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(54) **A LAUNDRY DRYER**

(57) The invention relates to a laundry dryer (1) comprising:
o a casing (2);
o a laundry chamber (3) housed in said casing and suitable to receive laundry to be dried;
o a process air circuit (18) for circulating process air into said laundry chamber (3);
o a temperature sensor (80) located at least partially within said process air circuit and apt to measure a quantity dependent on the temperature of the process air;
o a seat (81) apt to at least partially house said temper-

ature sensor (80) and configured so as to allow extraction from the seat of said temperature sensor by means of an axial translation; and
o a blocking element (90) positioned within said casing (2), said blocking element (90) being movable from a first operative position where it limits said axial translation of said temperature sensor (80) to avoid complete extraction of said sensor from said seat (81) to a second operative position where said complete extraction of the temperature sensor (80) from the seat (81) is allowed.

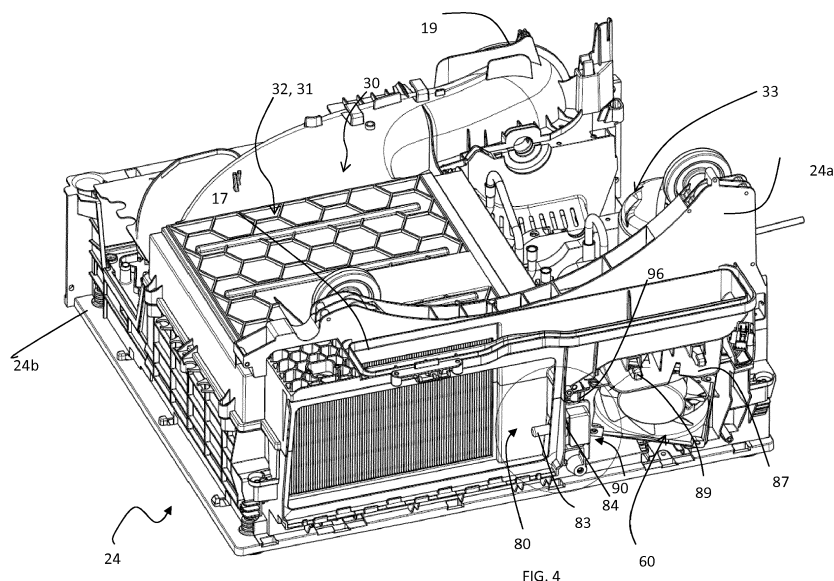


FIG. 4

Description

Technical field

[0001] The present invention relates to a laundry dryer. In particular, the present invention relates to a laundry machine with a sensor for the measurement of the process air temperature.

[0002] In the present description, the laundry dryer can be 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 casing, 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] The drum is part of a process air conduit where process air flows in order to dry the laundry. It is known to measure the temperature of the process air inside the conduit so as to check whether the drying process is properly ongoing or to modify parameters of the drying cycle. A temperature sensor is therefore for this purpose located within the process air conduit. The temperature sensor is commonly inserted in a gasket in order to keep the air conduit airtight. Indeed a portion of the temperature sensor needs to be located outside the process air circuit and to allow electrical cables sending the signals of the sensor to a central unit to reach the central unit itself from the sensor's location.

[0005] The temperature inside the process air circuit can be relatively high, in particular towards the end of the drying cycle, when the laundry - being relatively dry - does not absorb much of the heat present in the process air. The material in which the gasket is made, due to the high temperature, may become softer and slippery. In case of vibrations of the dryer during rotation of the drum or of accidental impact between the sensor and, for example, a user cleaning or maintaining the dryer, the temperature sensor may come out from the gasket. This accidental fall of the temperature sensor causes subsequent incorrect temperature measurements sent to the central unit and in turn an incorrect control of the drying cycle.

Summary of the invention

[0006] The present invention relates to a laundry dryer which overcomes the problems related to the prior art of record. In particular, the dryer of the invention is designed to avoid undesired or unintentional misplacement of the temperature sensor from its proper position. In addition, the dryer of the invention overcomes the mentioned problem in a simple manner, without adding expensive or complex component to the dryer itself.

[0007] According to a first aspect, the invention relates to a laundry dryer comprising:

o a casing;

o a laundry chamber housed in said casing and suitable to receive laundry to be dried;

o a process air circuit for circulating process air into said laundry chamber;

o a temperature sensor located at least partially within said process air circuit and apt to measure a quantity dependent on the temperature of the process air;

o a seat apt to at least partially house said temperature sensor and configured so as to allow extraction from the seat of said temperature sensor by means of an axial translation; and

o a blocking element positioned within said casing, said blocking element being movable from a first operative position where it limits said axial translation of said temperature sensor to avoid complete extraction of said sensor from said seat to a second operative position where said complete extraction of the temperature sensor from the seat is allowed.

[0008] 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).

[0009] 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.

[0010] The dryer of the invention can be either a "single" drying machine or a "combined" washer-dryer machine, therefore including any appliance having laundry drying function. Further, it may be a front-loading dryer, which means that a laundry chamber in which the laundry is located has an axis which is positioned in a horizontal manner or slightly tilted with respect to the horizontal plane, or a top-loading laundry dryer, where the axis of the laundry chamber is substantially vertical.

[0011] In a preferred embodiment, the laundry dryer is a front loading laundry dryer.

[0012] Preferably, the laundry chamber is apt to rotate around its axis, e.g. it is a drum.

[0013] The dryer comprises a casing preferably including a front wall, a rear wall, side walls and a base section or basement. The front wall may comprise a front top panel to command the functioning of the machine by the user. The casing defines the boundary between the internal or inner volume of the dryer and the exterior to the dryer. Further, preferably, the casing includes a loading/unloading aperture closable by a door hinged to the casing, e.g. to the front wall in case of a front loading dryer, which is openable in order to introduce the laundry in the laundry chamber.

[0014] The basement is preferably divided in an upper and a lower shell. The basement preferably houses several components of the dryer, as detailed below.

[0015] The dryer includes further a process air circuit connected to the drum and a hot-air generator which generates and circulates the same drying air continually inside the drum, so as to continuously extract surplus moisture from the air issuing from the drum after flowing over the laundry. The drying process air therefore enters the drum, for example by means of a drum air inlet, and exits the drum by means of a drum air outlet. Preferably, said air outlet may be located at a peripheral edge of the loading/unloading opening on the casing.

[0016] In addition, the terms "upstream" and "downstream" are used in the present description and claims with respect to the direction of a main flow of the process air in the process air conduit.

[0017] The process air exiting the drum preferably enters the basement where a hot-air generator is preferably present to heat and dehumidify the process air coming from the drum.

[0018] The hot-air generator of the present invention includes preferably a heat exchanger. In an embodiment such a heat exchanger includes an air-to-air heat exchanger. In a different embodiment, the laundry dryer includes a heat pump having a condenser and an evaporator and the hot-air generator includes the heat pump.

[0019] Preferably, the hot-air generator is located within the basement, that is, advantageously between the

upper and lower shells.

[0020] A temperature sensor is positioned at least partially within the process air circuit. The portion of the sensor which is present in the process air circuit is preferably that part of the sensor which is apt to measure a temperature. The sensor is therefore apt to measure a value which is a function of the temperature of the ambient where it is located, and in this case of the process air circuit where the process air is flowing. The temperature measured by the sensor is thus connected to the temperature of the process air.

[0021] In order to remain substantially fixed in a given position within the process air circuit so as, for example, to measure the temperature always in the same location, a seat is provided in the casing of the laundry apt to at least partially house the temperature sensor. For example, the temperature sensor can be inserted in the seat, with the measuring part sticking out in order to perform the temperature measurements within the process air circuit.

[0022] It is desirable that the temperature sensor can be removed from the seat. A removal of the sensor from the seat can be desired for example to clean the sensor: due to its position, the sensor can be subject to deposits of fluff or lint which is present inside the process air circuit. Additionally, a substitution and thus a removal of the temperature sensor might be necessary in case of breakage or malfunctioning of the sensor itself. For this purpose, the seat is configured so as to allow extraction from itself of the temperature sensor by means of an axial translation. The sensor is thus inserted into and removed from the seat by means of an axial movement. An "axial movement" means that the movement includes at least a component along an axis, i.e. a translation.

[0023] In order to avoid accidental removal of the temperature sensor from the seat, according to the invention, the dryer includes a blocking element positioned within the casing, advantageously proximate to the sensor. The blocking element is positioned in order to block a complete axial movement or translation of the sensor preventing its extraction from the seat when it is desired that the sensor remains into the seat, however such blocking element is adapted also to allow an extraction of the sensor from the seat in other occasions, for example when cleaning and/or substitution of the sensor is deemed necessary. The blocking element is thus so designed to be movable from a first operative position where it limits said axial translation of said temperature sensor from said seat to avoid complete extraction of said sensor to a second operative position where said complete extraction of the temperature sensor from the seat is allowed. In the first operative position, the blocking element does not allow an axial translation of a distance equal or longer than a length of the temperature sensor, while an axial translation of such a distance or longer is allowed in the second operative position of the blocking element.

[0024] Thanks to the provision of the blocking element, the temperature sensor cannot fall from the seat acci-

dentally, because the axial translation of the temperature sensor necessary for such an extraction is hindered by the blocking element. However, the temperature sensor can be still removed from the casing, simply moving the blocking element into its second position. The operation of moving the blocking element from the first to the second operative position could include, among others, a translation of the blocking element, a rotation of the blocking element, or a complete removal of the blocking element from the casing.

[0025] The dryer according to the first aspect may include, in combination or alternatively, any of the following characteristics.

[0026] Preferably, said second operative position includes the detachment of said blocking element from said casing.

[0027] In order to allow a complete extraction of the temperature sensor from the seat, a complete removal of the blocking element can be performed, so that a relatively large free space is available for the axial translations of the temperature sensor.

[0028] Preferably, said blocking element includes a wall and wherein, in said first operative position, an axial translation of said temperature sensor implies an abutment of the temperature sensor against said wall.

[0029] In order to block the axial translations of the temperature sensor, in an embodiment, the blocking element may include a physical obstacle, such as a wall, positioned at a given distance from the temperature sensor, distance shorter than the length of the temperature sensor, so that, when the sensor begins the axial translation, it impinges onto the wall and remains in abutment thereto, being further translations impossible by the presence of the wall which is fixed in such position.

[0030] Advantageously, said casing includes a basement and said temperature sensor is located within said basement.

[0031] As mentioned above, in the basement, many components of the dryer are present. Further, in the basement, normally a door is provided in order to access a filter and/or an air moisture condensing device, which are positioned within the process air circuit for, respectively, trapping fluff and lint, or removing moisture present in the process air due to the wet laundry in the drum. The filter and particular types of air moisture condensing devices, like air-air type heat exchangers, need constant cleaning from the deposited fluff and lint and therefore a door is used to access and remove the filter itself. Other types of air moisture condensing devices, like a refrigerant evaporator of a heat pump system, may also require periodical cleaning operations, and therefore they can also be accessed via a door provided in the basement. The above cited filter is generally located in the basement upstream the hot air generator. The door in the basement could be used not only to access the filter, but also to access the temperature sensor, in case of need of maintenance or cleaning.

[0032] Advantageously, the casing of the dryer with its

walls defines a boundary between an inner volume and the outside of the dryer. The temperature sensor is preferably positioned in a neighborhood of the casing so that it can be reached from the outside of the casing, for example by a user or by maintenance personnel, without disassembling too many components of the dryer itself. Thus, a temperature sensor positioned closed to the casing allows an easy maintenance of the same, easily accessing the sensor from the outside.

[0033] More preferably, said basement includes a condensing device for removing moisture from the process air coming from said laundry chamber and said temperature sensor is located at least partially in said process air circuit between said laundry chamber and said condensing device.

[0034] Preferably, the process air leaves the laundry chamber, e.g. the drum, and turns downwards toward the basement and enters the same, passing through a first filter placed at the air outlet located at a peripheral edge of the loading/unloading opening on the dryer casing, to remove fluff and lint collected in the drum from the laundry. Then, preferably, the process air flows through the hot air generator which includes a condensing device, such as a heat pump evaporator or an air-to-air heat exchanger, and returns into the drum. Preferably, the temperature sensor is located in front of the condensing device, even more preferably in front of a second filter which is placed upstream the condensing device and downstream the first filter. The term "in front" means in this context "upstream" with respect to the flowing direction of the process air. The temperature sensor is therefore advantageously just behind the door to access the second filter and/or the air moisture condensing device.

[0035] Advantageously, the dryer of the invention includes a gasket surrounding said temperature sensor, said gasket being inserted in said seat.

[0036] In a preferred embodiment, the temperature sensor has a portion within in the process air circuit and another portion outside it. The seat thus puts into fluid communication two different volumes, one where the process air flows, and a volume outside the air process conduit, but still within the casing. It is preferred that the process air circuit where the process air flows does not allow, or allows to a minor extent, leakage of process air towards the exterior of the process air circuit, so as to keep a certain efficiency in the drying process and avoid pressure drops. For this reason, it is preferred that any aperture connecting different volumes in the dryer involving the process air circuit is sealed with a gasket. The dryer therefore preferably includes a gasket surrounding the sensor, and the gasket is introduced in the seat so as to divide a portion of the temperature sensor within the air circuit and a portion of the temperature sensor outside it.

[0037] In a preferred embodiment, said process air circuit comprises a delimiting wall representing an outer boundary of said process air circuit, said delimiting wall including a through-aperture and wherein said seat in-

cludes said through-aperture where said temperature sensor is inserted.

[0038] The process air conduit is delimited by a process air conduit wall which channels the process air within the basement. This conduit includes a through-aperture, or hole, where the temperature sensor is introduced. More preferably, the temperature sensor is first inserted in a gasket which is in turn inserted in the hole forming the seat.

[0039] Preferably, the dryer of the invention comprises a heat pump system having a refrigerant circuit in which a refrigerant can flow, said refrigerant circuit including a first heat exchanger where the refrigerant is cooled off, a second heat exchanger where the refrigerant is heated up, a compressor to pressurize and circulate the refrigerant through the refrigerant circuit, and a pressure-lowering device; said first and/or second heat exchanger being apt to perform heat exchange between said refrigerant flowing in said refrigerant circuit and said process air; and further comprising a compressor cooling fan associated with the compressor, wherein said seat of said temperature sensor is formed in a wall separating said process air circuit and a location where said compressor cooling fan is positioned.

[0040] In order to be energy efficient, it is preferred to heat and dehumidify the process air with a heat pump system as a hot air generator and condensing device. 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 air that flows towards the drum, while the second heat exchanger is configured to heat said refrigerant. The second heat exchanger is also configured to dehumidify and cool the process air exiting the drum.

[0041] In order to cool the compressor and to avoid overheating that may occur during operation of the same, it is advantageous to use a compressor cooling fan. The cooling fan, in order to cool the compressor, needs to draw "fresh" air from outside of the basement, and for this purpose preferably it is located close to the casing walls so that, for example from some apertures formed in the casing walls, it can suck such air. Advantageously, the temperature sensor is located in a seat formed in the proximity of the compressor cooling fan so that in turn it is also in the proximity of the casing's walls and thus it can be easily accessed from the outside of the laundry dryer in case of need.

[0042] Preferably, the dryer of the invention comprises a heat pump system having a refrigerant circuit in which a refrigerant can flow, said refrigerant circuit including a first heat exchanger where the refrigerant is cooled off, a second heat exchanger where the refrigerant is heated up, a compressor to pressurize and circulate the refrigerant through the refrigerant circuit, and a pressure-lowering device; said first and/or second heat exchanger being apt to perform heat exchange between said refriger-

ant flowing in said refrigerant circuit and said process air; and a grid positioned in front of said second heat exchanger, wherein said temperature sensor is positioned at least partially in said process air circuit behind said grid.

[0043] As mentioned above, preferably the dryer of the invention is a heat pump dryer. In heat pump dryers, in order to protect the heat exchangers, to avoid that the user may damage the same, and to obtain a desired aesthetical appearance of the cabinet front wall, a grid is positioned in front of the heat exchangers within the process air circuit. Advantageously, the temperature sensor is located in the process air circuit behind the grid which thus has advantageously also the function of protecting the temperature sensor.

[0044] More preferably, said casing includes a door to access said second heat exchanger and said temperature sensor is located at least partially behind said door.

[0045] As mentioned, the door to access the second filter and/or the air moisture condensing device cited above is also preferably used to access the temperature sensor. More preferably, the whole sensor is located behind the door.

[0046] Advantageously, the dryer of the invention includes a basement defining a basement plane substantially parallel to a ground where said dryer is positioned on, and wherein said axial translation is substantially parallel to said basement plane.

[0047] Preferably, the sensor is inserted and removed translating the same along an axis substantially parallel to the basement. A movement along such an axis maximizes the "available free space" for the movement itself, that is, there is more space to translate the temperature sensor along an axis parallel to the ground than in any other direction. Indeed, in the basement dryer's components are rather tightly packed and a horizontal movement is the one that is easier for the user to perform without hitting or being blocked by other components of the dryer.

[0048] The dryer of the invention, according to a preferred embodiment, comprises a control unit and the temperature sensor includes one or more cables to electrically connect it to said control unit, said blocking element further comprising a protective element to shield said one or more cables, said protective element being positioned between said casing and said one or more cables.

[0049] The dryer is often located in a wet environment and droplets of water may be sprayed from many directions towards the interior of the dryer. Therefore, droplets may be sprayed from the outside of the casing towards the interior of the basement. The basement includes apertures to draw air into it and therefore also the sprayed droplets of water can enter the basement through these apertures and damage the electrical cables or cause short-circuits. Therefore, preferably a protective element, such as a wall, is provided to avoid that water or dirt can easily deposit on the cables.

[0050] Preferably, said temperature sensor includes a NTC sensor.

[0051] Thermistors are temperature-sensing elements made of semiconductor material that has been sintered in order to display large changes in resistance in proportion to small changes in temperature. This resistance can be measured by using a small and measured direct current, or dc, passed through the thermistor in order to measure the voltage drop produced. Thermistors are an accurate category of temperature sensors. NTC sensors are negative temperature coefficient thermistors.

[0052] In the preferred embodiment, the dryer according to the invention, includes a control unit connected to the temperature sensor, said control unit being apt to receive signals from said temperature sensor and to emit a warning if said signals received from said temperature sensor are deviating from expected values of more than a given amount.

[0053] The temperature sensor is preferably used to control and/or monitor the drying cycles. Preferably, for each drying cycle there is an expected temperature curve of the process drying air versus time. If the measurements of the temperature sensor substantially differ from the expected values or curve of temperatures, a warning is preferably emitted. Indeed, temperature values in an unexpected range may mean that something is not properly working in the dryer, or that the temperature sensor is not properly placed, it is broken or needs cleaning.

[0054] Preferably, said blocking element comprises a hole and a screw so as to be removably coupled to said casing.

[0055] In order to fasten and unfasten said blocking element to the casing, so as to move the blocking element from a position where it is close enough to the sensor to limit its axial movements to a position where it is detached from the casing, a simple screw/threaded hole coupling is provided.

Brief description of the drawings

[0056] 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. 4a is an enlarged view of the circled portion A of the basement of Fig. 4;

- Fig. 5 is the perspective view of Fig. 3 showing the basement in a partially disassembled configuration; and

- 5 • Fig. 5a is an enlarged view of the circled portion B of the basement of Fig. 5.

Detailed description of one or more embodiments of the invention

[0057] 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 washer-dryer machine.

- 15 **[0058]** 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.

[0059] Laundry machine 1 comprises an outer box casing 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 casing 2. Access to the drum 3 is achieved for example via a door 4, preferably hinged to casing 2, which can open and close a loading/unloading opening 4a realized on the cabinet itself.

[0060] More in detail, casing 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 casing 2 further comprises a top wall 22. Preferably, the basement 24 is realized in plastic or polymeric 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 casing 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 3 and 4).

- 30 **[0061]** 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 plane (X,Y).

- 45 **[0062]** 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.

[0063] Further, laundry machine 1 may include an electronic central control unit 100 (schematically depicted in figure 1) which controls both the electrical motor assembly

bly 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 100. 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.

[0064] 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 casing 2 and is apt to rotate around a general rotational axis which can be horizontal, i.e. parallel to the (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).

[0065] 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.

[0066] 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.

[0067] 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.

[0068] The process air is dehumidified and heated in laundry machine 1 by a heat pump system 30.

[0069] 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 in the basement 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 casing 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 casing 2.

[0070] With reference to Figures 2, 3 and 5, 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.

[0071] Evaporator and condenser in the figures are shown always contained in the process air circuit 18 and thus not visible individually.

[0072] 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.

[0073] 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 (shown 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.

[0074] 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.

[0075] 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 process 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.

[0076] The process air circuit also includes an air circuit fan or blower (not visible in the figures) for inhaling process air exiting the drum 3 and passing through the heat pump system 30 and blowing it back into the drum 3.

[0077] As mentioned, 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 dehumidified 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. 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 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 process air conduit 18 in the basement includes a separating and guiding wall 18a which separates the inside of the process air conduit where the process air flows and the remaining of the basement where other components, for example the motor 50 and the compressor 33, are located. The separating and guiding wall 18a is formed by the upper and lower shells 24a, 24b connected together and it defines also a seat for the evaporator and condenser of heat pump 30. Further, the wall 18a of the process air conduit, downstream of the seat of the evaporator and condenser, forms a bend or curve to connect the seat of the evaporator and condenser to the outlet 19 of the basement 24, where the wall 18a terminates. The separating and guiding wall 18a begins at pass-through opening 17 from which process air from the drum 3 enters.

[0079] Upstream the pass-through opening 17, preferably a first filter (not depicted in the drawings) is provided, so as to be located in the process air conduit 18 downstream of the drum 3 and upstream of the heat pump heat exchangers 31, 32, so that fluff and lint present in the process air coming from the drum is blocked before entering the evaporator. A second filter may be located behind a grid 26 which is part of the front wall 20 of the casing 2. Advantageously, grid 26 is formed on a door 27 hinged in a front part of the basement below the loading/unloading opening 4a of the dryer. Door 27 can be therefore opened in order to access the second filter, for example to clean or substitute the same or in order to access the evaporator 32.

[0080] 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.

[0081] As shown in Fig. 3, the compressor cooling fan 60 and the compressor 33 are placed within the base-

ment 24, rested on the bottom wall 23 of the casing 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 casing 2. The grid 26 (see figure 1) provided on the front wall 20 is also placed in front of the compressor cooling fan 60.

[0082] A further grid (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. 3) provided into the lower shell 24b, in order to prevent the compressor cooling fan 60 to be reached once the grid 26 is removed or opened.

[0083] With now reference to figs. 4, 4a, 5, 5a, the dryer further includes a temperature sensor 80, such as a NTC, connected to the casing 2 by means of a seat 81 including a through hole 82 (better visible in figure 5 and 5a) formed in the separating and guiding wall 18a of the process air conduit 18. The through hole 82 is formed at the beginning of the process air conduit 18 located in the basement 24, upstream of the heat pump heat exchangers 31, 32 in the direction of flow of the process air in the conduit. More preferably, the temperature sensor is located upstream the above cited second filter of the process air conduit. Advantageously, the seat 81 including hole 82 is formed in that portion of the wall 18a which separates the process air conduit 18 and a seat for the compressor cooling fan 60. Thus, opening door 27 having the grid 26 allows access to the second filter and to the temperature sensor 80. The grid 26 is thus positioned in front of the temperature sensor 80.

[0084] The temperature sensor 80 includes a first portion 83 projecting out of the seat 81. The first portion 83 is in contact with the process air flow, being located within the process air circuit. The temperature sensor 80 further preferably includes a second portion 84 which also projects out from the seat 81 in an opposite direction than the first portion 83 and it is located adjacent to the compressor cooling fan 60 outside the process air conduit 18. The first portion 83 is apt to measure the temperature of the surrounding environment, while the second portion 84 preferably comprises an electrical connection box 86 apt to connect electrical cables (not shown) to the central control unit 100 in order to send signal to the unit 100 relative to the temperature within the process air conduit 18.

[0085] The basement 24 advantageously includes one or more flaps 87, for example positioned above the compressor cooling fan 60 forming a top cover of the latter, where one or more hooks 89 to guide the electrical cables exiting the temperature sensor 80, from electrical connections box 86, towards the control unit 100.

[0086] The control unit 100 preferably stores one or more curves or look-up tables in which reference temperature behaviour versus time during different drying

cycles is saved. These temperature values for different drying cycles are compared by the control unit 100 with the real temperature values derivable from the signals received from the temperature sensor 80, in order to compare them. If the temperature values in the tables or curves stored in the control unit 100 and those derivable from the signals received from the temperature sensor 80 are deviating one from the others more than a certain tolerance value, preferably a warning is emitted. The deviation of the process air temperature from a "standard" behaviour is a symptom of a malfunctioning of the dryer.

[0087] The temperature sensor 80, when in use, is preferably first inserted in a gasket 85 which includes a groove 85a, advantageously annular, and then inserted into the seat 81, so that the groove 85a is in contact to a rim of the through hole 82. Advantageously, in order to be inserted in the through hole 82, the temperature sensor 80 has to be inserted by means of a movement having an axial component along an axis M substantially parallel to the (X, Y) plane. As shown in figure 4a, the temperature sensor 80 is preferably tubular-shaped having longitudinal axis M. In order to insert the sensor in the through hole 82, the temperature sensor has to be inserted from the compressor cooling fan side, pushing the sensor along the M axis in the hole 82. The translation along the M axis terminates when the electrical connection box 85, advantageously having dimensions bigger than the dimensions of the hole 82, abuts against the wall 18a on the compressor cooling fan side. To remove the temperature sensor 80 from the hole 82, a translation along the M axis, but in the opposite versus, has to be performed. The sensor has to be pulled from the cooling compressor fan side, or pushed from the process air circuit side, and thus extracted by means of a translation along the M axis.

[0088] In order to avoid that such a translation along the M axis takes place when it is undesired, e.g. without the manual intervention and pushing or pulling of the maintenance personnel or of a user, a blocking element 90 is provided in the laundry dryer 1.

[0089] The blocking element 90 is removably coupled to the basement 24 by means of a screw/threaded hole coupling. The blocking element 90 comprises a hole 88 which can overlap a threaded hole already formed in the basement, such as threaded receiving holes 55a or 55b, where the a further grid (not visible) is coupled in order to prevent the compressor cooling fan 60 to be reached once the grid 26 is removed or opened. A single screw (not depicted in the drawing) therefore couples both the said further grid and the blocking element 90 to the basement 24. However an independent coupling, i.e. a coupling between the basement 24 and the blocking element 90 only, is foreseen as well. Other coupling types instead of the screw coupling are envisaged and possible as well.

[0090] The blocking element 90 preferably includes a bracket frame 91 having an abutment wall 92 disposed substantially perpendicular to the M axis, when mounted to the basement 24 as shown in figure 4 and 4a. Further, the blocking element 90 advantageously comprises a

protective element or wall 93 substantially parallel to the M axis, disposed in such a way that the abutment wall 92 and the protective wall 93 form a corner therebetween. The bracket frame 91 has, in an embodiment, two opposite axial ends 91 a, 91 b, one end 91 a includes hole 88 and is disposed lowermost when the blocking element 90 is fastened to the basement 24, and the opposite axial end 91 b which is disposed topmost. The end 91 b preferably includes an elastic protrusion 95. The elastic protrusion 95 cooperates with the screw/threaded hole coupling to keep the blocking element 90 in the correct position when the blocking element 90 is fastened to basement 24. The dryer 1 includes a counter-element 96 in the basement 24 protruding substantially adjacent and more preferably parallel to the wall 18a where the hole 92 is realized. A gap is formed between the counter-element 96 and the wall 18a, where the elastic protrusion 95 is inserted and compressed so as to abut against the wall 18a of the process air conduit 18 and counter-element 96. This elastic compression allows to better keep the blocking element 90 in place when screwed and avoid rotation of the same around hole 88.

[0091] The location of the blocking element 90 when fastened on the basement 24 is such that a distance along the M axis between an axial end of the second portion 84 of the temperature sensor, e.g. the electrical connection box 85, and the abutment wall 92 is smaller than a distance necessary for a complete extraction of the temperature sensor from hole 82. That is to say, the distance between the wall 18a and the abutment wall 92 is shorter than the length of the temperature sensor. Thus, when the blocking element 90 is mounted on the basement 24, a temperature sensor translation along the M axis results in an abutment of the electrical connection box 85 onto the abutment wall 92 of the frame 91. The abutment prevents further translation of the temperature sensor 80 along the M axis, and thus prevents the complete removal of the temperature sensor 80 from the seat 81.

[0092] The protective wall 93 is located close to the front wall 20, so that it shields the electrical connection box 85 from the outside of the casing, e.g. from water or dirt that may enter within the casing from the grid 26.

[0093] Preferably, the distance between the temperature sensor 80 and the front wall 20 is of about few centimetres so as to have the temperature sensor easily accessible from the outside, for example opening door 27 having grid 26.

[0094] The blocking element 90 avoids accidental extraction of the temperature sensor 80 from the seat 91, also when the gasket 95 - due to a temperature increase - becomes slippery and the temperature sensor tends to slip out.

Claims

1. A laundry dryer (1) comprising:

- o a casing (2);
 - o a laundry chamber (3) housed in said casing and suitable to receive laundry to be dried;
 - o a process air circuit (18) for circulating process air into said laundry chamber (3);
 - o a temperature sensor (80) located at least partially within said process air circuit and apt to measure a quantity dependent on the temperature of the process air;
 - o a seat (81) apt to at least partially house said temperature sensor (80) and configured so as to allow extraction from the seat of said temperature sensor by means of an axial translation; and
 - o a blocking element (90) positioned within said casing (2), said blocking element (90) being movable from a first operative position where it limits said axial translation of said temperature sensor (80) to avoid complete extraction of said sensor from said seat (81) to a second operative position where said complete extraction of the temperature sensor (80) from the seat (81) is allowed.
2. The dryer (1) according to claim 1, wherein said second operative position includes the detachment of said blocking element (90) from said casing (2).
 3. The dryer (1) according to claim 1 or 2, wherein said blocking element (90) includes a wall (92) and wherein, in said first operative position, an axial translation of said temperature sensor (80) implies an abutment of the temperature sensor against said wall (92).
 4. The dryer (1) according to any of the preceding claims, wherein said casing (2) includes a basement (24) and said temperature sensor (80) is located within said basement.
 5. The dryer (1) according to claim 4, wherein said basement (24) includes a condensing device (30) for removing moisture from the process air coming from said laundry chamber (3) and wherein said temperature sensor (80) is located at least partially in said process air circuit (18) between said laundry chamber (3) and said condensing device (30).
 6. The dryer (1) according to any of the preceding claims, including a gasket (85) surrounding said temperature sensor (80), said gasket being inserted in said seat (81).
 7. The dryer (1) according to any of the preceding claims, wherein said process air circuit (18) comprises a delimiting wall (18a) representing an outer boundary of said process air circuit, said delimiting wall (18) including a through-aperture (82) and wherein said seat (81) includes said through-aperture where said temperature sensor (80) is inserted.
 8. The dryer (1) according to any of the preceding claims, comprising a heat pump system (30) having a refrigerant circuit in which a refrigerant can flow, said refrigerant circuit including a first heat exchanger (31) where the refrigerant is cooled off, a second heat exchanger (32) where the refrigerant is heated up, a compressor (33) to pressurize and circulate the refrigerant through the refrigerant circuit, and a pressure-lowering device; said first and/or second heat exchanger (31,32) being apt to perform heat exchange between said refrigerant flowing in said refrigerant circuit and said process air; and further comprising a compressor cooling fan (60) associated with the compressor (33), wherein said seat (81) of said temperature sensor (80) is formed in a wall (18a) separating said process air circuit (18) and a location where said compressor cooling fan (60) is positioned.
 9. The dryer (1) according to any of the preceding claims, comprising a heat pump system (30) having a refrigerant circuit in which a refrigerant can flow, said refrigerant circuit including a first heat exchanger (31) where the refrigerant is cooled off, a second heat exchanger (32) where the refrigerant is heated up, a compressor (33) to pressurize and circulate the refrigerant through the refrigerant circuit, and a pressure-lowering device; said first and/or second heat exchanger (31, 32) being apt to perform heat exchange between said refrigerant flowing in said refrigerant circuit and said process air; and a grid (26) positioned in front of said second heat exchanger (32), wherein said temperature sensor (80) is positioned at least partially in said process air circuit (18) behind said grid (26).
 10. The dryer (1) according to claim 9, wherein said casing (2) includes a door (27) to access said second heat exchanger (32) and said temperature sensor (80) is located at least partially behind said door (27).
 11. The dryer (1) according to any of the preceding claims, including a basement (24) defining a basement plane (X, Y) substantially parallel to a ground plane where said dryer is positioned on, and wherein said axial translation is along an axis (M) substantially parallel to said basement plane (X, Y).
 12. The dryer (1) according to any of the preceding claims, comprising a control unit (100) and wherein said temperature sensor (80) includes one or more cables to electrically connect to said control unit, said blocking element (90) further comprising a protective element (93) to shield said one or more cables, said protective element (93) being positioned between

said casing (2) and said one or more cables.

13. The dryer (1) according to any of the preceding claims, wherein said temperature sensor (80) includes a NTC sensor. 5
14. The dryer (1) according to any of the preceding claims, including a control unit (100) connected to said temperature sensor (80), said control unit being apt to receive signals from said temperature sensor and to emit a warning if said signals received from said temperature sensor are deviating from expected values of more than a given amount. 10
15. The dryer (1) according to any of the preceding claims, wherein said blocking element (90) comprises a hole (88) and a screw so as to be removably coupled to said casing (2). 15

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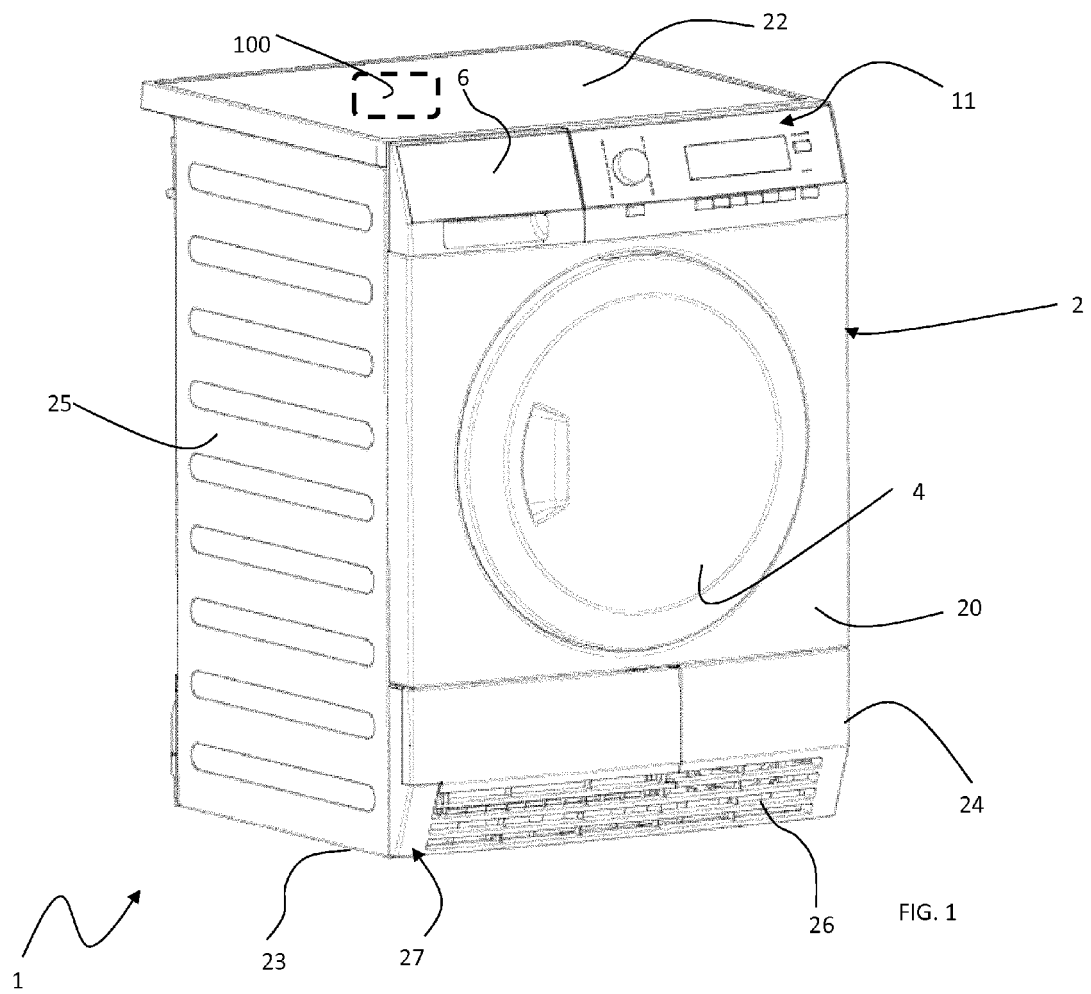
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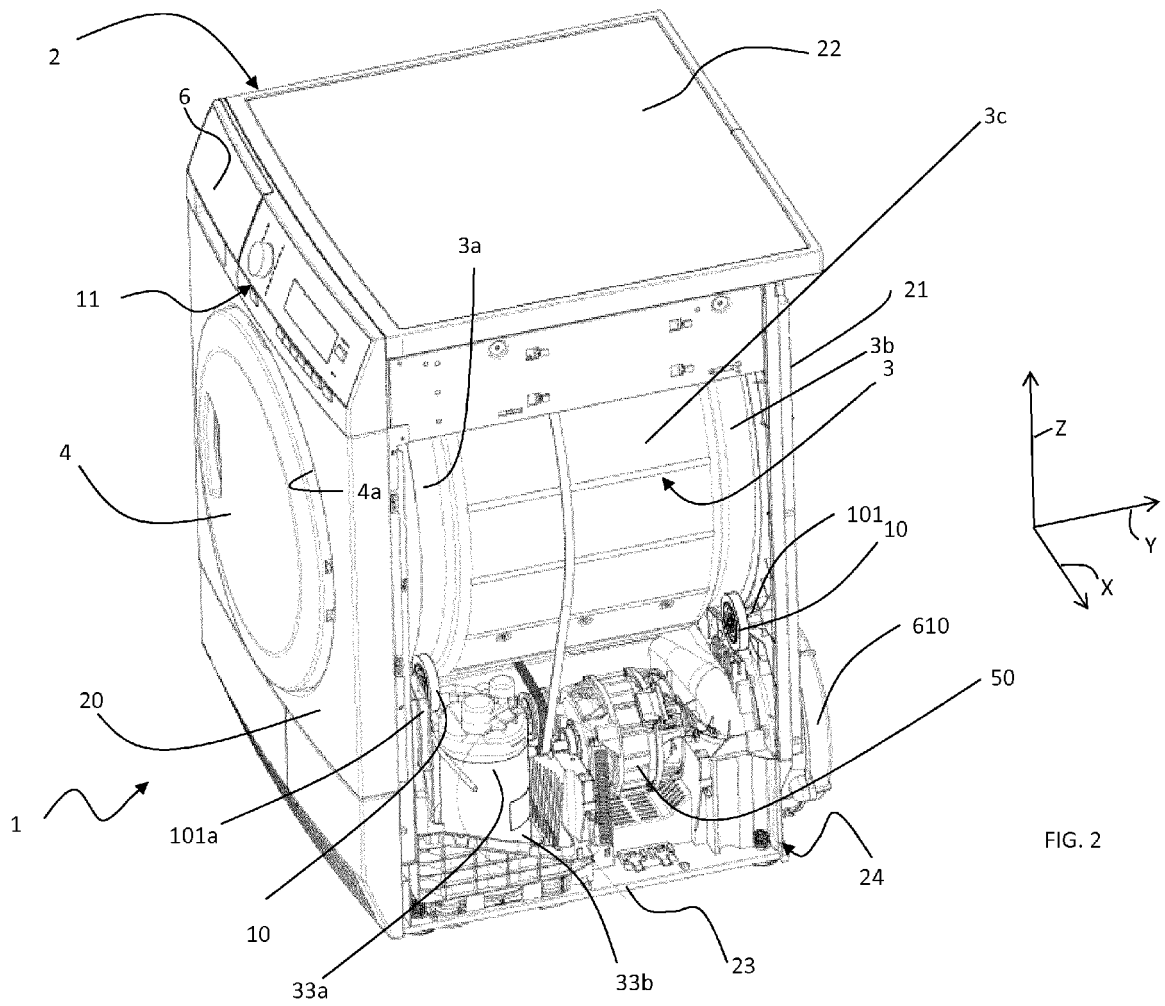


FIG. 2

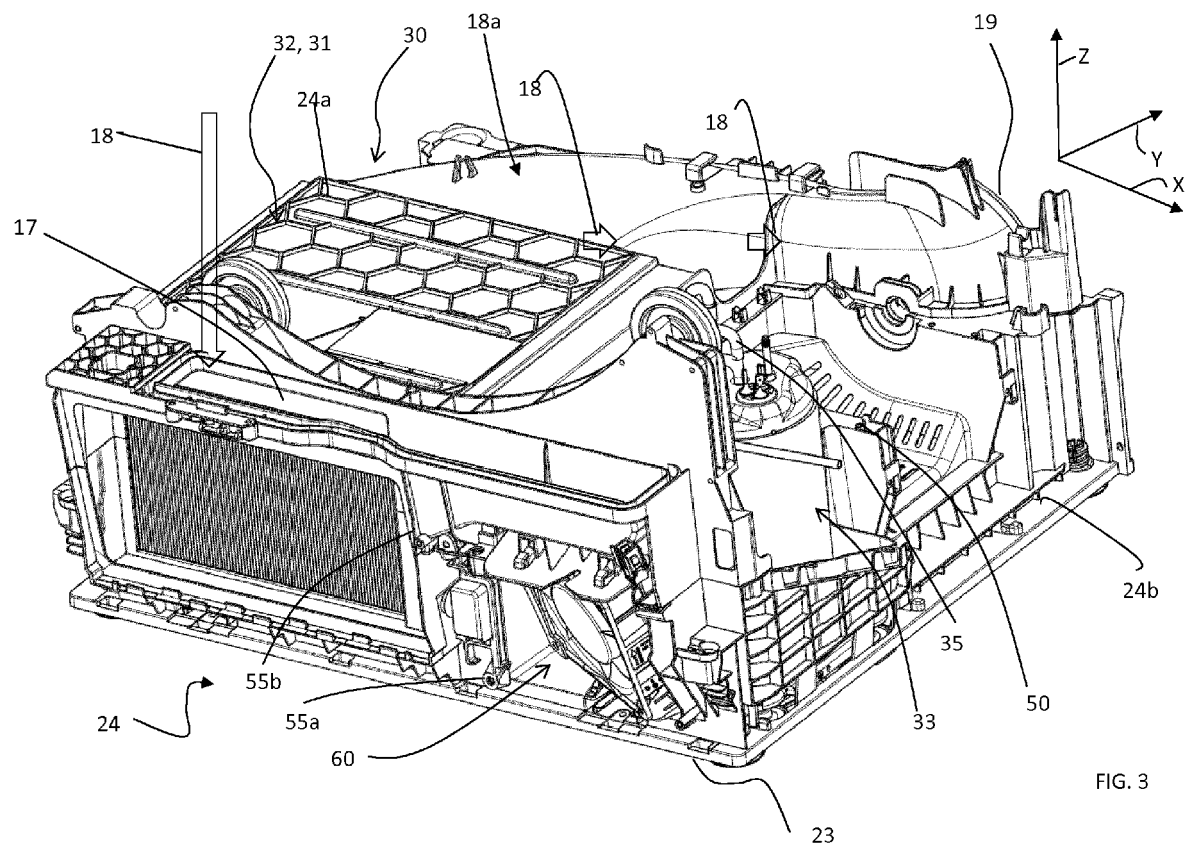


FIG. 3

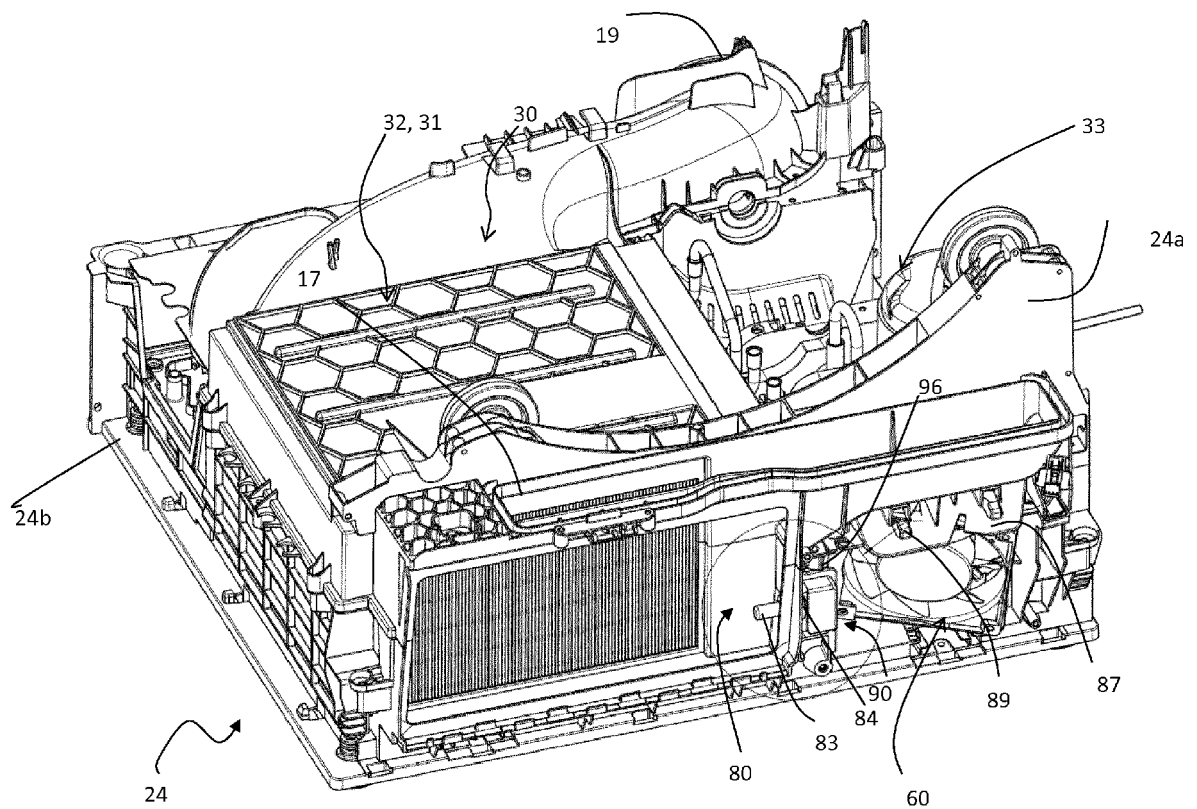
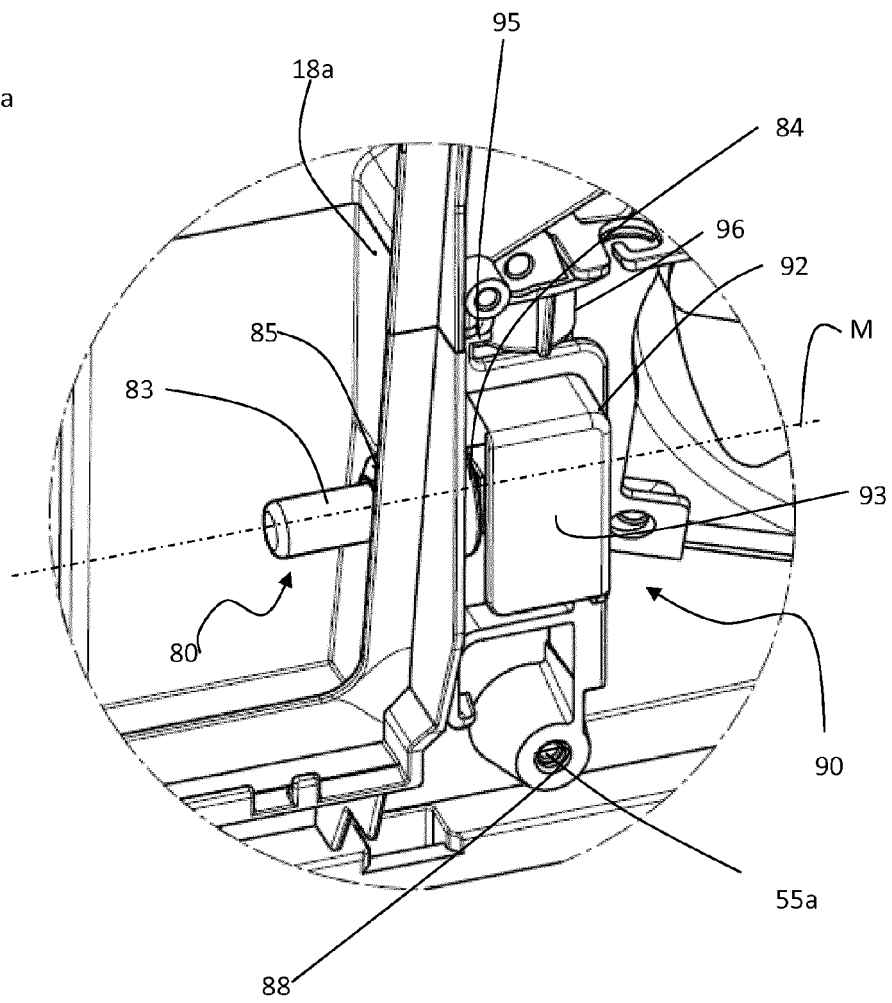
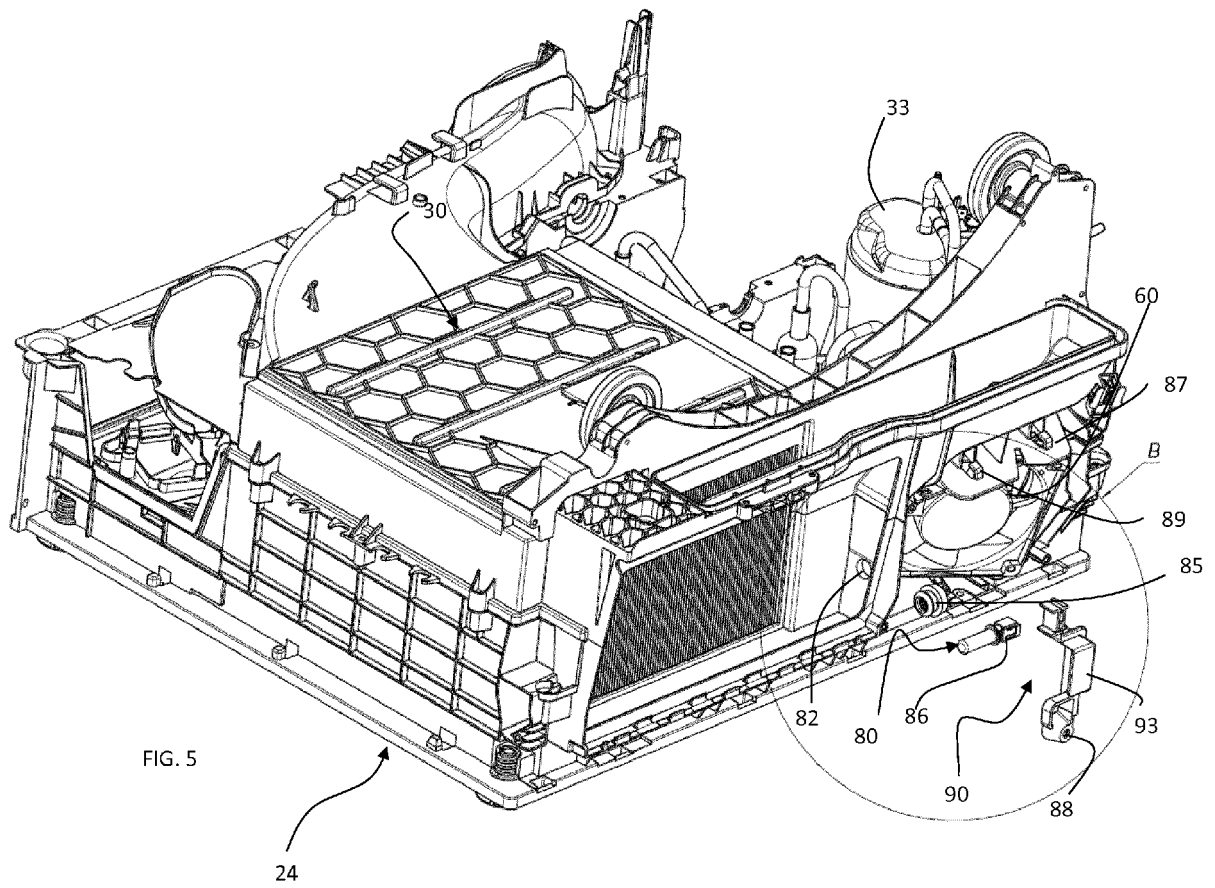


FIG. 4

FIG. 4a





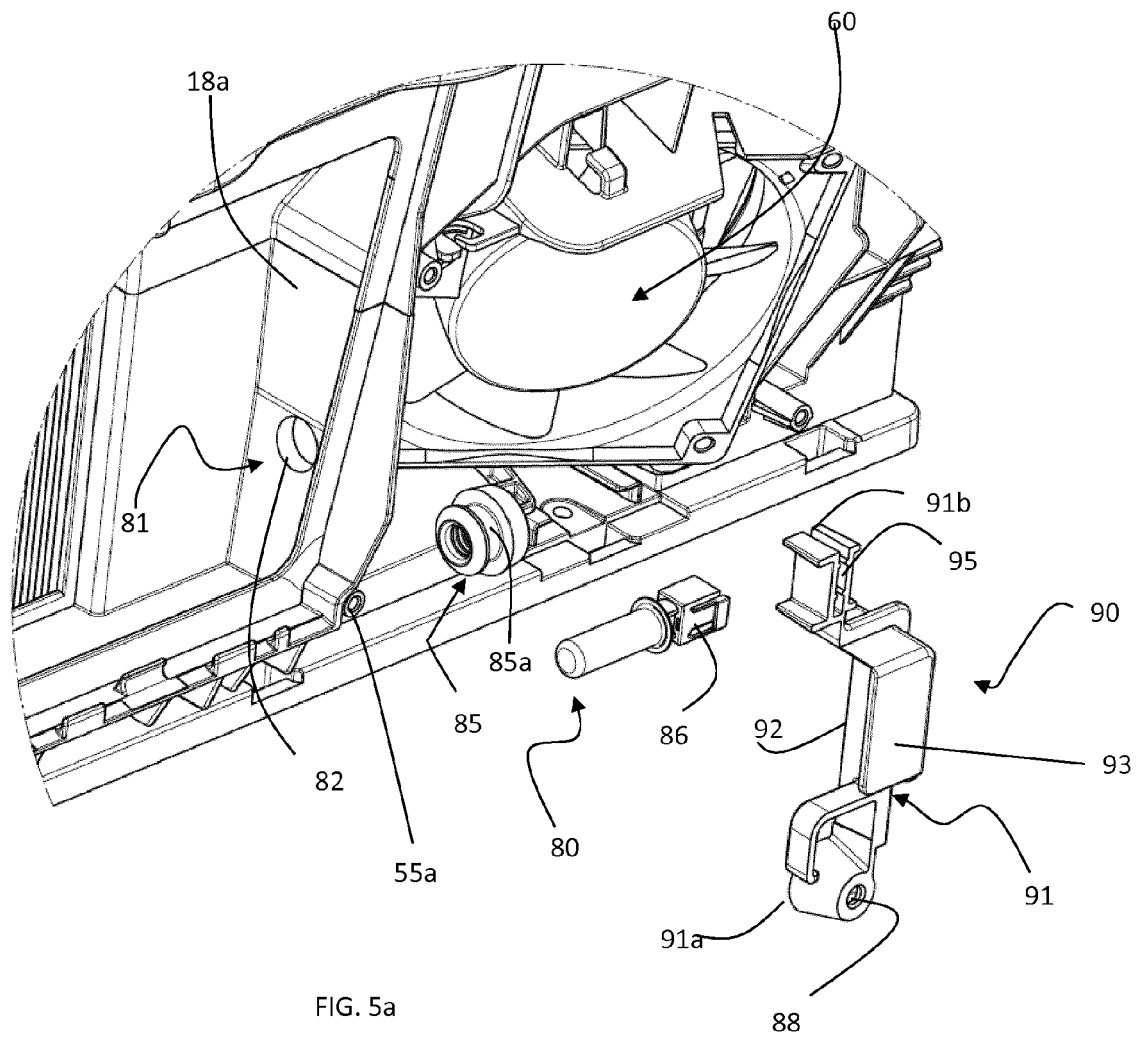


FIG. 5a



EUROPEAN SEARCH REPORT

 Application Number
 EP 15 17 8401

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 2 674 524 A1 (ELECTROLUX HOME PROD CORP [BE]) 18 December 2013 (2013-12-18) * paragraphs [0023] - [0024] * * paragraphs [0028] - [0035] * * paragraphs [0055] - [0056] * * paragraphs [0043], [0072] * * claims 14,15; figures 1-8 *	1-7, 11-15	INV. D06F58/28 ADD. D06F58/20
Y	EP 1 589 144 A2 (SAMSUNG ELECTRONICS CO LTD [KR]) 26 October 2005 (2005-10-26) * paragraphs [0005] - [0008] * * paragraphs [0014] - [0017] * * paragraphs [0021] - [0038] * * figures 1-4 *	1,2,4-7, 12-15	
Y	US 5 621 370 A (ST LOUIS ROBERT [CA]) 15 April 1997 (1997-04-15) * column 1, line 14 - column 1, line 49 * * column 3, line 35 - column 6, line 5 * * figures 1-7 *	1-5,7,11	
A	DE 10 2008 051508 A1 (LG ELECTRONICS INC [KR]) 30 April 2009 (2009-04-30) * paragraphs [0010] - [0017] * * paragraphs [0050] - [0085] * * figures 1-8 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) D06F
A	JP 2007 300945 A (TOSHIBA CORP; TOSHIBA CONSUMER MARKETING; TOSHIBA KADEN SEIZO KK) 22 November 2007 (2007-11-22) * paragraphs [0009] - [0010] * * paragraphs [0015] - [0035] * * abstract; figures 1-3 *	1-15	
A	EP 1 698 723 A1 (ZERTAN SA [ES]) 6 September 2006 (2006-09-06) * paragraphs [0018] - [0027] * * figures 1-8 *	1,2, 12-14	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 October 2015	Examiner Weinberg, Ekkehard
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			

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 EPO FORM 1503 03.82 (P04C01)

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 17 8401

5 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
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20-10-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2674524 A1	18-12-2013	EP 2674524 A1	18-12-2013
		WO 2013186134 A1	19-12-2013
EP 1589144 A2	26-10-2005	EP 1589144 A2	26-10-2005
		US 2005235519 A1	27-10-2005
US 5621370 A	15-04-1997	NONE	
DE 102008051508 A1	30-04-2009	CN 101187145 A	28-05-2008
		DE 102008051508 A1	30-04-2009
		FR 2922904 A1	01-05-2009
		KR 20090038297 A	20-04-2009
		US 2009119944 A1	14-05-2009
JP 2007300945 A	22-11-2007	JP 4690936 B2	01-06-2011
		JP 2007300945 A	22-11-2007
EP 1698723 A1	06-09-2006	CN 1918335 A	21-02-2007
		EP 1698723 A1	06-09-2006
		ES 1056475 U	01-04-2004
		US 2007214873 A1	20-09-2007
		WO 2005061775 A1	07-07-2005