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(54) LAUNDRY TREATING MACHINE

(57) The present invention relates to a laundry treating machine (1) comprising:
• a cabinet (2) with a basement (24) defining a bottom wall (23) of the cabinet (2) in a horizontal plane (X,Y);
• a drum (3) rotatably accommodated within said cabinet (2);
• a heat pump system (30) comprising a compressor (33) and a compressor cooling fan (60) housed in said basement (24), the compressor (33) substantially extending in a vertical direction Z perpendicular to the horizontal plane (X,Y), from a basement lower part (33b), placed onto said bottom wall (23), to an upper part (33a), located in an upper part (24a) of the basement (24);
• wherein the compressor cooling fan (60) is positioned onto said bottom wall (23) in a tilted position so that the main air flow is blown by the compressor cooling fan (60) along a direction tilted upward, towards the upper part (33a) of the compressor (33).

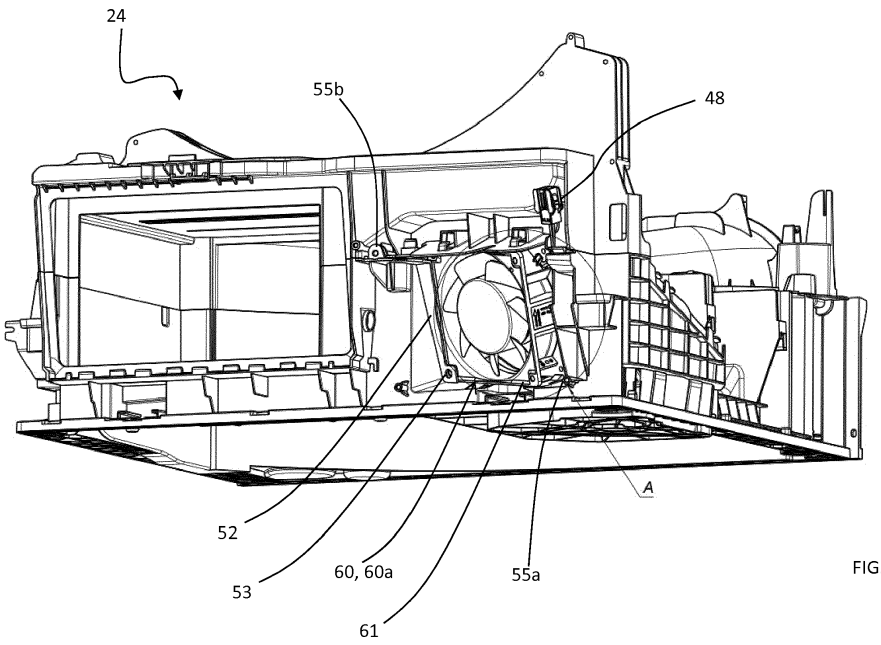

FIG. 4

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Description

Technical field

[0001] The present invention relates to a laundry machine. In particular, the present invention relates to a laundry machine with a heat pump system.

[0002] In the present description, the laundry machine can be a washer machine, a dryer machine or a washer-dryer machine (i.e. a machine that can both wash and dry the laundry).

Background of the invention

[0003] Laundry machines typically have a bearing structure or cabinet, which generally includes a front wall, a rear wall, a top wall, a bottom wall, as well as sidewalls. The bottom wall is part of a basement wherein the front wall, the rear wall and the sidewalls are mounted. The front wall is suitably provided with a through opening, at which a door is mounted to access a drum for laundry loading/removal. The drum is mounted into the cabinet, rotatable around an axis. Such an axis can be horizontal, vertical or tilted. The drum, where the laundry items are contained in order to be treated (dried and/or washed), is actuated through an electric motor. In operation, the drum is made to rotate in order to cause agitation of the laundry items to be processed, which repeatedly tumble into the drum while being processed by a process fluid, as process water and/or air. In a washer or washer-dryer, the drum is rotatable within a tub.

[0004] In laundry machines, it is known to heat the process fluid with a heat pump system. The heat pump system typically comprises a compressor, a first heat exchanger and a second heat exchanger forming a refrigerant circuit configured to circulate a refrigerant. The first heat exchanger is typically configured to cool the refrigerant and to heat the process fluid (e.g. process water in a washing cycle or process air in a drying cycle) that flows towards the drum, while the second heat exchanger is configured to heat said refrigerant. In case of a dryer, the second heat exchanger is also configured to dehumidify and cool the process air exiting the drum.

[0005] In order to cool the compressor and to avoid overheating that may occur during operation of the same, it is known to use a compressor cooling fan.

[0006] The Applicant observed that the part of the compressor, which is mainly overheated during operation, is the upper part thereof, wherein the compressor motor is typically placed. The Applicant further observed that the heat exchangers, the compressor and the process fluid conduits used for channeling the process fluid from and into the drum, are mainly placed into the basement of the cabinet. The room of the basement is thus very packed so that it is very difficult to find a proper space for placing the compressor cooling fan. In particular, it is very difficult to place the compressor cooling fan in the basement in a position that guarantees that the main flow of air blown by the compressor cooling fan (which typically has a lower vertical extent than the compressor) directly points to the upper part of the compressor. For example, a position of the compressor cooling fan at an upper part of the basement, so that the output face of the fan directly faces the upper part of the compressor, even if optimal for efficiently cooling the upper part of the compressor, would be very critical in term of available room in the basement. In fact, the upper part of the basement is very packed due to the presence of the above mentioned process fluid conduits and of the opening for the laundry loading/removal. Moreover, interferences between the compressor cooling fan and the bottom part of the drum facing the basement may occur.

[0007] Accordingly, an efficient cooling of the compressor poses the problem of overcoming challenging design constraints.

Summary of the invention

[0008] It is thus an object of the invention to provide a laundry machine with a heat pump system wherein the compressor is efficiently air cooled by a compressor cooling fan.

[0009] It is another object of the invention to provide a laundry machine with a heat pump system and a compressor cooling fan, wherein the compressor cooling fan has an improved design and positioning into the laundry machine aiming at improving the compressor cooling.

[0010] The Applicant found that the above objects are achieved by a laundry machine comprising a basement and a heat pump system with a compressor and a compressor cooling fan, wherein the compressor cooling fan is positioned within the basement in a tilted position so that the main air flow blown by the compressor cooling fan is tilted upward, towards an upper part of the compressor. This solution is advantageous because, as stated above, the part of the compressor, which is mainly overheated during operation, is the upper part thereof, which is typically located in an upper part of the basement. Moreover, the vertical extent of the compressor cooling fan is typically lower than that of the compressor. Thus, the use of a compressor cooling fan positioned within the basement in a tilted position so that the main air flow blown by the compressor cooling fan is tilted upward, towards the upper part of the compressor, advantageously enables to place the compressor cooling fan into the bottom part of the basement, which is typically less crowded than the upper part of the basement, while guaranteeing an effective cooling of the compressor.

[0011] Accordingly, in an aspect, the invention relates to a laundry treating machine comprising:

- a cabinet with a basement defining a bottom wall of the cabinet in a horizontal plane (X,Y);
- a drum rotatably accommodated within said cabinet;

- a heat pump system comprising a compressor and a compressor cooling fan housed in said basement, the compressor substantially extending in a vertical direction Z perpendicular to the horizontal plane (X, Y), from a basement lower part, placed onto said bottom wall, to an upper part, located in an upper part of the basement,

wherein the compressor cooling fan is positioned onto said bottom wall in a tilted position so that a main air flow is blown by the compressor cooling fan along a direction tilted upward, towards the upper part of the compressor.

[0012] In the present description and claims, relative terms such as "front", "back", "rear", "lateral", "side", "top", "bottom", "inner", "outer" etc., refer to geometric and structural elements of the laundry machine and components thereof, as they are oriented in the normal operational position of the laundry machine when in use, e.g. located on a floor, which usually is (substantially) horizontal. The location of a door of the laundry dryer, generally coupled to a front wall of the cabinet in order to access the drum, defines the "front" of the dryer itself. The laundry machine, and in particular the basement thereof, defines a horizontal plane (X, Y) which is substantially the plane of the ground on which the laundry machine is situated. Given the horizontal plane (X, Y) on which the laundry is located, "top" and "bottom" - as their normal common meaning - refer to the position of an object according to a vertical direction (Z) perpendicular to the plane (X, Y).

[0013] In the present description and claims, the terms "plastic material" and the like, are used to indicate any plastic, i.e. polymeric or synthetic material, or based on plastic, i.e. polymeric or synthetic material, possibly added with fillers suitable to improve the functional and robustness characteristics thereof, such as minerals, textile synthetic fillers and so on and so forth.

[0014] With the term "laundry machine" or "machine" or "laundry treating machine", an appliance having drying function only, washing function only, or a combined washer-dryer appliance, which is capable of performing both washing and drying cycles, is meant.

[0015] In addition, the terms "upstream" and "downstream" are used in the present description and claims with respect to the direction of a fluid (e.g. air) main flow.

[0016] The term "main air flow" is used to indicate a substantial part, preferably at least 50%, of air blown by a fan (compressor cooling fan or circuit air fan). For example, for an axial fan, the "main air flow" refers to the air flow blown in the direction of the fan axis.

[0017] The present invention according to the aforementioned aspect can have, alternatively or in combination, at least one of the following preferred characteristics.

[0018] Preferably, with reference to the Cartesian coordinate system (X, Y, Z), the cabinet further comprises sidewalls substantially parallel to a plane (Y, Z) and front and rear walls substantially parallel to a plane (X, Z). The front wall, the rear wall and the sidewalls are mounted in the basement.

[0019] Advantageously, with reference to a Cartesian coordinate system (X, Y, Z), the tilted position of the compressor cooling fan is such that the main air flow blown by the compressor cooling fan has a direction whose projection on plane (X, Z) forms an acute angle Az with axis Z. Preferably, plane (X, Z) is a vertical plane. Still referring to the same Cartesian coordinate system (X, Y, Z), the tilted position of the compressor cooling fan can further be such that the main air flow blown by the compressor cooling fan has a direction whose projection on the horizontal plane (X, Y) forms an acute angle Ay with axis Y. The acute angle Az and/or Ay are preferably such that $10° \leq Az, Ay < 90°$, and more preferably such that $30° \leq Az, Ay \leq 60°$.

[0020] This solution is advantageous to guarantee that the main air flow blown by the compressor cooling fan is efficiently directed towards the compressor even when the compressor and the compressor cooling fan are placed onto the bottom wall of the cabinet with different X and Y coordinates in the plane (X, Y).

[0021] Preferably, the upper part of the compressor comprises a compressor motor for operating the compressor.

[0022] Preferably, the basement defines a seat for the compressor cooling fan. In a preferred embodiment, the basement comprises an upper shell and a lower shell. Preferably, the compressor cooling fan is fixed between the upper shell and the lower shell. Preferably, said compressor cooling fan seat is defined between the upper shell and the lower shell.

[0023] Preferably, at said bottom wall of the cabinet, the compressor cooling fan seat has a bottom supporting surface tilted with respect to the bottom wall of the cabinet (that is, with respect to said horizontal plane (X, Y)) and directed upward towards the upper part of the compressor so as to keep said compressor cooling fan in said tilted position.

[0024] Preferably, said seat for the compressor cooling fan is configured for engaging the compressor cooling fan by means of a snap coupling. The use of a snap coupling for fixing the compressor cooling fan into the basement is advantageous with respect, for example, to the use of fixing screws in terms of simplicity and velocity of mounting/removing operations of the compressor cooling fan into/from the basement. Preferably, said seat comprises snap coupling members (e.g. snap-hooks) for engaging edges of inlet and/or outlet faces of said compressor cooling fan. The snap coupling members are provided in suitable positions of the upper shell and lower shell of the basement.

[0025] In a preferred embodiment, the compressor cooling fan is snap coupled to a support, which -in turn- is mounted onto said compressor cooling fan seat. In this case, the snap coupling members are suitably provided in the support. The support may, for example, be fixed to the compressor cooling fan seat by means of screwing

or snap coupling, or it may be pinched or fitted between the upper shell and lower shell of the basement, or similar. This solution is advantageous because it enables to snap couple the compressor cooling fan to the support (and not directly to the seat of the basement). In this way, if a snap coupling member gets broken during the mounting operation, it is sufficient to replace the support (and not the basement itself), which is a structural part much more simple to replace than the whole basement.

[0026] In alternative or combination with the previous preferred embodiment, the seat or the support and the compressor cooling fan are configured to enable a screw fixing of the compressor cooling fan to the seat or the support. The screw fixing, when used in combination with the snap coupling, can be conveniently used as a precautionary fixing, in case a snap coupling member gets broken during a mounting operation, or to avoid/limit vibration diffusion from the compressor cooling fan or the support.

[0027] Preferably, the compressor cooling fan is an axial-type fan and the main air flow is blown by the compressor cooling fan parallel to a rotational axis of the compressor cooling fan.

[0028] In a preferred embodiment, the compressor cooling fan is an axial fan wherein air is inhaled and blown linearly, in a same axial direction. The axial fan has a casing comprising a rotating impeller with a central shaft about which a set of blades, or ribs, are attached. The central shaft defines the fan axis. The blades or ribs force the air to move parallel to the shaft or fan axis. The casing of the compressor cooling fan has an inlet face from which air is inhaled and an outlet face from which air is blown out. The inlet face and the outlet face are substantially parallel to each other, perpendicular to the fan axis. The main air flow blown by the compressor cooling fan is substantially parallel to the fan axis.

[0029] The compressor cooling fan preferably comprises a motor for operating the fan itself. The motor is supplied by means of a power supply cable. In a preferred embodiment, the basement is configured to define a passage for said cable in proximity of said seat for the compressor cooling fan, or in proximity of the support on which the compressor cooling fan can be mounted.

[0030] The compressor and the compressor cooling fan are in direct fluid connection to each other, without interfering objects positioned along the direction of the main air flow blown by the compressor cooling fan. Preferably, the compressor and the compressor cooling fan are positioned onto said bottom wall so as to substantially face each other. As the compressor extends in the vertical direction Z for a greater extent than the compressor cooling fan, the outlet face of the compressor cooling fan faces the lower part of the compressor. However, as the main air flow blown by the compressor cooling fan points the upper part of the compressor, effective cooling of the compressor is advantageously guaranteed.

[0031] Preferably, the compressor is positioned near one of said sidewalls of the cabinet. Preferably, the compressor fan is positioned close to the sidewall near which the compressor is positioned. In a preferred embodiment, the compressor cooling fan is positioned onto said bottom wall near the front wall of the cabinet, preferably at the front wall. This advantageously enables to inhale fresh and clean air directly from the outside of the cabinet without the need of using any connection conduits between the front wall of the cabinet and the compressor cooling fan. Moreover, such arrangement simplifies the access to the compressor cooling fan for any maintenance/replacement operation. Preferably, the front wall has an aperture for the compressor cooling fan, preferably closed by a suitable removable grating. Preferably, the compressor cooling fan is positioned onto said bottom wall in the proximity of a corner of the basement formed by the front wall and one of the sidewalls of the cabinet near which the compressor is positioned.

[0032] The heat pump system is configured to heat a process fluid for treating the laundry. The heat pump system preferably comprises a compressor, a first heat exchanger and a second heat exchanger forming a refrigerant circuit configured to circulate a refrigerant. The first heat exchanger is configured to cool the refrigerant and to heat the process fluid (e.g. process water in a washing cycle or process air in a drying cycle) that flows towards the drum, while the second heat exchanger is configured to heat said refrigerant. In case of a dryer, the second heat exchanger is also configured to dehumidify and cool process air exiting the drum.

[0033] Preferably, said basement is realized in plastic, i.e. polymeric, material.

[0034] In a preferred embodiment, the rear wall of the cabinet comprises a rear bulkhead. The rear bulkhead includes a first surface facing the interior of the cabinet, such as the back wall of the drum, and a second surface facing the outside of the cabinet.

[0035] The drum preferably is a closed drum, i.e. it includes a mantle, for example cylindrically shaped, one of whose ends is closed by a back wall or a flange, which rotates as a single piece together with the mantle when the drum is driven into rotation. The connection between the mantle and the back wall or flange can be of any type, and it depends on the material in which mantle and/or back wall or flange are/is realized. The back wall of the drum is preferably perforated, e.g. it includes a plurality of apertures, so that a process fluid to treat laundry, like air, water or other liquor, can be introduced through the rear wall.

[0036] In case of a drying machine, the drum is part of a process air circuit, in particular a closed-loop circuit in case of a condensed dryer or an open circuit in case of a vented dryer, which in both cases includes process air conduits for channeling a stream of air to dry the load. The process air circuit comprises the drum and, within the basement, the heat pump system, an air circuit fan and process air conduits. Preferably, a portion of the process air circuit is formed in the rear bulkhead as well, which is connected to the basement via an air outlet.

More specifically, hot dry air is fed into the drum, flowing over the laundry, and the resulting humid and cooled down air exits the same. In case of a closed-loop drying air circuit, the humid air stream, rich in water vapor, is then fed into a humidity removal element, such as an evaporator of the heat pump system, where the moist process air is further cooled down and the humidity present therein condenses. The resulting cool dry air is then heated up before re-entering again in the drum by means of a condenser of the heat pump system, and the whole loop is repeated till the end of the drying cycle. The air circuit fan, that may be located downstream of the condenser of the heat pump system and upstream of the drum, circulates the process air along the air circuit by inhaling the process air coming from the drum and blowing the inhaled process air back towards the drum.

[0037] In other possible solutions of dryer machine, process air may circulate in inverse direction from the front of the drum to the back thereof.

[0038] The front wall of the cabinet is suitably provided with a through opening, at which a door is mounted to access the drum in order to locate or remove the laundry.

[0039] The rear bulkhead of the rear wall of the cabinet may include a drum aperture facing the back wall of the drum or it has one or more wall portions facing the back wall of the drum. Furthermore, the rear bulkhead might include further or different aperture(s). Preferably, a rim of the rear drum end abuts against the rear bulkhead and even more preferably a gasket is interposed therein between. The rear bulkhead is substantially the major part of the rear wall of the cabinet, facing on one side the back wall of the drum, or anyhow the interior of the cabinet, and on the other side the exterior or the outside of the cabinet.

[0040] Preferably, the rear bulkhead is realized in plastic, e.g. polymeric, material as a single, unitary element.

[0041] Within the cabinet, the drum is rotatably mounted for rotating according to a substantially horizontal or tilted rotation axis. At least one drum support assembly for rotatably supporting the drum in this rotation around this given rotation axis is provided for within the cabinet.

[0042] In a preferred embodiment, a portion of the at least one of said drum support assembly of the drum is formed at the rear bulkhead. The rear bulkhead thus has also the function to hold at least partially the drum for its rotation via a support assembly.

[0043] Preferably, the drum support assembly includes a drum support element, which is for example a shaft or a roller (or both), and a respective holder is provided according to this embodiment at the rear bulkhead. The holder can be of any type and it depends or follows the configuration of the drum supporting element.

[0044] In an advantageous embodiment, said drum support assembly includes a shaft, said shaft being connected to said back wall of the drum, said shaft defining said axis of rotation of said drum.

[0045] Preferably, in addition to the shaft, also rollers, generally in the number of two, are used in combination to the shaft to support the drum and are present at or in proximity of the front end of the drum. Instead or rollers, a friction reducing surface may be provided in the region where the front drum end is rotatably coupled to the cabinet front wall. Such friction reducing surface acts as a supporting surface for the drum. The shaft can be supported by a bearing. Depending on whether the shaft is located on the rear bulkhead or in the back wall of the drum, the bearing can be respectively located at the drum itself, e.g. for example integrated or mounted in the back wall of the drum, or at the rear bulkhead, for example integrated or mounted to the latter. In the latter case, a metallic bearing cross integrated in the plastic of the rear bulkhead can be envisaged, e.g. cast to the plastic material of the bulkhead. More preferably, said shaft is fixed to said back wall and said portion of at least one drum support assembly includes a bearing for said shaft.

[0046] In case the drum support assembly includes a shaft and a bearing, the shaft could be located at the back wall of the drum, and the portion of drum support assembly located at the rear bulkhead includes the bearing. For example, the bearing might be embedded in a ring, provided to support the shaft, and said ring is held by supporting ribs which can be realized in the rear bulkhead as well, for example in the center of the drum aperture facing the back wall of the drum and closed by the cover. This ring is preferably realized integral to said rear bulkhead, thanks to the plastic material of the latter that allows a relatively easy integration in a single piece of different elements.

[0047] In case said shaft is located at the rear bulkhead, the bearing - generally realized in metal - is fixed on the back wall of the drum itself.

[0048] Alternatively or in addition, said drum support assembly includes a roller.

[0049] The drum can be rotatably supported either by a shaft coupled with a bearing at the back of the drum and by rollers supporting the front of the drum, or only by rollers, for example two rollers at the back of the drum and two rollers at the front of the drum. However, any different number of rollers is included in the invention as well.

[0050] More preferably, said at least drum support assembly includes a boss or a bracket for supporting said roller.

[0051] In case the dryer includes as supporting elements rollers in the back of the drum, in addition or alternatively to the shaft, the rear bulkhead includes a boss where the roller can be fixed. The boss might further include a pin where the roller can be fastened, for example by screws or a snap-fitting combination. Alternatively to bosses, brackets can be formed as well.

[0052] In an advantageous embodiment, said portion of drum support assembly is integrally formed with said rear bulkhead.

[0053] Due to the fact that the rear bulkhead is realized in plastic material as a single body, additional structural elements, such as the portion of drum support element,

e.g. the holder of the drum support element, can be realized as well integrally, i.e. in a single unitary piece, therewith. In this way, the assembly of different parts is minimized.

[0054] In a preferred embodiment, said bulkhead includes a water collector for the collection of condensed water, said water collector being integral to said bulkhead.

Brief description of the drawings

[0055] Further advantages of the present invention will be better understood with non-limiting reference to the appended drawings, where:

- Fig. 1 is a perspective view of a laundry machine according to an embodiment of the invention;
- Fig. 2 is another perspective view of the laundry machine of Fig. 1 with a sidewall of the cabinet removed for showing some internal components;
- Fig. 3 is a perspective view of the basement of the laundry machine of Fig. 1;
- Fig. 4 is another perspective view of the basement of Fig. 3;
- Fig. 5 is an enlarged view of the circled portion A of the basement of Fig. 4;
- Fig. 6 is the perspective view of Fig. 3 showing the basement in a partially disassembled configuration;
- Fig. 7 is a perspective view of a lower shell of the basement of Fig. 3;
- Fig. 8 is a perspective view of an upper shell of the basement of Fig. 3, shown upside down with respect to the assembled configuration;
- Fig. 9 is an enlarged view of the squared portion B of the upper shell of Fig. 8;
- Fig. 10 shows the arrangement of the compressor cooling fan relative to axis Y of a Cartesian coordinate system (X, Y, Z); and
- Fig. 11 shows the arrangement of the compressor cooling fan relative to axis Z of a Cartesian coordinate system (X, Y, Z).

Detailed description of one or more embodiments of the invention

[0056] The Figures show a laundry machine in the particular case of a dryer machine. However, as stated above, the principle of the present invention also applies to a washing machine or a washer-dryer machine.

[0057] With initial reference to Figures 1 and 2, a laundry machine realized according to a preferred embodiment of the present invention is globally indicated with 1.

[0058] Laundry machine 1 comprises an outer box casing or cabinet 2, preferably but not necessarily parallelepiped-shaped, and a treatment chamber, such as a drum 3, for example having the shape of a hollow cylinder, for housing the laundry and in general the clothes and garments to be treated. The drum 3 is preferably rotatably fixed to the cabinet 2. Access to the drum 3 is achieved for example via a door 4, preferably hinged to cabinet 2, which can open and close an opening 4a realized on the cabinet itself.

[0059] More in detail, cabinet 2 generally includes a front wall 20, a rear wall 21, a bottom wall 23 and two sidewalls 25, all mounted on a basement 24. The cabinet 2 further comprises a top wall 22. Preferably, the basement 24 is realized in plastic material. Preferably, basement 24 is molded via an injection molding process. Preferably, on the front wall 20, the door 4 is hinged so as to access the drum 3. The cabinet 2, with its walls, defines the volume of the laundry machine 1. Advantageously, basement 24 includes an upper and a lower shell portion 24a, 24b (visible, for example, in figures 6-8 in a disassembled configuration and described in more detail below).

[0060] The laundry machine 1, and in particular basement 24, defines an horizontal plane (X,Y) which is substantially the plane of the ground on which the laundry machine 1 is situated, thus it is considered to be substantially horizontal, and a vertical direction Z perpendicular to the plane (X,Y). As shown in figure 2, in a Cartesian coordinate system, the front wall 20 and the rear wall 21 are substantially parallel to plane (X,Z), sidewalls 25 are substantially parallel to plane (Y,Z), and bottom wall 23 and top wall 22 are parallel to horizontal plane (X,Y).

[0061] Laundry machine 1 also preferably comprises an electrical motor assembly 50 for rotating, on command, revolving drum 3 according to its axis inside cabinet 2. Door 4 and electrical motor assembly 50 are common parts in the technical field and are considered to be known; therefore they will not be described in detail.

[0062] Further, laundry machine 1 may include an electronic central control unit (not shown) which controls both the electrical motor assembly 50 and other components of the dryer 1 to perform, on command, one of the user-selectable treatment cycles preferably stored in the same central control unit. The programs as well other parameters of the laundry machine 1, or alarm and warning functions can be set and/or visualized in a control panel 11, preferably realized in a top portion of the laundry machine 1, such as above door 4.

[0063] With reference to Figure 2, the rotatable drum 3 includes a mantle 3c, having preferably a substantially cylindrical, tubular body, which is preferably made of metal material, is arranged inside the cabinet 2 and is apt to rotate around a general rotational axis which can be horizontal, i.e. parallel to the horizontal (X, Y) plane, or tilted with respect to the latter. The mantle 3c defines a first end 3a and a second end 3b and the drum 3 is so arranged that the first end 3a of the mantle 3c faces the laundry loading/unloading opening 4a realized on the front wall 20 of the cabinet 2 and the door 4, while the second end 3b faces the rear wall 21 of the cabinet 2. The rear end 3b of the drum 3 is closed by a back wall (not shown).

[0064] Preferably, the drum back wall faces the rear

wall 21 of the cabinet 2 and is permanently and rigidly coupled to the second end 3b of mantle 3c of the drum 3 so as to close said second end 3b. The drum back wall forms, together with lateral mantle 3c, a substantially cylindrical, cup-shaped rigid container structured for housing the laundry to be dried.

[0065] Preferably, the drum back wall is suitably perforated so as to allow a stream of process air to flow through it towards the inside of the drum 3.

[0066] In operation, the drum 3 is made to rotate by motor 50 in order to cause agitation of the laundry items to be dried, which repeatedly tumble into the drum while being processed by process air.

[0067] The process air is dehumidified and heated in laundry machine 1 by a heat pump system 30.

[0068] In particular, with reference to Figures 2 and 3, laundry machine 1 includes a process air circuit, which comprises the drum 3 and a process air conduit 18, depicted in figure 3 as a plurality of arrows showing the path flow of a process air stream through the laundry machine 1. In the basement 24, process air conduit 18 is formed by the connection of the upper shell 24a and the lower shell 24b. Air process conduit 18 is preferably fluidly connected with its opposite ends to the two opposite sides of drum 3. In particular, the process air conduit 18 communicates with, i.e. is fluidly connected to, the front end 3a of the rotatable drum 3 via a pass-through opening 17 (visible in Figure 3) provided in the basement 24 and fluidly connected to the part of the front wall 20 of the cabinet 2 that delimits/surrounds the laundry loading/unloading opening 4a. In addition, the process air conduit 18 communicates with, i.e. is fluidly connected to, the rear end 3b of the rotatable drum 3 via an outlet 19 of basement 24 and a portion (not shown) of the same process air conduit realized in the rear wall 21 of the cabinet 2. As shown in Figures 7 and 8, the outlet 19 is formed by two semi-circular facing indentations defined in the upper shell 24a and lower shell 24b of the basement 24.

[0069] With reference to Figures 2, 3 and 6, laundry machine 1 comprises a heat pump system 30. The heat pump system 30 includes a condenser 31 and an evaporator 32. The heat pump system 30 also includes a refrigerant closed circuit (partly depicted and indicated with the reference number 35) in which a refrigerant fluid flows, when the laundry machine 1 is in operation, cools off and may condense in correspondence of the condenser 31, releasing heat, and warms up, in correspondence of the evaporator 32, absorbing heat. A compressor 33 receives refrigerant in a gaseous state from the evaporator 32 and supplies the condenser 31, thereby closing the refrigerant cycle. More in detail, the heat pump circuit connects via piping 35 the evaporator 32 via the compressor 33 to the condenser 31. The outlet of condenser 31 is connected to the inlet of the evaporator 32 via an expansion device (not visible), such as a choke, a valve or a capillary tube.

[0070] It is to be understood that in the laundry machine 1 of the invention, an air heater, such as an electrical heater, can also be present, in addition to the heat pump system 30. In this case, heat pump system 30 and heater (not shown) can also work together to speed up the heating process (and thus reducing the drying cycle time). In the latter case, preferably condenser 31 of heat pump system 30 is located upstream of the heater. Appropriate measures should be provided to avoid the electric heater to fuse any plastic components of the laundry machine 1.

[0071] Preferably, in correspondence of evaporator 32, the laundry machine 1 of the invention may include a condensed-water canister (also not visible) which collects the condensed water produced, when the laundry machine 1 is in operation, inside evaporator 32 by condensation of the surplus moisture in the process air stream arriving from the drum 3. The canister may be located at the bottom of the evaporator 32. Preferably, through a connecting pipe and a pump (not shown in the drawings), the collected water is sent in a reservoir 6 (visible in Figures 1 and 2) located in correspondence of the highest portion of the laundry machine 1 so as to facilitate a comfortable manual discharge of the water by the user of the laundry machine 1.

[0072] The condenser 31 and the evaporator 32 of the heat pump system 30 are located in correspondence of the process air conduit 18 formed in the basement 24. As shown in Fig. 7, the compressor 30 is housed in a suitable compressor seat 34 defined in the basement 24.

[0073] In case of a condense-type laundry machine - as depicted in the appended figures - where the process air circuit is a closed loop circuit, the condenser 31 is located downstream of the evaporator 32. The air exiting the drum 3 enters the process air conduit 18 and reaches the evaporator 32, which cools down and dehumidifies the process air. The dry cool process air continues to flow through the process air conduit 18 till it enters the condenser 31, where it is warmed up by the heat pump 30 before re-entering the drum 3.

[0074] The process air circuit also includes an air circuit fan (or blower) 12 (visible in Figures 3 and 6) for inhaling process air exiting the drum 3 and passing through the heat pump system 30 and blowing it back into the drum 3.

[0075] In the embodiment shown, the air circuit fan 12 is a centrifugal fan wherein air is inhaled in an axial direction and blown in a radial direction. The air circuit fan 12 comprises a generally cylindrical rotating impeller 12a. The impeller 12a comprises a central shaft (not visible) about which a set of blades (or ribs) 12c are circumferentially attached. The central shaft is suitably connected to the motor 50, configured to rotate, on command, the rotating impeller 12a about the central shaft.

[0076] In the embodiment shown, the air circuit fan 12, in particular the impeller 12a, is housed in a suitable seat (not shown) defined in the rear wall 21 of the cabinet 2. The rear wall 21 also comprises a fan cover 610 (shown in Fig. 2) for covering the air circuit fan 12.

[0077] It will be thus clear that the process air circuit of laundry machine 1 comprises the drum 3, the air conduit 18, the heat pump system 30 and the air circuit fan

12. The humid air from the laundry (processed in the drum 3) exits the drum 3 from its front end 3a. The process air conduct 18 (as stated above, depicted as arrows in Figure 3) communicates with, i.e. is fluidly connected to, the front end 3a of the rotatable drum 3 via pass-through opening 17 provided in the basement 24 and fluidly connected to the part of the front wall 20 of the cabinet 2 that delimits/surrounds the laundry loading/unloading opening 4a. The process air conduit 18 extends across the basement 24 of cabinet 2, where preferably also the heat exchangers 31, 32 are housed, and the circulated process air is dehumified and heated. Preferably, the lower and upper shells 24a, 24b are coupled one on top of the other, forming at least a portion of the process air conduit 18 and more preferably also include further cavities or seats adapted to receive therein further operational components of the dryer machine 1 for operating a drying process. Process air exits the basement 24 through the outlet 19 and enters the air circuit fan 12. As stated above, the process air conduit 18 includes a further portion (not shown) realized in the rear wall 21 of the cabinet 2. Accordingly, the process air blown by the fan 12 is guided by said further portion of the process air conduit 18 realized in the rear wall 21 of the cabinet 2, which conveys the process air back into the drum 3 through the apertures or vents realized in the drum back wall.

[0078] The laundry machine 1 further comprises a compressor cooling fan 60 associated with the compressor 33, configured to cool the compressor 33 and to avoid overheating of the same during operation.

[0079] As shown in Fig. 3, the compressor cooling fan 60 and the compressor 33 are placed within the basement 24, rested on the bottom wall 23 of the cabinet 2, in fluid connection to each other. In particular, they are located in proximity of a corner of the basement 24, which is formed by the front wall 20 and one of the sidewalls 25 of the cabinet 2. Preferably, the compressor cooling fan 60 is placed at the front wall 20 so as to be able to directly inhale fresh and clean air from the outside of the cabinet 2. A grating 26 provided on the front wall 20 is placed in front of the compressor cooling fan 60. Preferably, grating 26 is removable.

[0080] A further grating (not visible in the Figures) may be fixed to the basement 24 by means of a screw (not shown) to be inserted into a suitable receiving holes 55a and 55b (shown in Fig. 6) provided into the lower shell 24b.

[0081] As shown in Figures 4 and 5, the compressor cooling fan 60 has a casing 60a (in the example, with a generally parallelepiped shape) housing a rotating impeller with a central shaft 64 about which a set of blades, or ribs, 62 are attached. The central shaft 64 defines the fan rotational axis F. The compressor cooling fan 60 is of the axial type. Air flow is inhaled and blown linearly, in the direction of the fan axis F, from an inlet face 61 to an outlet face 63 of casing 60a. The inlet face 61 and the outlet face 63 are substantially perpendicular to the fan axis F. The compressor cooling fan 60 is actuated by an internal motor (not shown) which is supplied by means of power supply cables 47, which are coupled to a suitable connector 48.

[0082] As shown in Figures 6 and 7, the basement 24 defines a seat 40 for housing the compressor cooling fan 60. As shown in Fig. 7, the seat 40 is proximate to the compressor seat 34.

[0083] In particular, the seat 40 is formed between the upper shell 24a and the lower shell 24b of the basement 24.

[0084] With reference to Figures 6-9, at the lower shell 24b of the basement 24, the seat 40 comprises a bottom supporting surface 41 and peripheral walls 42 configured to support a lower part of the compressor cooling fan 60; at the upper shell 24a of the basement 24, the seat 40 comprises supporting walls 43 configured to support an upper part of the compressor cooling fan 60.

[0085] With reference to Fig. 3, the compressor 33 has a lower end 33b resting on the bottom wall 23 of the cabinet 2 and an upper part 33a extending into the upper shell 24a of the basement 24. The compressor 33 extends in the vertical direction Z for a greater extent than the compressor cooling fan 60 so that the compressor cooling fan 60, resting too on the bottom wall 23 of the cabinet 2, faces the lower end 33b of the compressor 33. However, as already noted above, the part of the compressor 33, which is mainly overheated during operation, is the upper part 33a thereof, wherein the internal compressor motor (not shown) is typically placed.

[0086] According to the invention, in order to optimize cooling of the compressor 33 and, in particular of the upper part 33a thereof, the compressor cooling fan 60 is housed in the basement 24 in a tilted position so as to direct the main air flow upward, towards the upper part 33a of the compressor 33. The seat 40 and, in particular, the bottom supporting surface 41 are configured to support the compressor cooling fan 60 so that the fan axis F is tilted upward with respect to the horizontal plane (X, Y), such that a projection of the fan axis on a vertical plane (X, Z) forms an acute angle Az with axis Z. Such angle Az has been found to be particularly advantageous for directing flow towards the compressor when it is such that $10° \leq Az < 90°$, and preferably $30° \leq Az \leq 60°$. Moreover, as in the embodiment shown, the compressor 33 is nearer the sidewall 25 than the compressor cooling fan 60; the seat 40 and, in particular, the bottom supporting surface 41 are also configured to support the compressor cooling fan 60 so that the fan axis F is tilted such that a projection of the fan axis on the horizontal plane (X, Y) forms an acute angle Ay with axis Y. Such angle Ay has been found to be particularly advantageous for directing flow towards the compressor when it is such that $10° \leq Ay < 90°$, and preferably $30° \leq Ay \leq 60°$. In this way, the main air flow blown by the compressor cooling fan 60 effectively points the upper part 33a of the compressor 33 and the cooling of the compressor is optimized. Figures 10 and 11 show the arrangement of the compressor cooling fan 60 and the angles Ay and Az formed by the

projections of fan axis F on planes (X, Y) and (X, Z) with axis Y and Z respectively.

[0087] The seat 40 preferably comprises coupling members 44, 45 adapted to hook edges of the external casing 60a of the compressor cooling fan 60. In particular, in the embodiment shown, the seat 40 comprises a first snap-hook 44, at the lower shell 24b, configured to hook a lower edge of the outlet face 63 of the compressor cooling fan 60 and a second snap-hook 45, at the upper shell 24b, configured to hook an upper edge of the inlet face 61 of the compressor cooling fan 60, as clearly visible in Fig. 5.

[0088] With reference to Figures 4, 6 and 7, the seat 40 also comprises, at the lower shell 24b, a bracket 52 provided with a hole 53. The bracket 52 advantageously provides a support for the inlet face 61 of the compressor cooling fan 60. As clear from Fig. 6, an operator mounting the compressor cooling fan 60 within the set 40, will need to pass the compressor cooling fan 60 beyond the bracket 52 so as to seat it between the bracket 52 and peripheral walls 42 of the seat 40. The hole 53 of bracket 52 advantageously provides a slot for a fixing screw (not shown) to be inserted both into said hole 53 and into a suitable hole 54 at a corner of the compressor cooling fan 60 to fix the latter to the seat 40. The fixing screw may be used as additional way or alternative precautionary measure to fix the compressor cooling fan 60, with respect to the snap hooks 44, 45.

[0089] With reference to Figures 5, 8 and 9, the basement 24 also comprises, at the upper shell 24a, in proximity of the seat 40, a tongue 49 configured to define a passage 46 for supporting the power supply cables 47 of the compressor cooling fan 60. The basement 24 also comprises, at the upper shell 24a, in proximity of the seat 40, suitable centring lugs 51 useful for aligning the upper shell 24a and the lower shell 24b of the basement 24 during mounting operations.

Claims

1. A laundry treating machine (1) comprising:

• a cabinet (2) with a basement (24) defining a bottom wall (23) of the cabinet (2) in a horizontal plane (X,Y);
• a drum (3) rotatably accommodated within said cabinet (2);
• a heat pump system (30) comprising a compressor (33) and a compressor cooling fan (60) housed in said basement (24), the compressor (33) substantially extending in a vertical direction Z perpendicular to the horizontal plane (X, Y), from a basement lower part (33b), placed onto said bottom wall (23), to an upper part (33a), located in an upper part (24a) of the basement (24);
wherein the compressor cooling fan (60) is positioned onto said bottom wall (23) in a tilted position so that a main air flow is blown by the compressor cooling fan (60) along a direction tilted upward, towards the upper part (33a) of the compressor (33).

2. The laundry treating machine (1) according to claim 1, wherein, with reference to a Cartesian coordinate system (X, Y, Z), the cabinet (2) further comprises sidewalls (25) substantially parallel to a plane (Y, Z) and front (20) and rear walls (21) substantially parallel to a plane (X,Z).

3. The laundry treating machine according to claim 1 or 2, wherein, with reference to a Cartesian coordinate system (X, Y, Z), the tilted position of the compressor cooling fan (60) is such that the main air flow blown by the compressor cooling fan has a direction whose projection on a plane (X, Z) forms an acute angle Az with axis Z.

4. The laundry treating machine according to any of the preceding claims, wherein, with reference to a Cartesian coordinate system (X, Y, Z), the tilted position of the compressor cooling fan (60) is such that the main air flow blown by the compressor cooling fan has a direction whose projection on the horizontal plane (X, Y) forms an acute angle Ay with axis Y.

5. The laundry treating machine according to claim 3 or 4, wherein the acute angle Az and/or the acute angle Ay is such that $10° \leq Az, Ay < 90°$.

6. The laundry treating machine (1) according to claim 5, wherein the acute angle Az and/or the acute angle Ay is such that $30° \leq Az, Ay \leq 60°$.

7. The laundry treating machine (1), wherein the compressor cooling fan (60) is an axial-type fan and the main air flow is blown by the compressor cooling fan parallel to a rotational axis of the compressor cooling fan (60).

8. The laundry treating machine (1) according to any of the preceding claims, wherein said basement (24) defines a seat (40) for the compressor cooling fan (60).

9. The laundry treating machine (1) according to claim 8, wherein at said bottom wall (23) of the cabinet (2), the seat (40) has a bottom supporting surface (41) tilted with respect to the bottom wall (23) of the cabinet (2) and directed upward towards the upper part (33a) of the compressor (33) so as to keep said compressor cooling fan (60) in said tilted position.

10. The laundry treating machine (1) according to claim 8 or 9, wherein said seat (40) for the compressor

cooling fan (60) is configured for engaging the compressor cooling fan (60) by means of a snap coupling (44, 45).

11. The laundry treating machine (1) according to claim 10, wherein said seat (40) comprises snap coupling members (44, 45) for engaging edges of inlet and/or outlet faces (61, 63) of said compressor cooling fan (60).

12. The laundry treating machine (1) according to any of the preceding claims when dependent on claim 8, wherein the compressor cooling fan (60) is snap coupled to a support (52), which -in turn- is mounted onto said seat (40).

13. The laundry treating machine (1) according to any of the preceding claims, the compressor cooling fan (60) comprises an internal motor supplied by means of a power supply cable (47), the basement (24) being configured to define a passage (46) for said power supply cable (47) in proximity of said seat (40) for the compressor cooling fan (60).

14. The laundry treating machine (1), according to any of the preceding claims, wherein said cabinet (2) comprises a front wall (20), the front wall (20) having an aperture for the compressor cooling fan, closed by a suitable removable grating (26).

15. The laundry treating machine (1) according to any of the preceding claims, wherein the laundry treating machine is a washing and/or drying machine.

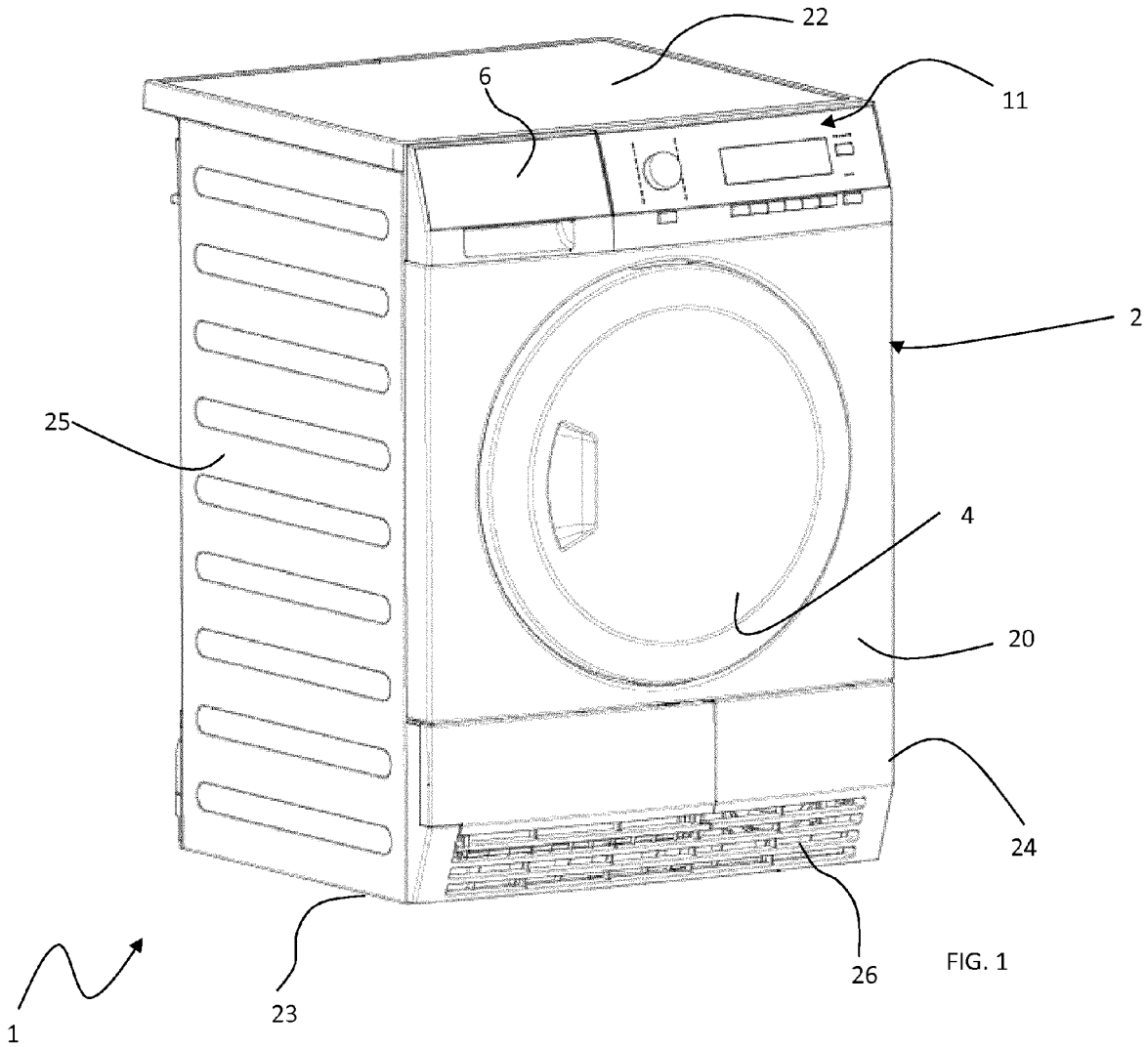
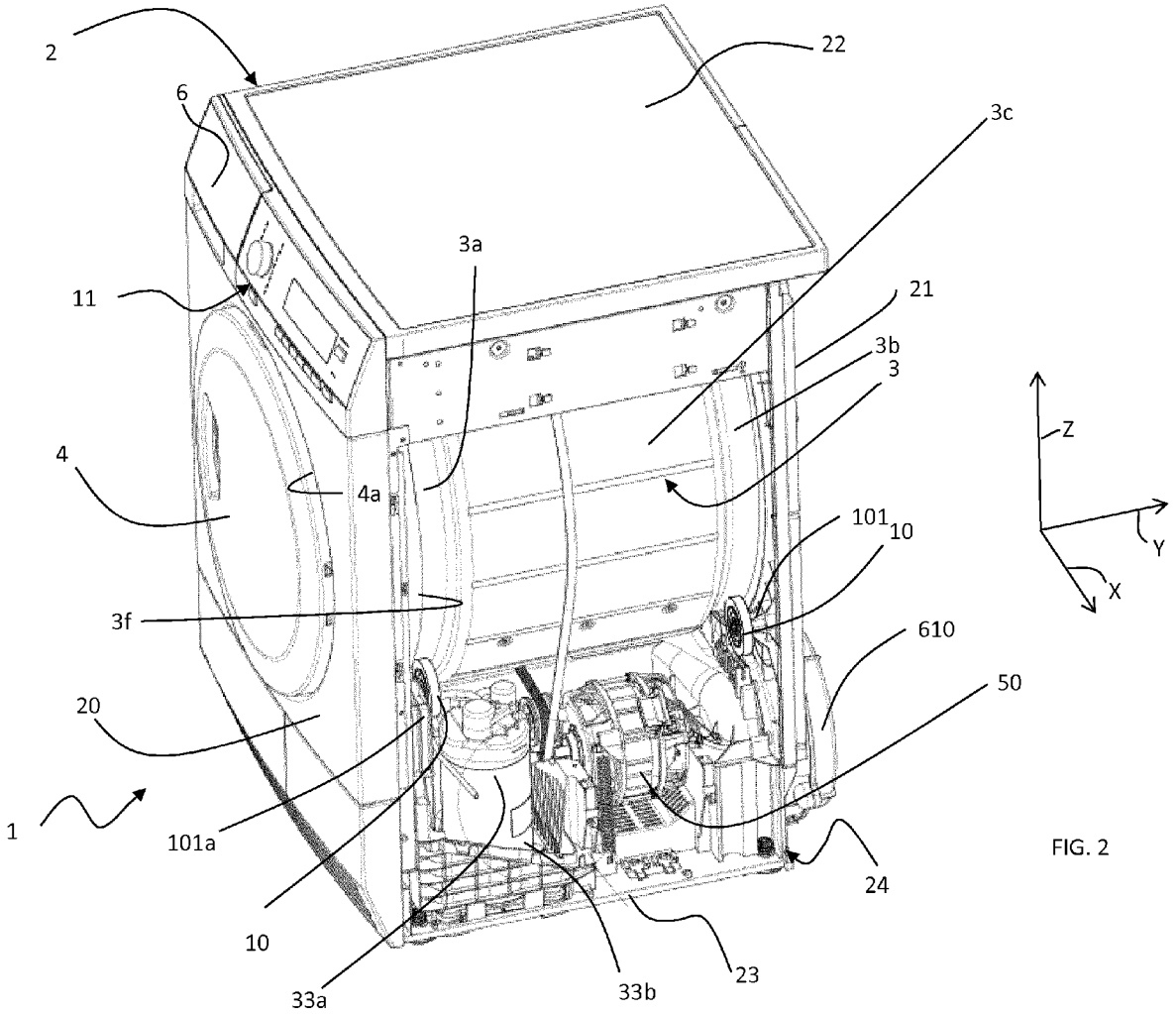


FIG. 1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3b
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33b
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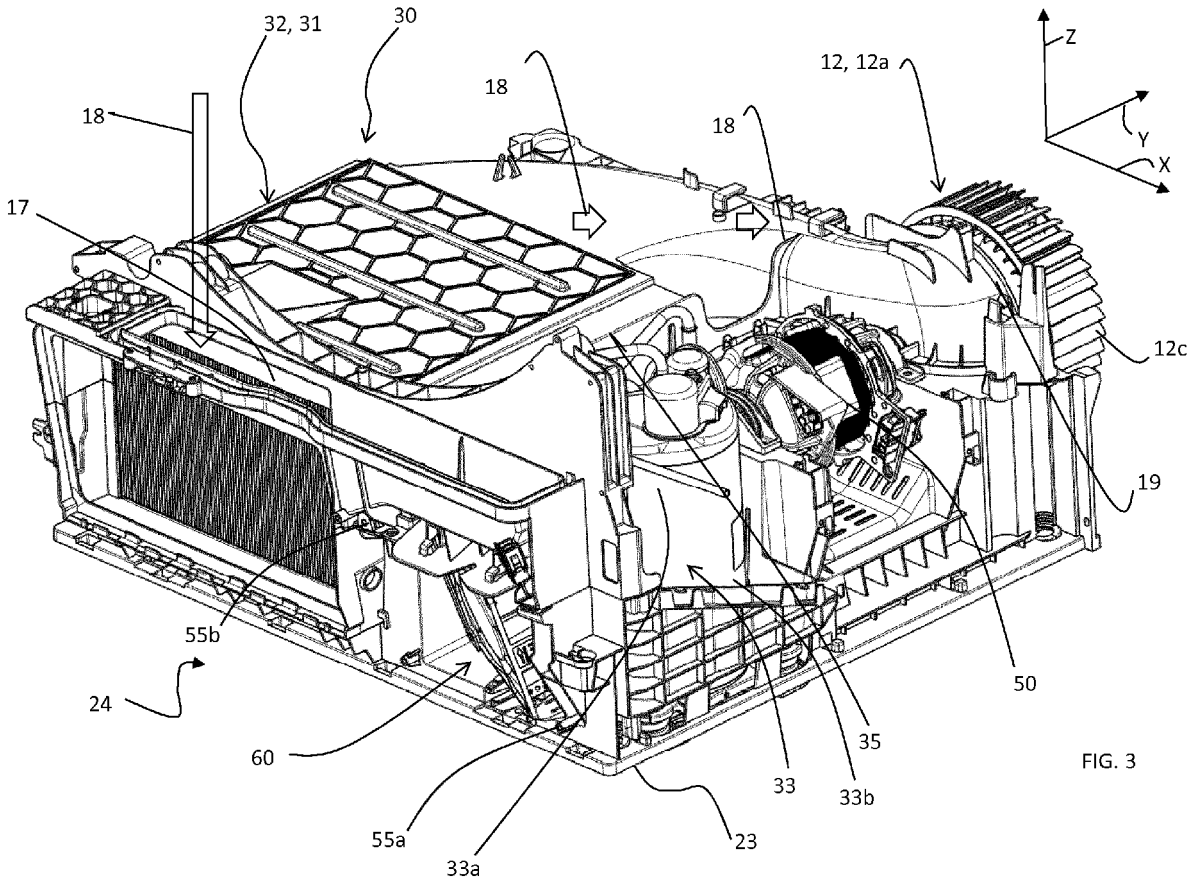
Y
X

FIG. 2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18
18
18
12, 12a
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12c
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55b
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60
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55a
33a
23

FIG. 3

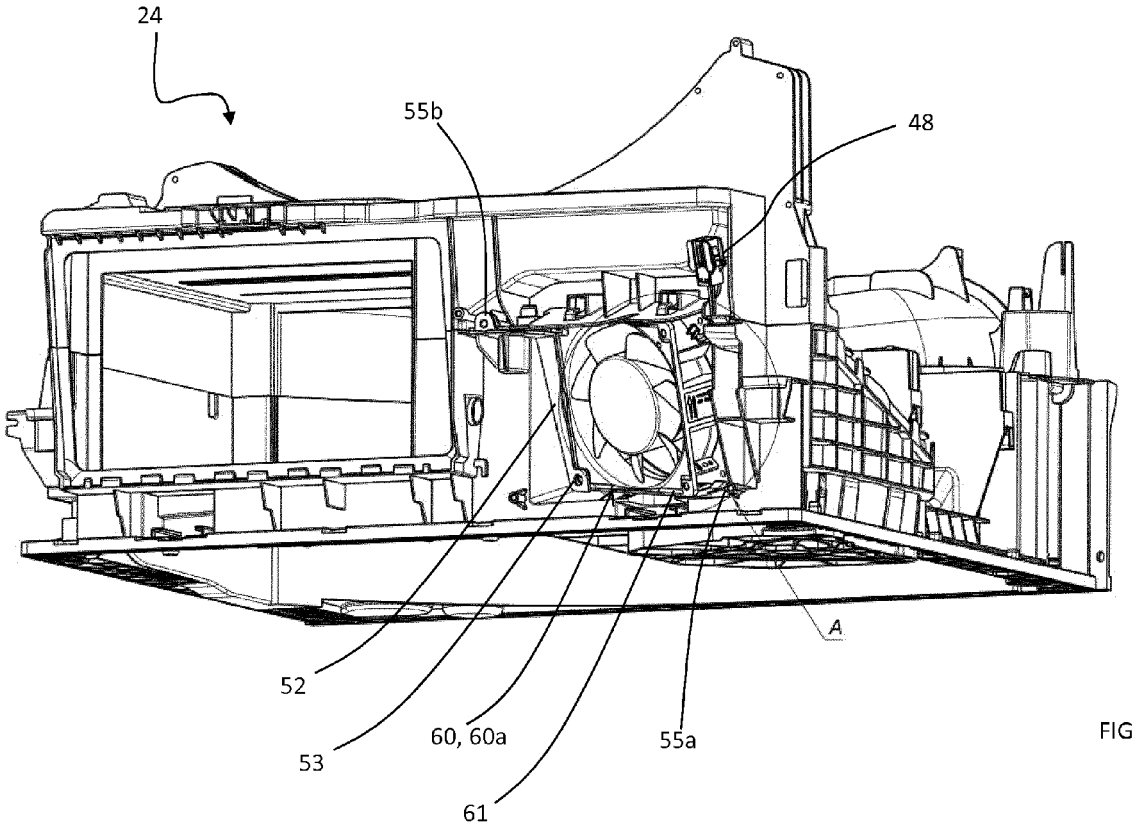

FIG. 4

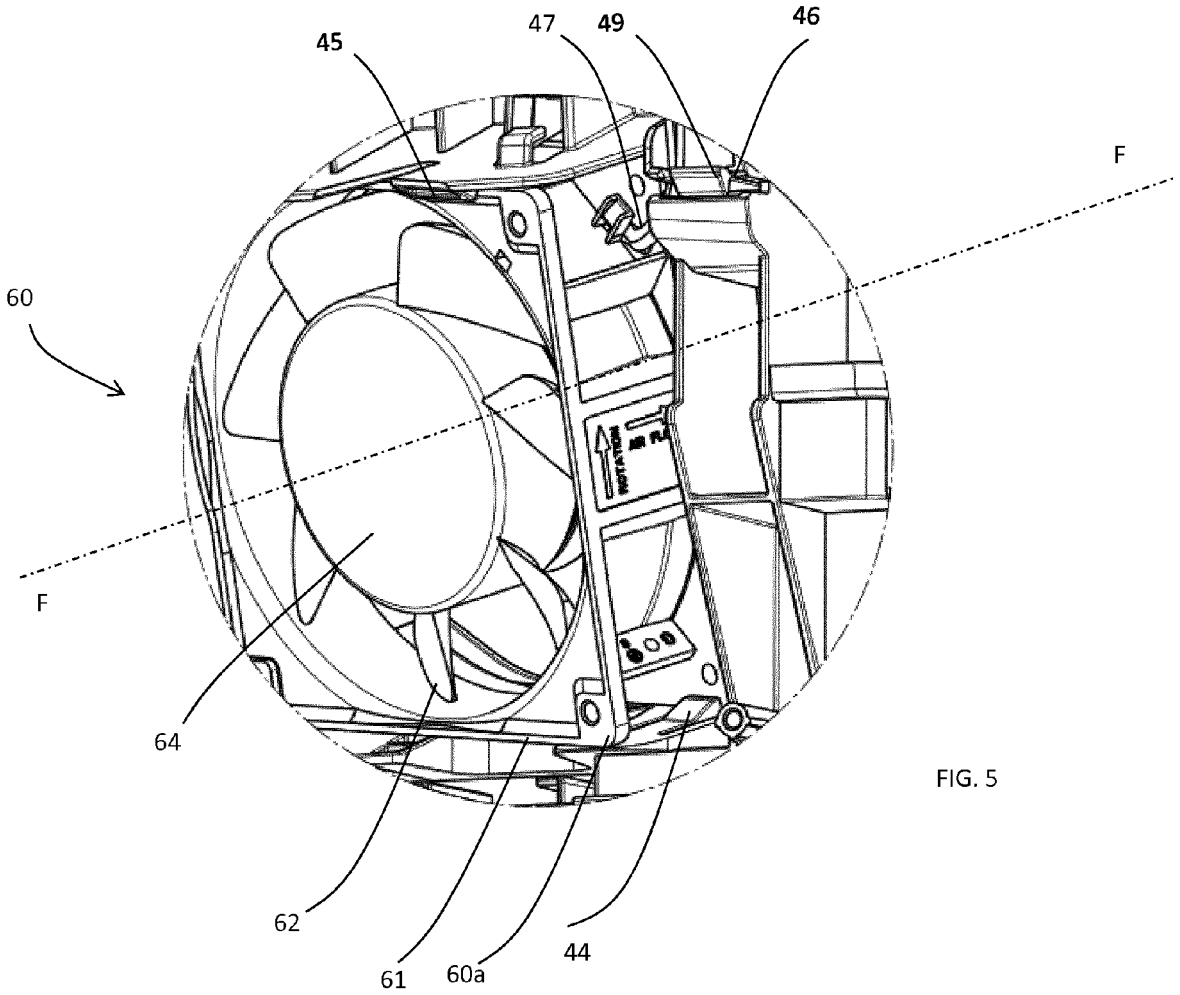

FIG. 5

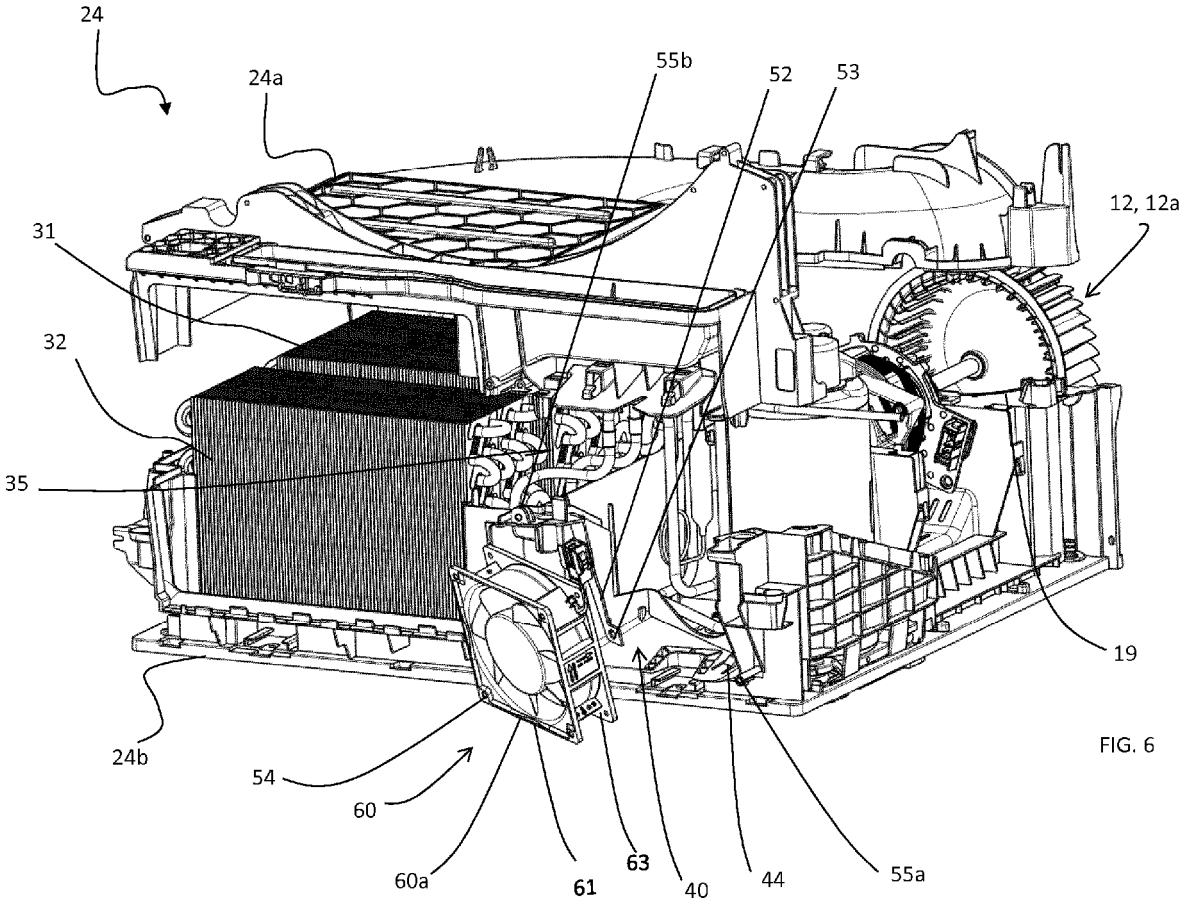

FIG. 6

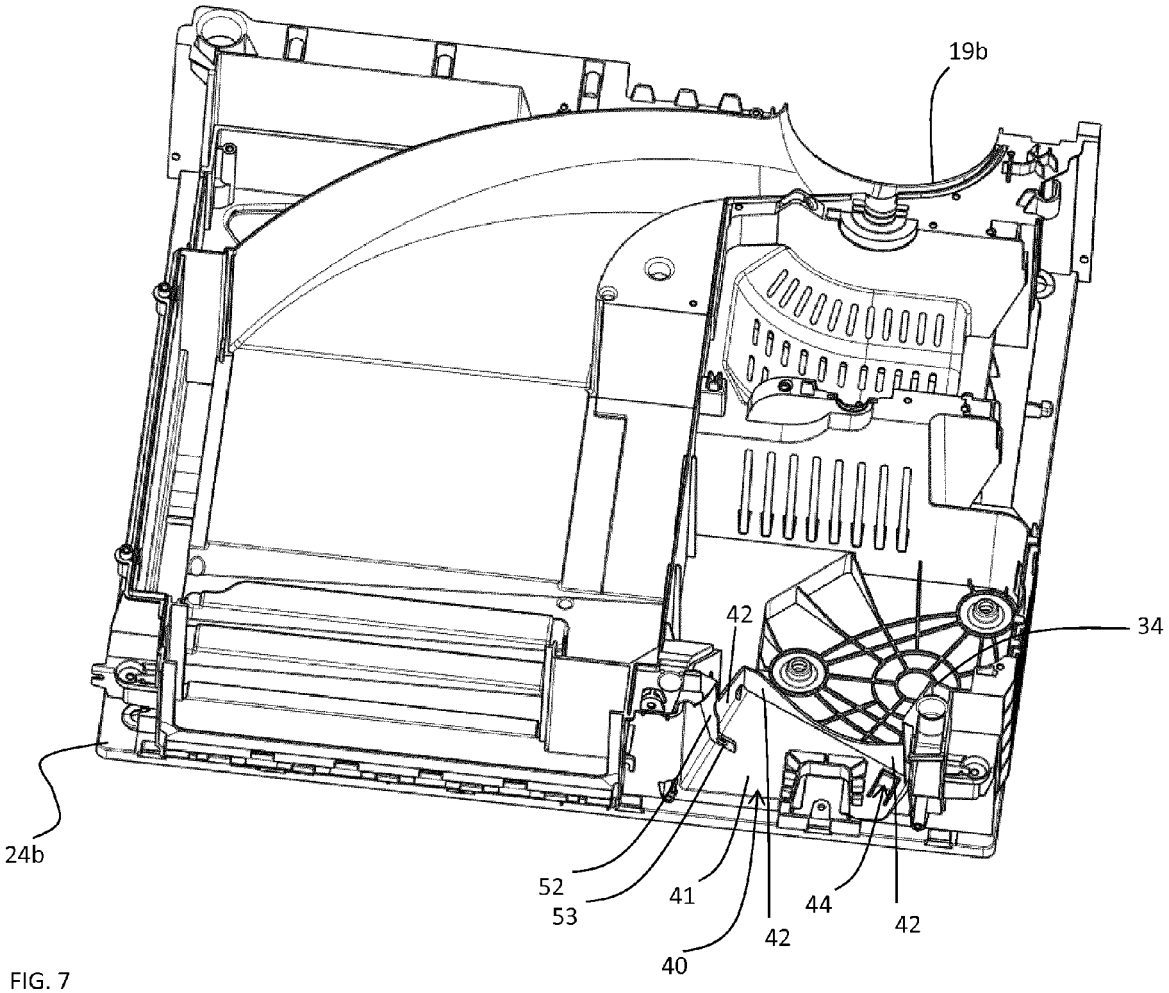

FIG. 7

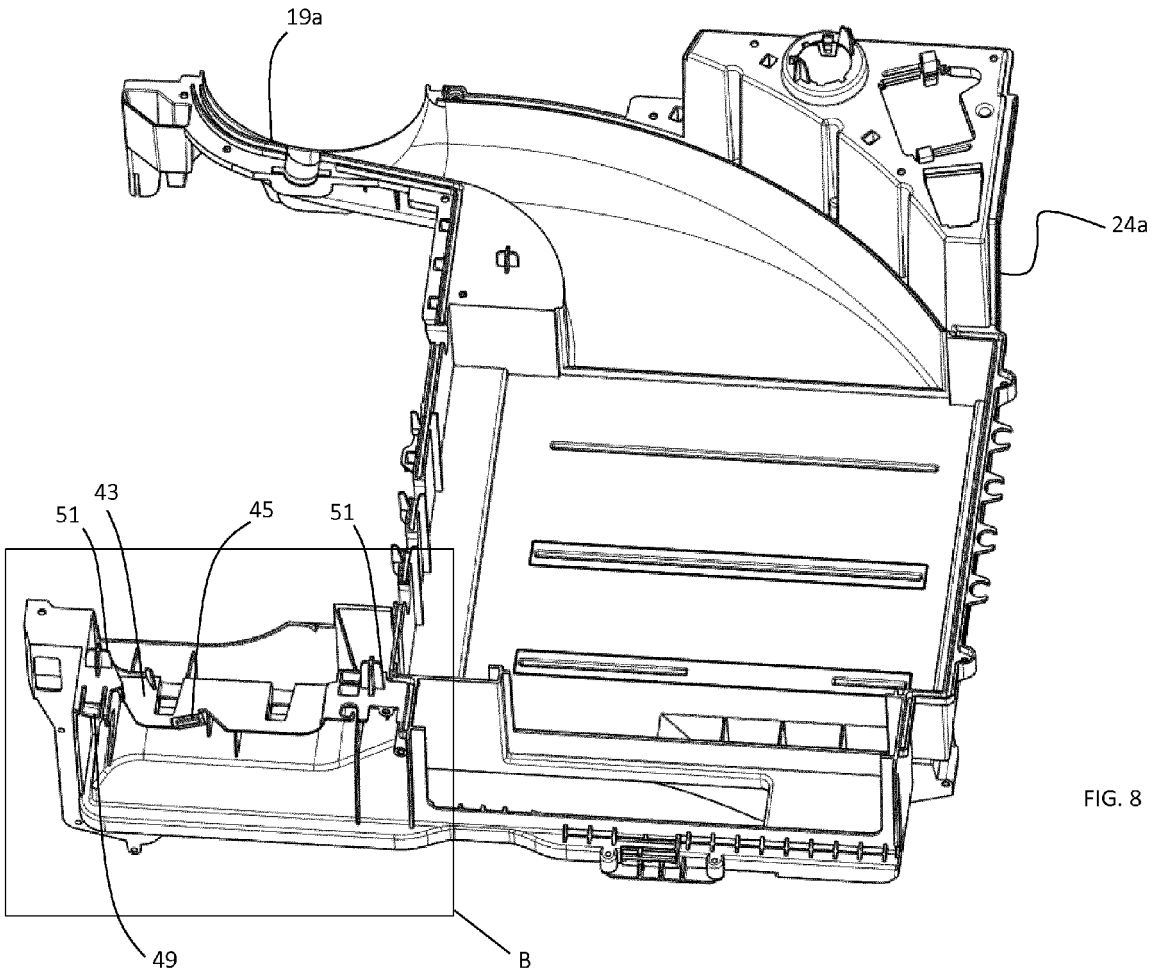

FIG. 8

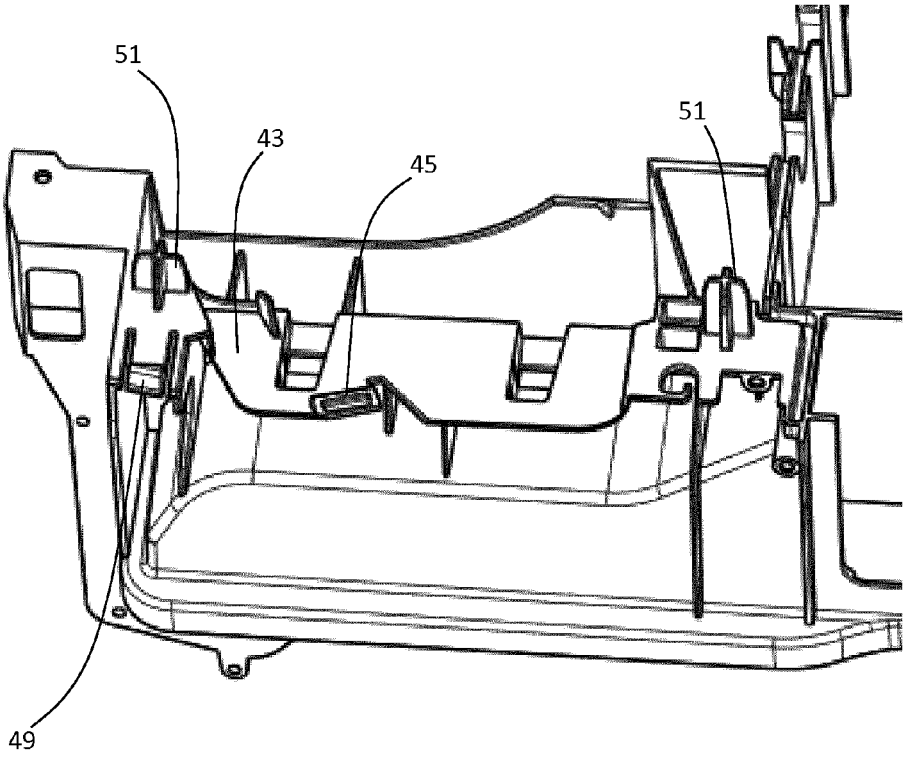

FIG. 9

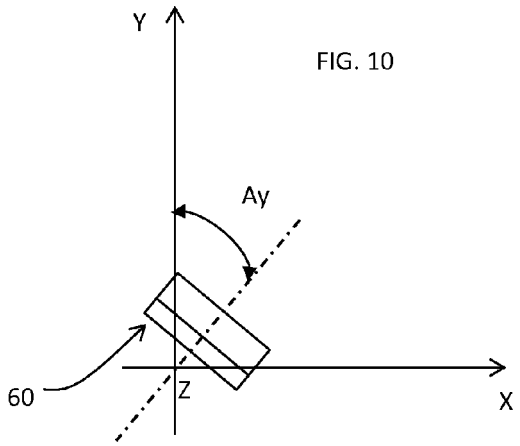

FIG. 10

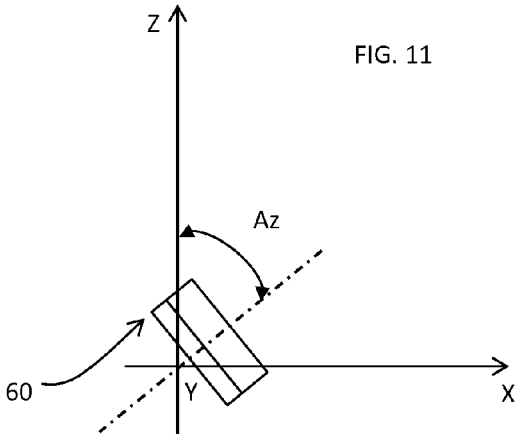

FIG. 11

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 8416

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2014/154251 A1 (ARCELIK AS [TR]; KASAPOGLU SERKAN [TR]; CETINKAYA VEYSEL ERTAN [TR]; D) 2 October 2014 (2014-10-02) * paragraphs [0009] - [0011] * * figures 1-6 * -----	1-15	INV. D06F58/20

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	13 January 2016	Bermejo, Marco

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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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 15 17 8416

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13-01-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2014154251 A1	02-10-2014	EP 2978889 A1	03-02-2016
		WO 2014154251 A1	02-10-2014

EPO FORM P0459

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