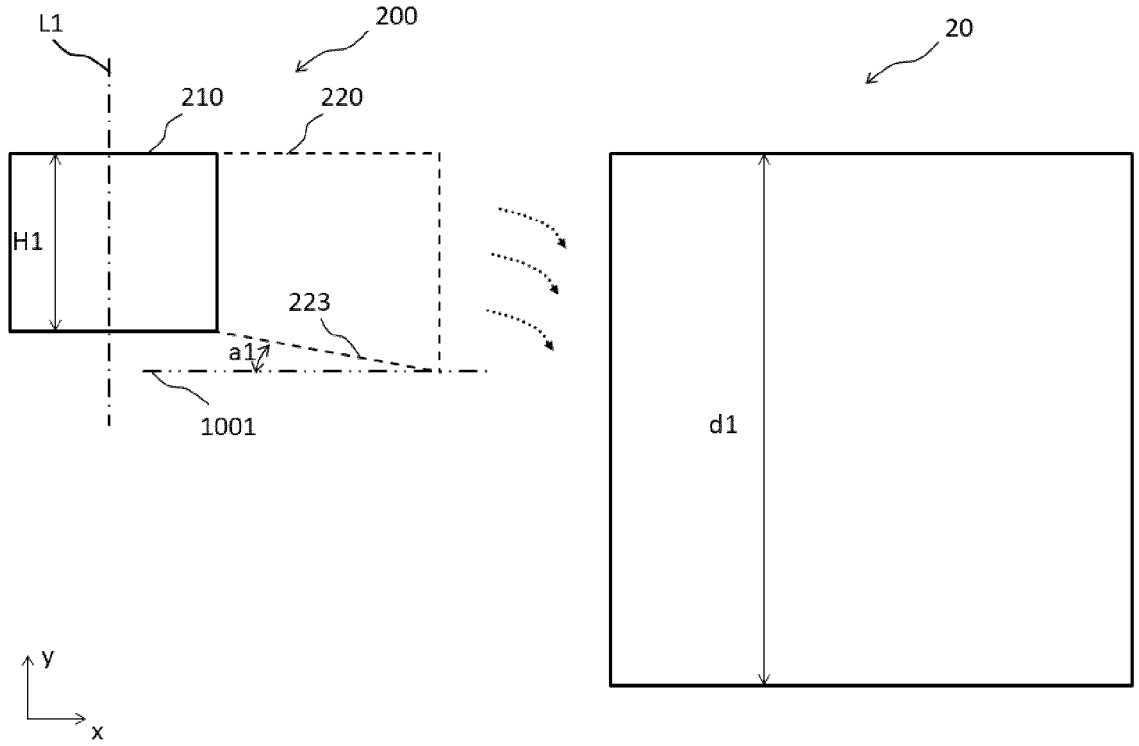
L1
200
20
210
220
H1
223
a1
1001
d1
y
x

Fig. 13

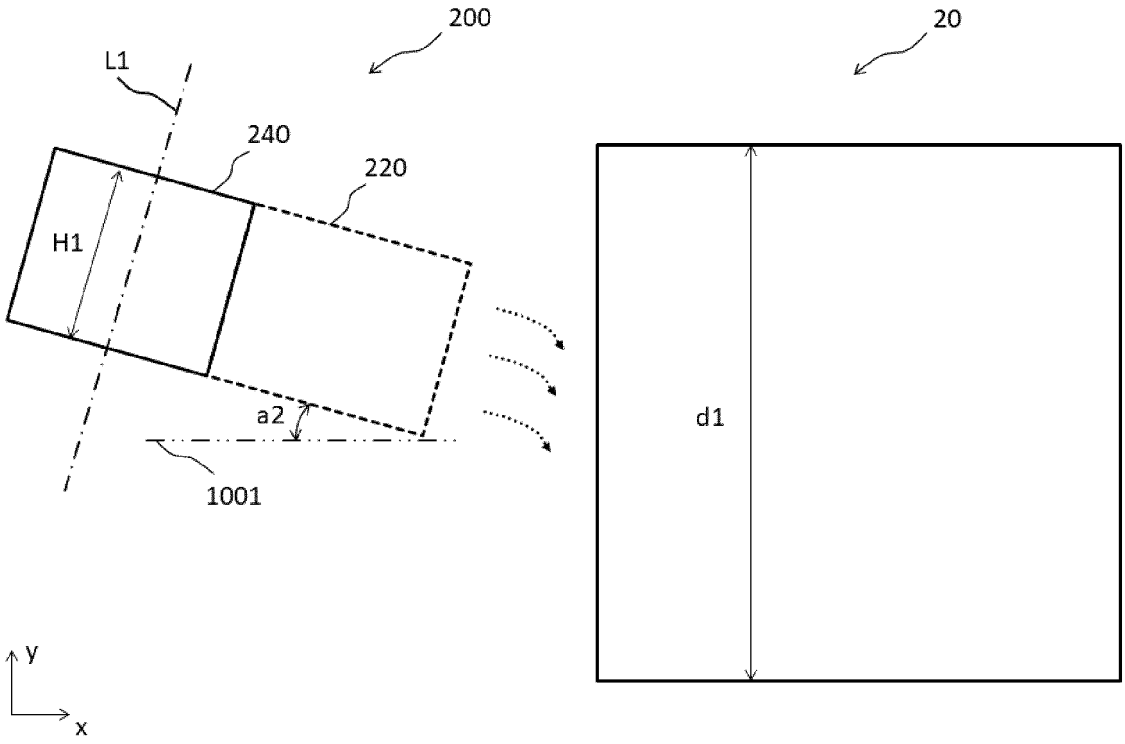

Fig. 14

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 24 16 3147

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 3 015 591 A1 (LG ELECTRONICS INC [KR]) 4 May 2016 (2016-05-04) * paragraphs [0043] - [0105] * * figures 1-5B *	1-12	INV. D06F25/00 D06F58/20
A	EP 3 252 220 A1 (WUXI LITTLE SWAN CO LTD [CN]) 6 December 2017 (2017-12-06) * paragraphs [0022] - [0034] * * figures 1-3 *	1,2,4,5, 10-12	
A	EP 3 026 168 A1 (HANGZHOU SANHUA RES INST CO LTD [CN]) 1 June 2016 (2016-06-01) * paragraphs [0022] - [0032] * * figures 1-9 *	1	
A	EP 3 792 389 A1 (LG ELECTRONICS INC [KR]) 17 March 2021 (2021-03-17) * paragraphs [0158] - [0193] * * paragraph [0236] * * figures 1, 4 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	29 July 2024	Weidner, Maximilian

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 16 3147

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

29-07-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3015591 A1	04-05-2016	CN 105544144 A	04-05-2016
		EP 3015591 A1	04-05-2016
		KR 20160049735 A	10-05-2016
		US 2016115638 A1	28-04-2016
EP 3252220 A1	06-12-2017	EP 3252220 A1	06-12-2017
		US 2017342649 A1	30-11-2017
EP 3026168 A1	01-06-2016	CN 105696290 A	22-06-2016
		EP 3026168 A1	01-06-2016
EP 3792389 A1	17-03-2021	AU 2019265183 A1	07-01-2021
		AU 2023200427 A1	02-03-2023
		CN 112088231 A	15-12-2020
		EP 3792389 A1	17-03-2021
		US 2021230788 A1	29-07-2021
		WO 2019216631 A1	14-11-2019

EPO FORM P0459

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