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

(11) **EP 2 990 520 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
11.03.2020 Bulletin 2020/11

(51) Int Cl.:
D06F 58/04 *(2006.01)* ***D06F 58/22*** *(2006.01)*
D06F 58/02 *(2006.01)* ***D06F 58/20*** *(2006.01)*

(21) Application number: **14182932.5**

(22) Date of filing: **29.08.2014**

(54) Laundry dryer including a heat pump system

Wäschetrockner mit Wärmepumpenanlage

Sèche-linge comprenant un système de pompe à chaleur

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(43) Date of publication of application:
02.03.2016 Bulletin 2016/09

(73) Proprietor: **Electrolux Appliances Aktiebolag**
105 45 Stockholm (SE)

(72) Inventors:
- **Dal Ben, Diego**
  33080 Porcia (PN) (IT)
- **Vian, Alessandro**
  33080 Porcia (PN) (IT)
- **Santarossa, Marco**
  33080 Porcia (PN) (IT)
- **Giovannetti, Andrea**
  33080 Porcia (PN) (IT)

(74) Representative: **Electrolux Group Patents**
AB Electrolux
Group Patents
105 45 Stockholm (SE)

(56) References cited:
EP-A1- 2 230 349
EP-A1- 2 581 488
EP-A1- 2 682 515
US-A1- 2009 211 309

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 2 990 520 B1

Description

Technical field

[0001] The present invention relates to a laundry dryer including a heat pump system having an improved air flow within the basement of the laundry dryer.

Background of the invention

[0002] The heat pump technology in a laundry dryer is at present the most efficient way to dry clothes in terms of energy consumption. In a heat pump system of the laundry dryer a process air stream flows in a closed process air stream circuit. Further, the heat pump system includes a closed refrigerant circuit. The process air stream is moved by a main fan, passes through a laundry chamber, which is preferably formed as a rotatable laundry drum, and removes there water from wet clothes. Then, the process air stream is cooled down and dehumidified in an evaporator, heated up in a condenser and re-inserted into the laundry drum again.

[0003] The refrigerant is compressed by a compressor, condensed in the condenser, expanded in an expansion device and then vaporized in the evaporator.

[0004] Thus, the condenser and the evaporator are components of the process air stream circuit as well as of the refrigerant circuit. The condenser and the evaporator are heat exchangers between the process air stream circuit and the refrigerant circuit.

[0005] Usually, the components of the heat pump system are placed in a basement of the laundry dryer. The basement of a laundry dryer is part of a casing, which includes in addition to the basement also walls, substantially vertically supported from the basement, such as for instance a front wall and a rear wall, and lateral walls. In the casing, a drum, where the laundry is introduced in order to dry the same, is rotatably supported. In particular, the compressor, the evaporator and the condenser are arranged in said basement below the laundry drum. An air duct of the process air stream circuit has to pass the basement of the dryer, bringing the humid air to the evaporator and reintroducing the dry air from the condenser in the drum. The duct in the basement can be formed in an advantageous embodiment by joining together two shells, an upper shell portion and a lower shell portion, which form the basement.

[0006] FIG 7 illustrates a top view of the open basement of a laundry dryer including a heat pump system according to the prior art. The compressor 140, the evaporator 160, the condenser 180, the main fan 200 and the motor 220 are arranged in the lower portion 100 of the basement. The evaporator 160 and the condenser 180 are placed in parallel in a straight basement process air duct. Furthermore, the flow of air exiting the condenser 180 has to perform two substantially 90° turns in order to reach the outlet of the basement process air duct in the basement where the main fan is located, the two 90° turns being connected again by a straight basement process air duct.

[0007] Such angles in the process air stream circuit cause pressure drops and turbulences increasing the energy consumption and the noise. Indeed, such a basement process air duct is far away from the best aerodynamic shape, this latter being the shape reducing air resistance considerably during the flow.

[0008] However, in order to have a basement process air duct in which sharp turns and angles are avoided, the heat exchangers have to be re-positioned inside the basement. In other words, the basement process air duct, wherein the process air is flowing from the heat exchangers to the main fan, needs "more space" so that it can gently bend avoiding sharp 90° corners.

[0009] Applicant has realized via numerous experiments that a threshold distance can be defined, i.e. a distance "usable" by the basement process air duct to channel process air from the heat exchangers to the main fan of the basement process air conduit, above which a "gentle" curve of the process air process duct can be formed.

[0010] Such additional space for the process air duct within the basement could be obtained either reducing the space occupied by the heat exchangers, which are commonly one of the bulkiest elements in the basement, and/or moving the heat exchangers, evaporator and condenser, as close as possible to the wall of the casing opposite to the outlet of the process air from the basement. The first solution, however, would decrease the efficiency of the heat pump system, because a too narrow heat exchange surface is present; therefore it is considered not optimal. The second solution has also further limitations, as detailed below.

[0011] Tumble dryers usually comprise filter systems for collecting fluff or lint which is detached from the laundry to be treated in the drying process. Typically, a prior art tumble dryer provides a filter system adjacent to a door (when the door is closed) of the tumble dryer to enable easy access to the filter system. An air flow is provided inside the tumble dryer that enters the filter system. Fluff or lint that is carried by the air flow from the laundry to be dried is filtered out by the filter system, such that air that leaves the filter system is substantially free from lint or fluff. Said air can be heated up again and conveyed to the laundry treatment chamber of the tumble dryer. The air is dried and heated by the heat exchangers which are located downstream the filter element in the flow path of the process air. The process air, due to the construction of the process air conduit, flows through the filter along a certain direction, for example substantially vertical, and then, due to the fact that the heat exchangers are located in the basement, changes direction in order to enter first into the refrigerant evaporator and then in the refrigerant condenser.

[0012] Therefore, if the evaporator is moved too close to the filter, either it hits the filter and further translational movements toward the front wall would hinder the pos-

sibility of keeping the filter in its correct position, or - in case of a filter of smaller dimensions so that the evaporator can be located below it - process air would impinge on top of the evaporator and not at the inlet of the same, thus a section of the length of the evaporator would not be properly traversed by air and, at the end, the effective heat exchange surface of the evaporator is reduced. Additionally, in order to circulate through the drum, the process air impinging on top of the evaporator has to change its flow direction inside the evaporator generating great losses in airflow energy, thereby causing the fan provided to move the process air to be oversized.

[0013] A different solution has been disclosed in EP 2581488, in the name of the same Applicant, which relates to a laundry dryer with a heat pump system including an evaporator and a condenser. The heat pump system includes an air stream circuit arranged in such a way to allow an air stream to pass the laundry drum, the evaporator and the condenser. At least one filter element is arranged upstream the evaporator. The evaporator is arranged below the filter.

[0014] In order to arrange the evaporator below the filter, a very small filter has to be used, which is not effective in removing all lint. Furthermore, the evaporator has also very limited dimensions, because its inlet has to face the filter and the position of the outlet is determined by the thickness of the basement. Thus again, a rather small heat exchange surface is achieved in such an evaporator.

[0015] US 2009/211309 discloses a drum-type washing-drying machine having a drum rotatably provided in a water tub; an air supply opening and an air discharge opening arranged at the water tub; a circulation path whose both ends are individually connected to the air supply opening and the air discharge opening; a heat pump mechanism having a condenser and an evaporator that are arranged in the circulation path; and a blower fan placed in the circulation path and circulating air between the circulation path and the water tub. The drum-type washing-drying machine has at least either branch paths provided between that portion of the circulation path at which the condenser is located and the air supply opening or branch paths provided between that portion of the circulation path at which the evaporator is located and the air discharge opening.

[0016] EP 2230349 describes a filtering cartridge for home laundry driers consisting of a supporting plate which is made of plastic material and is structured for being insertable in easy removable manner into a slit formed in the peripheral edge of the laundry loading/unloading opening of the laundry drier so as to completely close said slit, and of a substantially bag-shaped hollow shell which overhangingly protrudes from the rear face of the supporting plate so as to extend inside a section of the air recirculating conduit of the laundry drier; the hollow shell being realized in one piece with the supporting plate via an injection molding process, and being divided into two complementary valve-like pieces which are laterally hinged to one another; the filtering cartridge being also provided with a first annular gasket which is made of thermoplastic elastomer and is over-injected on the whole peripheral edge of the supporting plate, and/or with a second annular gasket which is made of thermoplastic elastomer and is over-injected along the whole coupling peripheral edge of at least one of the two valve-like pieces.

[0017] EP 2682515 shows a laundry dryer comprising an outer casing having a front wall provided with a laundry loading/unloading pass-through opening, and an air-filtering cartridge which is fitted in removable manner into an air-vent which is passed through by a laundry drying airflow, said air-filtering cartridge comprising a first substantially bag- or pocket-shaped, air-filtering shell or vessel which is dimensioned for being inserted/plugged into said air-vent and a second substantially bag- or pocket-shaped, air-filtering shell or vessel which is fitted/recessed into said first air-filtering shell or vessel, so as to be passed through by substantially the same airflow that crosses the first air-filtering shell or vessel, each of said first and second air-filtering shells or vessels; having a two valve-like structure which is openable in a book-like manner and has surfaces arranged to restrain fluff and/or lint particles in suspension into the airflow. The laundry dryer has the second air-filtering shell or vessel hingedly coupled to the first air-filtering shell or vessel, such that, in an open position, both valve-like structures displace the inner faces of said surfaces on the same side.

[0018] It is an object of the present invention to provide a laundry dryer with a heat pump system, wherein the flow of the process air stream is improved, with particular reference to the process air stream flow within the basement of the laundry dryer.

[0019] The core of the present invention is the combination of the arrangement of the evaporator and the condenser of the heat pump system inside said the basement on one hand and the positioning of an inlet of a drum exhaust process air conduit on the other hand. It is possible to have this "larger than usual" given distance in the basement for the process air duct thanks to the mutual positioning of those components. The process air flow from the condenser to the basement outlet is improved by keeping at least this aforementioned threshold distance, shifting the position of the evaporator from the usual location in prior art dryers and maintaining at the same time both an evaporator and an inlet of drum exhaust air with proper dimensions so that an efficient heat exchange and filtering are performed.

[0020] In addition, the energy consumption of the motors for the compressor and the main fan is reduced. Further, the noise of the laundry dryer is reduced, too.

[0021] According to an aspect, the invention relates to a laundry dryer including:

- a casing rotatably supporting a drum for receiving a load to be dried, said drum being apt to rotate around a drum axis, said casing including

◦ a rear wall and a front wall defining a rear side and a front side of said casing, an aperture being realized on said front wall to access said drum;
◦ a basement defining a basement plane;

- A process air conduit in fluid communication with the drum where a process air stream is apt to flow, said process air conduit including a drum exhaust process air conduit having an inlet in which process air exiting said drum is conveyed;
- A heat pump having a heat pump circuit in which a refrigerant can flow, said heat pump circuit including a first heat exchanger where the refrigerant is cooled off and the process air is heated up, and a second heat exchanger where the refrigerant is heated up and the process air is cooled off; said first and/or second heat exchanger being arranged in the process air conduit in order to perform heat exchange between said refrigerant flowing in said heat pump circuit and said process air;

Wherein

- Said drum exhaust process air conduit includes an inlet edge surrounding said inlet defining a front end and a rear end;
- A first portion of said second heat exchanger is located below said rear end of said edge and a second portion of said second heat exchanger is located below said drum;
- A filter to filter process air arranged at the inlet of said drum exhaust process air conduit in such a way that an air flow streaming through said drum enters said drum exhaust process air conduit passing through said filter, said filter having an inner abutment surface and an outer abutment surface, said inner abutment surface being the surface more distant from said front wall than the outer abutment surface, said inner and outer abutment surfaces being in abutment with a first and a second edge portions, respectively, of said inlet edge;
- Wherein said second heat exchanger is located downstream said filter in the direction of flow of said process air in said process air conduit; and
- wherein said first portion of said second heat exchanger is located below said inner abutment surface; and
- wherein said drum exhaust process air conduit includes a first portion having a substantially vertical component and a second portion having a longer horizontal component, so that said
- process air passes through said filter in a substantially vertical direction and through said second heat exchanger in a substantially horizontal direction.

[0022] In the following, with the term "dryer" both drying machines which dry only as well as combined washer-dryers capable of performing washing and drying cycles are meant.

[0023] The dryer of the invention includes a drying chamber, such as a drum, in which the load, e.g. clothes or laundry, to be dried is placed. The drum is part of a process air circuit which includes an air conduit for channeling a stream of air to dry the load. The process air circuit is connected with its two opposite ends to the drum. More specifically, hot dry air is fed into the drum, flowing over the laundry, and the resulting humid (and cooler) air exits the same.

[0024] Further, the dryer of the invention includes a heat pump system, including a first and a second heat exchanger. The humid air stream rich in water vapor is then fed to an evaporator (or second heat exchanger) of the heat pump, where the moist warm process air is cooled and the humidity present therein condenses. The resulting cool dry air is then heated up before entering again in the drying chamber by means a condenser (or first heat exchanger) of the heat pump, and the whole loop is repeated till the end of the drying cycle.

[0025] The dryer furthermore includes a casing or bearing structure, comprising preferably a basement, a front wall and a rear wall. The front wall is advantageously provided with a through opening, at which a door is mounted to access the drum in order to locate or remove the laundry. Preferably, a rim of the rear end of the drum abuts against the rear wall of the cabinet and even more preferably a gasket is interposed therein between; as well as a rim of the front end of the drum abuts against the front wall with also preferably a gasket therein between.

[0026] Within the casing, the drum is rotatably mounted for rotating according to a horizontal, or at least substantially horizontal, or tilted rotational axis. Support element(s) for rotatably supporting the drum are provided for within the casing. The drum is rotated preferably by means of a motor which defines a motor axis, for example which corresponds to the axis of a motor shaft.

[0027] In an advantageous embodiment, said drum support element includes a drum shaft, said drum shaft passing through a back wall of the drum, said drum shaft defining said axis of rotation of said drum. Alternatively or in addition, said drum support element includes a roller, the axis of the roller being substantially parallel to the drum axis of rotation.

[0028] The basement of the dryer of the invention includes a portion of the process air circuit, called basement process air conduit, which includes substantially a duct formed in the basement. Within said basement process air conduit both heat exchangers of the heat pump system are located. Furthermore, the basement process air conduit channels the process air exiting the condenser to an outlet of the basement. From the outlet of the basement, the process air - dried by the condenser - is fed, for example via an additional portion of the process air circuit realized preferably in the rear wall of the cabinet, to the drum so as to dry the laundry therein. The portion of basement process air conduit comprised between an exit of the condenser, i.e. a surface of the condenser from

which the process air exits the condenser, and the outlet of the basement where the process air exits from the basement is called basement air duct portion.

[0029] Preferably, process air passes through the second and then the first heat exchanger in a direction towards said rear wall of the casing. Thus, preferably, process air first impinges into an inlet surface of the evaporator, exits the latter and then impinges onto an inlet surface of the condenser (after having passed through the evaporator). The inlet surface of the evaporator is preferably substantially vertical or it has a wider vertical component.

[0030] The basement process air duct portion includes one or more lateral walls depending on its geometry. If the geometry of the duct portion is substantially cylindrical or of a cylindroid form, the duct portion includes a single lateral wall having substantially circular cross section, which may change in diameter depending on the position in which the cross section is measured. Alternatively, two opposite lateral walls can be present, for example one substantially parallel to the other and defining substantially parallel planes.

[0031] Preferably, the process air circuit can be considered as separated in two main portions, one first portion - the drum exhaust process air portion - from the exit of the drum to the exit of the condenser of the heat pump, and a second portion, from the exit of the condenser back to the drum again. Both these first and second portions have one of their parts positioned within the basement in form of the duct above described.

[0032] In a standard operative position, the basement of the dryer is positioned on a floor or other substrate on which the dryer performs its standard operations (e.g. drying and/or washing and/or spinning cycles). Such positioning defines a horizontal or at least substantially horizontal plane, which is called the basement plane (X, Y). Planes parallel to the basement plane are therefore substantially horizontal planes.

[0033] In this standard operative position, also other terms are well defined: "front" or "rear" (or "back"), "top" or "bottom", "upper" or "lower" are always referred to the normal standard configuration of a dryer with the basement positioned on a floor. The front wall of the dryer is defined by the wall in which the door from which the drum is accessed is positioned. Given the horizontal plane on which the laundry is located, "top" and "bottom" - as their normal common meaning - refer to the position of an object along a vertical axis.

[0034] Therefore, saying that a first element is in front, or in the rear of another second element, means that the first element in front is closer to, or farer from, the front wall than the second and that, on a vertical plane, the first and second elements have a first and a second projection which overlap.

[0035] If a first element is above, or below, a second element, means that the first element is along a vertical axis at a higher, or respectively lower, position than the second element and that the first and second elements have a first and second projection on a horizontal plane which overlap.

[0036] In the following, projections of a volume, of a surface or of a segment are considered.

[0037] A volume may have a projection onto a vertical plane and onto a horizontal plane, these projections being surfaces. If the volume defines a wider projection into the vertical plane than into the horizontal plane, then it is said that the volume has a "wider vertical projection".

[0038] A surface may have a projection onto a vertical plane and onto a horizontal plane, these projections being surfaces. If the surface is in itself vertical or horizontal, its projection onto the horizontal or vertical plane is, respectively, a line. If the surface defines a wider projection into the vertical plane than into the horizontal plane, then it is said that the surface has a "wider vertical projection".

[0039] In the same way, a segment may have a projection onto a vertical plane and onto a horizontal plane, these projections being lines. If the segment is in itself vertical or horizontal, its projection onto the horizontal or vertical plane is, respectively, a point. If the segment defines a longer projection into the vertical plane than into the horizontal plane, then it is said that the segment has a "longer vertical projection".

[0040] Preferably, on the basement of the dryer, the rear wall and the front wall are mounted. Even more preferably, the casing includes further walls, e.g. lateral walls and a top wall.

[0041] In a top view of the dryer, the basement can be considered as "divided" in two longitudinal halves by the axis of rotation of the drum (or the projection of said axis onto the basement plane). Whether the axis is horizontal (thus parallel to the basement plane (X,Y)) or tilted with respect to the latter, on a top view of the basement, the projection of the drum axis divides the basement in two halves, a first or left longitudinal half and a second or right longitudinal half. In other words, taking a plane which is perpendicular to the basement plane and which passes through the rotational axis of the drum, which generally coincides with the centerline of the basement, this plane virtually sections the basement in two longitudinal halves. This plane, called first plane, when sectioned by a plane parallel to the (X, Y) plane defines a line of division of the basement in two in a top view.

[0042] The two halves do not need to be identical. In other words with a first and a second half, a "right" and a "left" portion of the basement with respect of the above mentioned plane (first plane) passing through the rotational axis of the drum and perpendicular to the basement plane are meant. The projection on the basement of such rotational axis can be thus shifted from the centerline of the basement. Preferably, the centerline and the projection of the rotational axis of the drum coincide.

[0043] The layout of the heat pump system located in the basement of the dryer of the invention is the following.

[0044] The first heat exchanger and the second heat exchanger are located within the basement air conduit and extend for the majority of their volume within the first

longitudinal half of the basement, e.g. they are substantially located for the majority of their volume to the left of the rotational axis of the drum. The heat exchangers can be completely contained within the first longitudinal half of the basement or part of their volume, the minority, can also extend within the second longitudinal half of the basement. Also, the exit of process air from the condenser is located within the first longitudinal half of the basement, at least for most of its area.

[0045] On the other end, the outlet of process air from the basement is located within the second longitudinal half of the basement, i.e. on the half of the basement right of the rotational axis of the drum. Preferably, the basement outlet is realized in the rear part of the basement, i.e. facing the real wall of the cabinet. Thus, in order to channel the process air outside the basement, the basement duct portion extends from the exit of the condenser to the outlet of the basement starting from the first longitudinal half of the basement and reaching the second longitudinal half of the basement. Due to this geometry and layout, which is forced by the positioning of the various elements of the heat pump system in the basement, although the best aerodynamic solution for a duct channeling air would be a straight duct, the duct portion includes at least one "bend" or "turn".

[0046] Preferably, in front or in proximity of the basement process air outlet, a main fan, apt to blow the process air in the process air circuit, for example from the basement to the drum, is located. The main fan includes an impeller, which rotates to move the process air.

[0047] Preferably, at the aperture formed to access the drum, and more preferably at a lower edge of the same, an inlet for the drum exhaust process air conduit is formed.

[0048] The drum exhaust process air conduit includes preferably a first substantially vertical portion or a portion having a wider vertical projection. This first portion of the drum exhaust process air conduit is preferably partially formed within the basement.

[0049] The drum exhaust process air conduit includes preferably also a second portion, preferably a second substantially horizontal portion or a portion having a wider horizontal projection. In this second portion, starting from the end of the first portion and terminating at the exit of the condenser, preferably both evaporator and condenser are located.

[0050] The first portion includes the inlet, into which the exhaust air coming from the drum enters. The inlet defines an inlet edge which surrounds the inlet. The inlet edge is the "boundary" of the inlet and it delimits the beginning of the drum exhaust process air conduit. Preferably, said inlet edge has a vertical and an horizontal component, in other words in a projection along a vertical plane and along a horizontal plane of the edge surface, defines a vertical and an horizontal curve, respectively, which surrounds an area that may be different from zero.

[0051] The edge defines a front end and a rear end. The rear end of the edge is the point of the edge closest to the rear of the casing, i.e. closest to the rear wall of the casing. The front end is the point of the edge closest to the front of the casing, i.e. closest to the front wall of the casing. In a projection of the edge in a horizontal plane, the two ends are easily visible.

[0052] For example, if a filter having a permeable-to-air grid protruding from the inlet is inserted in the drum exhaust process air conduit; such a grid defines the new inlet edge with its outer boundary. The same applies if a filter is inserted in the inlet, having a part which projects outwardly the inlet itself. The boundary of the filter becomes the inlet edge being the first part in contact with process air coming out of the drum. Further similarly, the boundary of the inlet edge may be defined by a permeable-to-air grid which is mounted as a separate and independent piece from the process air filter.

[0053] The edge is thus delimited in one direction by an inner plane which is perpendicular to the first plane dividing the basement in two half and passes through the rear end of the edge and by an outer plane, perpendicular to the first plane dividing the basement in two half, and passing through the front end of the edge. Inner and outer planes are vertical planes. Those two planes, in other words, delimit horizontally the space in which process air enters the drum exhaust process air conduit.

[0054] In order to guarantee enough space for the process air duct in the basement, and in particular for its bending as above described, according to the invention, the evaporator, for one of its portion, is located below the rear end of the edge of the inlet.

[0055] This means that, taking the inner vertical plane passing through the rear end of the edge of the inlet, this inner vertical plane sections a portion of the evaporator as well. This vertical plane, called inner vertical plane, can be in a preferred embodiment parallel to the front wall of the casing.

[0056] Thus, the inner vertical plane divides the evaporator in two parts, one of which is located below the rear end of the edge of the inlet of the drum exhaust process air filter.

[0057] However, the evaporator does not extends till the front end of the edge to be located below the whole inlet, because in this configuration the process air cannot impinge the inlet surface of the evaporator in a correct way, i.e. cannot impinge the inlet surface of evaporator in a substantially horizontal direction or in a direction having a longer horizontal component. If the evaporator were below the whole inlet or below the majority thereof, the process air entering the inlet of the drum exhaust process air conduit would impinge on the evaporator from above, not at its inlet surface. As described above, the inlet surface of the evaporator is substantially vertical or at least having a vertical wider component, thus the process air - in order to enter to the evaporator from its inlet - needs to "turn" into a substantially horizontal direction from a substantially vertical direction. This is possible if the process air flow does not impinge onto the evaporator from above, but at its substantially vertical inlet surface, or at

least only the minority of such a flow impinges the evaporator outside its inlet surface.

[0058] For this reason, preferably there is a portion of the evaporator which is located below the drum. In this way, the evaporator is located as close as possible to the front wall of the casing, but at the same time does not hinder a correct flow of process air into the drum exhaust process air conduit.

[0059] In the inlet of the drum exhaust air conduit, a filter is preferably located so that fluff or lint which can be present inside the laundry is not pushed into the heat exchangers or it does not reach the impeller of the fan. This filter is inserted inside the drum exhaust process air conduit.

[0060] Preferably, in the first substantially vertical portion of the drum exhaust process air conduit, which starts at the inlet of the drum exhaust process air conduit, the filter is inserted, so also the filter is preferably located substantially vertically or it has a wider vertical projection. The process air flowing in this first portion of drum exhaust process air conduit passes through the filter following the direction imposed by the first portion and thus it flows with a direction of the velocity field substantially vertical or having a longer vertical projection. The filter is in abutment with the inlet of the drum exhaust process air conduit and in particular with the edge defined around said inlet.

[0061] The edge of the inlet of the drum exhaust process air portion defines a first and a second surfaces, which can be also a first and a second portion of the same surface, which are one in front of the other, i.e. one is closer to the front wall of the casing, preferably including the edge front end, and one is more remote to the front wall of the casing, preferably including the rear end of the edge. On these two surfaces or portions of the same surface encircling the inlet of the drum exhaust process air conduit, the filter abuts with respective inner abutment surface, abutting onto the portion of edge of the inlet which is more distant from the front wall, and an outer abutment surface, which abuts onto the portion of the edge of the inlet which is closer to the front wall of the casing.

[0062] The abutment surfaces of the filter are thus also one closer and one farer from the front wall. The one more distant from the front wall is called the inner abutment surface.

[0063] In order to guarantee enough space for the process air duct in the basement, and in particular for its bending as above described, according to the invention, the evaporator, for one of its portion, is located below the inner abutment surface of the filter.

[0064] This means that, taking an additional vertical plane passing through the free edge of the inner abutment surface of the filter, in other words a vertical plane which touches the inner boundary of the inner abutment surface (the boundary which is the most distant from the front wall), this vertical plane sections a portion of the evaporator as well. This vertical plane, called inner abutment vertical plane, may coincide with the inner vertical plane, and it can be in a preferred embodiment parallel to the front wall of the casing.

[0065] Generally, however, the inner abutment vertical plane is located closer to the rear wall of the casing than the inner plane. In other words, the inlet edge rear end extends closer to the rear wall than the end of the inner abutment surface of the filter.

[0066] Thus, the inner abutment vertical plane divides the evaporator in two parts, one of which is located below the filter, i.e. below its inner abutment surface.

[0067] However, not all the evaporator is located below the filter, so that process air can impinge the inlet surface of the evaporator in a correct way, i.e. in a substantially horizontal direction or in a direction having a longer horizontal component, as described above. Preferably, said inlet of said drum exhaust process air conduit is arranged adjacent to said aperture to access said drum.

[0068] More preferably, said inlet of said drum exhaust process air conduit is located at a lower edge of said aperture to access said drum.

[0069] The inlet of the drum exhaust process air conduit is located at the edge of the aperture to access the drum, aperture generally closed by a door, and the process air is directed into the inlet for example by the shape of the door itself.

[0070] Preferably, the process air stream passes the drum in a direction of flow from the rear side to the front side of said casing and it passes the bottom of the laundry dryer in a direction of flow from the front side to the rear side of the casing.

[0071] The process air conduit is substantially a closed loop and process air is flowing back and forth the casing along its longitudinal direction. In the basement of the laundry dryer in particular, preferably the process air flows substantially horizontally or with a longer horizontal component from the front wall to the back wall passing through evaporator first and then condenser.

[0072] Advantageously, the laundry dryer includes a main fan to blow air in said process air conduit, said main fan being located downstream said first and second heat exchanger in the direction of flow of said process air.

[0073] For the process air circulation, a main fan is located in the process air circuit. In this embodiment, the process air flow first traverses the two heat exchangers and then is sucked in the fan.

[0074] More preferably, said main fan is located at or in proximity to said rear wall and said filter is located at or in proximity to said front wall.

[0075] The fan and the filter are thus positioned at the two ends of the casing, rear wall and front wall, respectively.

[0076] Preferably, said filter includes a first and a second openable shells, said inner and outer abutment surfaces being formed on said first and second shells, respectively.

[0077] This configuration of the filter allows a quick and easy cleaning of the same, with an easy removal of the

fluff and lint trapped therein.

[0078] Advantageously, the laundry dryer includes a door to open and close said aperture and wherein said filter includes a topmost surface located below a bottom surface of said door when the latter is in closed position on said front wall.

[0079] The aperture in the front wall to access the drum is preferably closed by a door, which is advantageously hinged to the front wall so that it can be opened and closed. Preferably, to minimize the space occupied by the various components in the casing, such as the filter, the filter itself is located at the edge of the aperture with its topmost surface facing a bottom surface of the wall. Preferably the two surfaces, belonging to the filter and the door, are very close, so as to avoid any piece of laundry to be entrapped between the filter and the door during a drying process.

[0080] In a preferred embodiment, said first and second shells include a net to block lint or fluff contained in said process air coming from said drum.

[0081] The net in the shells is responsible for allowing the process air flow to pass and at the same time for blocking the fluff and/or lint contained in the process air flow.

[0082] More preferably, said first and second openable shells are hinged by means of a hinge, said first portion of said second heat exchanger being located below a portion of filter included between said first abutment surface and said hinge.

[0083] A hinge allows the opening and the closing of the two shells of the filter. The evaporator is thus located in an area below the filter which is included between the inner edge of the inner abutment surface and a vertical plane passing through the location of the hinge.

[0084] Preferably, said first and second heat exchangers are located within said basement of said dryer.

[0085] Advantageously, in said basement a first and a second longitudinal half are identifiable by means of a first plane perpendicular to said basement plane (X,Y) and passing through said drum axis; and wherein a majority of the volume of said first and second heat exchanger and at least a portion of said filter are located in said first half of said basement and an outlet of said air process circuit for process air from said basement is located in said second half.

[0086] As mentioned, the basement can be considered as virtually divided in two by the first plane, and in a top view of the basement, such a first plane is a line. The process air duct in the basement thus is forced to bend to go from the first to the second half. However this bend can have a large radius of curvature thanks to the extra space provided by shifting the evaporator closer to the front wall of the casing.

[0087] The basement can also be considered to be divided in "quarters" by the first plane and a second plane perpendicular to it and passing through a center line of the basement parallel to the front (or rear) wall of the casing. The quarters could be indicated as the first quarter, the second quarter the third quarter and the fourth quarter in a clockwise manner. The first quarter is the rearmost quarter of the first longitudinal half of the basement, the second quarter is the rearmost quarter of the second longitudinal half of the basement and so on.

[0088] The basement process air duct portion has a part which extends in the first longitudinal half, starting from the process air exit of the condenser, and a part extending in the second longitudinal half of the condenser, reaching the process air outlet of the basement. In this second longitudinal half, the extension of the basement process air duct portion is limited to the second quarter, i.e. there is no basement process air duct portion in the third quarter.

[0089] In a preferred embodiment, said basement includes an outlet for directing process air back to said drum, said main fan is located in front of said outlet of process air from said basement.

[0090] The fan efficiently blows air exiting from the basement into the drum.

[0091] In a preferred embodiment, said second heat exchanger is located in said basement, and wherein said outer abutment surface is located above a portion of said basement free from said second heat exchanger.

[0092] As mentioned, it is preferred that the evaporator is located below the filter only for a portion of the filter, so that the process air flow has enough room to change direction to enter the evaporator inlet surface.

[0093] Said drum exhaust process air conduit includes a first portion having a longer vertical component and a second portion having a longer horizontal component, so that said process air passes through said filter in a substantially vertical direction and through said second heat exchanger in a substantially horizontal direction.

[0094] In the first portion of the drum exhaust process air conduit, the filter is located. This first portion is preferably substantially vertical. The second portion of the circuit houses the heat exchangers and it is substantially horizontal. Process air changes direction from a substantially vertical one to a substantially horizontal one.

[0095] Preferably, said second portion of said second heat exchanger located below said drum includes the majority of the volume of said second heat exchanger.

[0096] The horizontal dimension of the filter, in particular its width from the outer abutment surface to the inner abutment surface, e.g. the direction from the front to the rear of the casing, is rather limited, therefore the portion of evaporator that can be located below the filter is limited as well.

[0097] Advantageously, said second heat exchanger includes an inlet surface and a portion of said filter is located in front of said inlet surface.

[0098] Preferably the filter occupies a wide surface so that the filtering surface is big enough to block and filter the process air completely. Being the surface of the filter wide, the filter itself, which in the vertical direction is limited from above by the presence of the door, extends downwardly towards the bottom of the basement. In this

way, the filter is positioned for a portion in front of the inlet surface of the evaporator. In other words, preferably, the filter is located between the evaporator and the front wall of the casing, the projections of the filter and of the inlet surface of the evaporator on a vertical plane at least partly overlapping.

Brief description of the drawings

[0099] 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 dryer realized according to the present invention;
- Fig. 1a is a top view of the laundry dryer of Fig. 1;
- Fig. 1b is a schematic representation of the flow of process air inside the laundry dryer of Fig. 1;
- Fig. 2 is a perspective view of the laundry dryer of Fig. 1 with an element of the casing removed for showing some internal components;
- Fig. 3 is a perspective view, in a disassembled configuration, of the basement of the dryer of Fig. 1 or Fig. 2;
- Fig. 4 is a front view of the laundry dryer of Figs. 1 and 2 with some parts removed;
- Fig. 5 is a perspective view of the basement of Figs. 3 with internal components removed;
- Fig. 6 is a top view of the basement of Figs. 3 and 5;
- Fig. 7 is cross section of the laundry dryer of Figs. 1 and 1a along line A-A of Fig. 1a;
- Fig. 7a is an enlarged view of a detail of Fig. 7;
- Fig. 8 is cross section of the laundry dryer of Figs. 1 and 1a along line A-A of Fig. 1a with the filter removed; and
- Fig. 8a is an enlarged view of a detail of Fig. 8.

Detailed description of one or more embodiments of the invention

[0100] With initial reference to Figs. 1, 1a, 1b and 2, a laundry dryer realized according to the present invention is globally indicated with 1.

[0101] Laundry dryer 1 comprises an outer box or casing 2, preferably but not necessarily parallelepiped-shaped, and a drying 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 dried. The drum 3 is preferably rotatably fixed to the casing 2, so that it can rotate around a preferably horizontal axis R (in alternative embodiments, rotation axis may be tilted). Access to the drum 3 is achieved for example via a door 4, preferably hinged to casing 2, which can open and close an opening 4a realized on the cabinet itself.

[0102] More in detail, casing 2 generally includes a front wall 20, a rear wall 21 and two sidewalls 25, all mounted on a basement 24. Furthermore, casing 2 may include also a top wall 23. 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. The casing, with its walls 20, 21, 23, 25, defines the volume of the laundry dryer 1. Advantageously, basement 24 includes an upper and a lower shell portion 24a, 24b (visible in Figures 3 and 6 detailed below).

[0103] The front door 4 has preferably, but not necessarily, a specifically formed inner side 40. In the example illustrated in enclosed Figures, the inner side 40 of the front door 4 is advantageously substantially bowl-shaped and has advantageously a curved section 41 that merges into a bottom section 42 (all visible in Figs. 7 and 8).

[0104] The dryer 1, and in particular basement 24, defines an horizontal plane (X,Y) which is substantially the plane of the ground on which the dryer 1 is situated, thus it is considered to be substantially horizontal, and a vertical direction Z perpendicular to the plane (X,Y).

[0105] Laundry dryer 1 also preferably comprises an electrical motor assembly 50 for rotating, on command, revolving drum 3 along its axis inside cabinet 2. Motor 50 includes a shaft 51 which defines a motor axis of rotation M.

[0106] Further, laundry dryer 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 drying cycles preferably stored in the same central control unit. The programs as well other parameters of the laundry dryer 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 dryer 1, such as above door 4.

[0107] With reference to Figure 2, the rotatable drum 3 includes a mantle, having preferably a substantially cylindrical, tubular body 3c, which is preferably made of metal material and is arranged inside the cabinet 2 and apt to rotate around the general rotational axis R which can be - as said - 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 is faced to the laundry loading/unloading opening realized on the front wall 20 of the cabinet 2 and the door 4, while the second end 3b faces the rear wall 21.

[0108] Drum 3 may be an open drum, i.e. both ends 3a and 3b are opened, or it may include a back wall (not shown in the appended drawings) fixedly connected to the mantle and rotating with the latter.

[0109] In order to rotate, support elements for the rotation of the drum are provided as well in the laundry of the invention. Such support elements might include rollers at the front and/or at the back of the drum, as well as or alternatively a drum shaft connected to the rear end of the drum (shaft is not depicted in the appended drawings). In Fig. 2, for example, a roller 10 connected to the basement via a bracket 101a and a roller 10 connected

via a boss 101 to the rear wall 21 is depicted. Any support element for the rotation of the drum around axis R is encompassed by the present invention.

[0110] Dryer 1 additionally includes a process air circuit which comprises the drum 3 and a process air conduit 18, depicted as a plurality of arrows showing the path flow of a process air stream through the dryer 1 (see Figures 1b and 3). In the basement 24, a portion of the process air conduit 18 is formed by the connection of the upper shell 24a and the lower shell 24b. Process air conduit 18 is preferably connected with its opposite ends to the two opposite sides of drum 3, i.e. first and second rear end 3a,3b of mantle 3c. Process air circuit also includes a fan or blower 12 having an impeller 12a (shown in Fig. 3).

[0111] The process air conduit 18 includes the drum 3 and a duct in the basement 24. The conduit 18 can be divided in two portions: a drum exhaust process air conduit 18a (depicted as light colored arrows in Fig. 1b), starting from an inlet 17 in which the humid process air exiting the drum 3 enters the conduit till an outlet, and within such portion the process air is cooled and dried; and a dry process air conduit 18b (depicted as dark colored arrows in Fig. 1b), whose inlet is the outlet of the first portion 18a, where the cooled and dry process air flows back in the drum 3. This situation is schematically depicted in Fig. 1b.

[0112] To allow the exhausted process air from the drum 3 to re-enter the drum in a condition suitable to further remove humidity from laundry, in the drum exhaust process air conduit 18a a heat pump system 30 is provided.

[0113] The heat pump system 30, part of the dryer 1 of the invention, includes a first heat exchanger (called also condenser) 31 and a second heat exchanger (called also evaporator) 32 (see figure 3). Heat pump 30 also includes a refrigerant closed circuit (partly depicted) in which a refrigerant fluid flows, when the dryer 1 is in operation, cools off and may condense in correspondence of the condenser 31, releasing heat, and warms up, in correspondence of the second heat exchanger (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. In the following the heat exchangers are named either condenser and evaporator or first and second heat exchanger, respectively. More in detail, the heat pump circuit connects via piping 35 (see Fig. 3) the second heat exchanger (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.

[0114] Preferably, in correspondence of evaporator 32, the laundry dryer 1 of the invention may include a condensed-water canister (also not visible) which collects the condensed water produced, when the dryer 1 is in operation, inside evaporator 32 by condensation of the surplus moisture in the process air stream arriving from the drying chamber (i.e. drum) 3. The canister is 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 located in correspondence of the highest portion of the dryer 1 so as to facilitate a comfortable manual discharge of the water by the user of the dryer 1.

[0115] The condenser 31 and the evaporator 32 of the heat pump 30 are located in correspondence of the process air conduit 18 formed in the basement 24 (see Figure 3), in the portion corresponding to the drum exhaust conduit 18a. After the condenser 31, the dry process air conduit 18b starts.

[0116] In case of a condense-type dryer - as depicted in the appended figures - where the air process circuit is a closed loop circuit, the condenser 31 is located downstream of the evaporator 32. The air exiting the drum 3 enters the 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 conduit 18 till it enters the condenser 31, where it is warmed up by the heat pump 30 before re-entering the drum 3.

[0117] It is to be understood that in the dryer 1 of the invention, an air heater, such as an electrical heater, can also be present, in addition to the heat pump 30. In this case, heat pump 30 and heater 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 30 is located upstream the heater. Appropriate measures should be provided to avoid the electric heater to fuse plastic components of the dryer 1.

[0118] Further, with now reference to Figures 5 and 6, in the basement, the process air conduit 18 includes a duct formed by the upper and the lower shells 24a, 24b, from which process air is received from the drum 3 and includes an outlet 19 to channel process air out of the basement 24, back to the drum, for example preferably via a passage realized in the rear wall 21 (not depicted in the present drawings). The duct is formed preferably as two single pieces joined together and belonging to the upper and lower shell 24a, 24b, and including a first and a second portion 28 and 29. In the first portion 29 of this duct, which is part of the drum exhaust process air conduit 18a, seats 29s are formed for locating the first and the second heat exchangers 31, 32. Preferably, first and second heat exchanger 31, 32 are placed one after the other, the first heat exchanger 31 being downstream in the direction of flow of the process air the second heat exchanger 32. Further, the second portion 28, which is part of the dry process air conduit 18b, channels the process air exiting from the first heat exchanger 31 towards the basement outlet 19.

[0119] The second portion 28 thus starts at the location of an exit surface 28in of the first heat exchanger 31 which is the surface of the first heat exchanger 31 from which process air exits.

[0120] The evaporator 32 defines in turn an inlet surface 32a, which is the surface in which the air enters the

evaporator itself. The evaporator 32 have a specifically designed inlet surface, in other words if air enters the evaporator not through the inlet surface, a lower heat exchange takes place. The inlet surface 32a is preferably a vertical plane or a surface the vertical component of which, i.e. the projection of the inlet surface onto a vertical plane, is wider than the horizontal projection of the evaporator inlet surface onto a horizontal plane such as the basement plane.

[0121] Furthermore, preferably also the outlet 19, defined as the area at which the air exits the basement, defines in turn a surface substantially perpendicular to the basement plane, e.g. a vertical surface, or at least a surface having a wider vertical component.

[0122] Considering now a first plane P1 (see Figs. 5 & 6) perpendicular to the basement plane (X,Y) and embedding the rotational axis R of the drum 3, this first plane P1 divides the basement 24 in two halves, called, with now reference to figure 6, basement first or right half 24 first half and basement second or left half 24 second half. These two halves 24 first half and 24 second half need not to be identical in dimension (i.e. they are not mathematical halves), however in the present depicted embodiment P1 also embeds a first - longitudinal - centerline H1 of the basement. Furthermore, still in the depicted embodiment, P1 is a vertical plane.

[0123] On the first half of the basement, 24 first half, the portion 29 of the duct is positioned, where also the first and the second heat exchanger 31, 32 of heat pump 30 are located. The heat exchanger can be completely contained within the first half of the basement 24 first half or they can also extend beyond the limit defined by the first plane P1. If a portion of the first and/or second heat exchanger 31, 32 is also located within the second half of the basement 24 second half, this portion is the minority of the whole volume occupied by the first and/or second heat exchanger 31, 32.

[0124] On the second half of the basement 24 second half, preferably the compressor 33 is located. More preferably, also the motor 50 is located in this second half.

[0125] Preferably, motor 50 including shaft 51 defining motor axis M has the motor axis substantially parallel to the first plane P1 (see Figure 6).

[0126] Again with reference to Figs. 5 and 6, considering now a second plane P2, perpendicular to P1 and to the basement plane (X,Y) and passing through a second centerline H2 of the basement, perpendicular to the first centerline H1, the basement 24 is divided, by a combination of the first and the second plane P1, P2, in four quarters Q1 - Q4. The quarters are numbered in a clockwise manner, the first quarter Q1 being the rearmost quarter of the first half of the basement 24 (e.g. the quarter facing the rear wall 21), the second quarter Q2 being the rearmost quarter of the second half of the basement 24, the third quarter Q3 the foremost quarter (e.g. the quarter facing the front wall 20) of the second half of the basement and the last fourth quarter Q4 the foremost quarter of the first half of the basement 24.

[0127] It can be therefore seen that the heat exchangers 31, 32 and the duct portion 29 are substantially contained for the majority of their volume within the fourth quarter Q4, the second heat exchanger closer to the front wall 20 than the first heat exchanger 31; preferably compressor 33 is contained within the third quarter Q3, and the outlet 19 of basement 19 is located in the second quarter Q2, preferably facing rear wall 21 of casing 2.

[0128] Motor 50 is preferably contained within the second quarter Q2 as well and its shaft 51 extends in such a way that it sticks out from the outlet 19, i.e. it exits the basement 24 with one of its ends through the basement outlet 19. Preferably, motor shaft 51 is also the shaft of fan 12, which is located in proximity of outlet 19, preferably facing the latter (see Fig. 3). Fan 12 blows the process air exiting the basement 24 through outlet 19 into the drum 3, preferably through a passage, not shown, part of the process air circuit 18, formed within the rear wall 21.

[0129] The duct portion 28 therefore comprises at least one curve or bend in order to extend from the first to the second quarter. Furthermore, duct portion 28 includes walls 28w which form and delimit the duct portion itself. Any embodiment of the geometrical configuration of walls 28w is encompassed in the present invention. In order to obtain a "gentle" curve or bend, enough space is preferably available within the basement, as detailed below.

[0130] With now reference to Figs. 7, 7a, 8 and 8b, a filter 14, which will be better described in the following, is removably fixed to one or more parts of the casing 2 in such a way to be placed, when the door 4 in a closed position, in a region, considered in an horizontal plane, between front door 4 and drum 3.

[0131] In the example illustrated in the enclosed drawings, the filter 14 is advantageously arranged, when the door 4 in the closed position, below the bottom section 42 of the inner side 40 of the front door 4. Further, the filter 14 is arranged in or at an inlet 17 of the drum exhaust process air conduit 18a of the tumble dryer 1.

[0132] Leaving the interior side of the drum 3, the air flow passes the drum front end 3a, wherein the process air flow is guided, advantageously by the curved section 41 and the bottom section 42 of door 4, towards the filter 14. The filter 14 is preferably arranged in such a way that the air flow passes there through and advantageously reaches the basement 24, where it is again sucked in by the main fan 12 after having passed the first and second heat exchangers 31,32.

[0133] In the drying process, when the drying air flows through and around the laundry to be dried, the air picks up or takes fluff or lint from the laundry which is then carried away in the air flow. By passing through the filter 14, the fluff or lint which is carried in the air flow is caught or hold back by or within the filter 14. Thus, it is prevented that fluff or lint can enter the first or second duct portions 29, 28 in the basement 24 or the fan 12 or can re-enter the drum 3.

[0134] As stated above, preferably the filter 14 is provided in a region between front door 4 and drum 3 in a

horizontal direction from the front to the back of the casing 2. Further, the filter 14 preferably extends in a vertical direction partially inside the basement 24, as shown in Fig. 4 where a portion of the front wall 20 of the casing 2 has been removed. From the removed portion, the evaporator 32 can be seen, in front of which a portion of the filter 14 is positioned. Thus in the vertical direction, the filter 14 extends from the edge of aperture 4a, in particular from the lower edge of aperture 4a, to a given height which is located within the basement 24.

[0135] The filter 14 is removably seated in a recess (or alternatively in a support structure) provided by in the casing 2 which also forms the drum exhaust process air conduit 18a, as better detailed below.

[0136] Preferably, at the aperture 4a to access the drum 3, and more preferably at the lower edge of this aperture 4a, the above mentioned recess, which is the inlet 17 of the drum exhaust process air conduit 18a, is formed. From the inlet 17, a first portion 16 of the drum exhaust process air conduit 18a departs, connected with an end opposite to inlet 17 to the basement duct portion 29 formed in the basement 24 where the heat exchangers 31, 32 are located. The first portion 16 preferably extends substantially vertically, or with a longer vertical component. A part of this first portion 16 is preferably realized within the basement 24 itself.

[0137] As seen, the portion 29 of the basement duct where the heat exchangers 31, 32 are located is substantially horizontal, or at least with a wider horizontal component. In particular, the inlet surface 32a of the evaporator 32 is also substantially vertically aligned or has a wider vertical component.

[0138] Advantageously, the process air stream or flow passes the drum 3 substantially in an horizontal direction, or in a slightly tilted one in case of laundry dryer having a tilter rotational axis, and the process air stream impinges against the inner door surface 40. The process air flow is then forced to change direction to a substantially vertical one, or to a direction in which the vertical component is the longer one, and enters the inlet 17 of the drum exhaust process air conduit 18a. At the inlet 17, the filter element 14 is located. It is to be understood that additional filters downstream of the filter 14 can be present as well in the process air conduit 18 of the dryer of the invention.

[0139] Advantageously, the filter 14 is inserted inside the first portion 16 of the drum exhaust process air conduit 18a preferably in a substantially vertical manner (or the projection of the filter onto a vertical plane is wider than the projection of the filter onto an horizontal plane) and a topmost surface 14c of the filter protrudes or it is visible from inlet 17. This topmost surface 14c is preferably at least partially adapted in its form (i.e. counter-shaped) to the bottom region 42 of the front door 4 in such way that the form of the filter 14 at least partially follows the form of the bottom region 42 of the front door 4 when the front door 4 is in a closed position. The shape of the filter 14 is preferably at least partially adapted to the form of the bottom region 42 of the front door 4.

[0140] Inlet 17 defines an inlet edge 17s surrounding the inlet 17 itself. This edge has a vertical and a horizontal component, i.e. the projections of the edge in a vertical and in a horizontal plane, define closed curves encircling surfaces that may have a non-zero area.

[0141] In a top view of the edge, the latter defines a front end and a rear end. In other words, the inlet edge has a point closest to the front wall 20 of the casing, called front end, and a point closest to the rear wall 21 of the casing, called rear end.

[0142] Therefore, considering two vertical planes, a first one, called inner plane Pinner, passing through the rear end of the edge, and a second one, called outer plane Pouter, passing through the front end of the edge, the planes Pinner and Pouter being further perpendicular to the first plane P1, the inlet 17 and the edge 17s are located between these two planes Pinner-Pouter. These planes are visible in Figs. 7a and 8a.

[0143] The two planes Pinner-Pouter delimits in the horizontal direction given by the horizontal line going from front of the casing to the rear of the casing, the dimensions of the inlet 17, in other words, of the beginning of the drum exhaust process air conduit 18a, where the process air from the drum 3 enters the conduit itself 18a.

[0144] The filter 14 is inserted in the conduit first portion 16 till it abuts against the inlet 17 itself. In other words, the topmost surface 14c of filter 14 is external to the first portion 16 of the conduit 18 and the filter 14 abuts against the edge 17s of conduit 16 with a first and a second abutment surface 114a and 114b. The first abutment surface 114a is located closer to the front of casing 2, in the depicted embodiment closer to the front door 20, than the second abutment surface 114b, therefore the second abutment surface 114a is called the "inner" abutment surface and the first abutment surface 114b the "outer" one. The abutment surfaces 114a and 114b abut against a first edge portion 17a and a second edge portion 17b, respectively, of the edge 17s defined by the inlet 17. Edge portions 17a and 17b are visible in Fig. 8 and in the enlarged detail of Fig. 8a where the filter 14 has been removed from the casing 2. Figure 8a is an enlarged view of the detail identified with a rectangle "I" in Fig. 8. Inner and outer abutment surfaces 114a, 114b could be two horizontally spaced apart portions of the same surface or two different surfaces. Preferably inner edge portion 17a, onto which the inner abutment surface 114a abuts, includes the rear end of the edge surface 17s, while the outer edge surface portion 17b, onto which the outer abutment surface 114a abuts, includes the front end of the edge 17s. In the depicted embodiment, the inner edge portion 17a, onto which the inner abutment surface 114a abuts, does not include the rear end of the edge 17s, while the outer edge portion, onto which the outer abutment surface 114a abuts, includes the front end of edge 17s.

[0145] Inner and outer abutment surfaces 114a and 114b delimit in a horizontal plane the extension of the

filter 14, in other words the filter 14 is comprised in one direction between the inner abutment surface 114a and the outer abutment surface 114b. This horizontal direction is the direction from the front to the rear of the casing 2 (i.e. from the front wall 20 to the rear wall 21). Therefore, considering two vertical planes, a first one, called inner abutment plane Pinner' passing through the free edge of the inner abutment surface 114a and the second one, called outer abutment plane Pouter', passing through the free edge of the outer abutment surface 114b, the filter 14 is sandwiched between these two planes Pinner'-Pouter'. Therefore, these two planes Pinner', Pouter' delimit the dimension in a horizontal plane of the filter 14 in the direction front-rear of the casing 2. These two planes are parallel to the planes passing through the front end and the rear end of the edge 17s of the inlet 17. Furthermore, in this embodiment the outer plane and the outer abutment plane coincide, i.e. Pouter=Pouter', because in this case the outer abutment surface 114b of the filter 14 cover the front edge portion completely when the filter 14 rests in its seat, however the inner planes are different, i.e. Pinner and Pinner' are separated but parallel to each other.

[0146] According to the invention, the evaporator 32 is located below the rear end of the edge 17s and preferably below at least a portion of the inner abutment surface 114a. In other words, the evaporator 32 is passing through plane Pinner and extends on both sides of the same. More preferably, the evaporator 32 is passing through plane Pinner' and extends on both sides of the same. The evaporator 32 could also be located below the whole inner abutment surface 114a, and can even extend beyond it.

[0147] Preferably, however, below the front end of the edge 17s and/or below the outer abutment surface 114b there is no evaporator present, so that the process air in the conduit portion 16 can correctly turn in order to properly enter into the inlet surface 32a of evaporator 32. As above described, the inlet surface 32a of evaporator 32 is preferably vertical or having a wider vertical component. On the other hand, the velocity field of the process air flow within the conduit portion 16 passing through filter 14 is also substantially vertical or having a longer vertical component. The process air has therefore to turn by substantially 90° in order to enter the inlet surface 32a of the evaporator 32 and continue to flow inside the evaporator 32 without further changing direction. Therefore, preferably the evaporator 32 is located for its major part on the side of the plane Pinner which is not facing plane Pouter, in other words on the rear side of plane Pinner. More preferably, the evaporator 32 is located for its major part on the side of the plane Pinner' which is not facing plane Pouter', in other words on the rear side of plane Pinner. At least a portion 32b of the evaporator 32 is however below the filter 14, and in particular below its inner abutment surface 114a, as mentioned above, or at least below the rear end of the edge surface 17s, so that the evaporator 32 is as close as possible to the front wall 20 without hindering the proper process air flow and the proper functioning and dimensions of the filter 14, and at the same time leaving as much space as possible for the duct portion 28 where the dry process air flow exiting the condenser 31 flows before exiting basement 24 from outlet 19 located in proximity of the rear wall 21.

[0148] Furthermore, a portion 32d of the evaporator 32 is positioned below drum 3. The evaporator 32, as said, is only partially positioned below the filter 14, substantially all its remaining part 32d is located below the drum 3 which is very close to filter 14 and more specifically it is very close to topmost surface 14c. In this way a wide heat exchanging surface may be provided in the evaporator.

[0149] Advantageously, a bigger part of the process air flow changes its direction before reaching the evaporator 32 from substantially vertical to substantially horizontal. The process air flow then passes the condenser 31 in the basement duct portion 29 of the laundry dryer 1.

[0150] The portion of duct 16 merges to portion of duct 19 in the basement. Preferably a part of the duct portion 16 is already realized in the basement 24.

[0151] Further advantageously, the filter 14 has a first and second filter shell 14a, 14b which are preferably partially arranged within the conduit first portion 16. Further, first and second filter shell 14a, 14b preferably comprise one or more nets (not visible in the drawings) through which the process air flow can pass, wherein the fluff or lint carried by the process air flow and passing through the filter 14 is caught in the meshes of the net(s).

[0152] First filter shell 14a and a second filter shell 14b are preferably interconnected by a hinge 14d. Preferably the hinge 14d represents the lowermost point of the filter 14. Thus, the filter 14 can be advantageously released and removed from its seat in the tumble dryer 1 and folded apart for removing the fluff or lint and the filter 14 can be folded again and reinstalled.

[0153] Advantageously, the evaporator 32 is located below the filter in a portion comprised between the first abutment surface 114a and said hinge 14c.

[0154] Preferably, in the first shell 14a the inner abutment surface 114a is realized, and in the second shell 14b the outer abutment surface 114b is formed. Further, the filter shells 14a, 14b have side walls which are formed and adapted such that the filter 14, when folded (i.e. closed) completely encloses an interior space, where air with fluff or lint can pass through and the fluff or lint is held back in the interior space.

[0155] The filter 14 can be easily removed from inlet 17 by an upward motion. The filter element 14 can be cleaned outside the laundry dryer 10.

[0156] With the above mentioned positioning of evaporator 32 and filter 14, there is more space in the air stream circuit 18 downstream the condenser 31 improving the flow of the air stream. This allows, for example, a better curvature of the basement duct 28 in order to optimize the flow of the air stream.

Claims

1. A laundry dryer (1) including:

- a casing (2) rotatably supporting a drum (3) for receiving a load to be dried, said drum being apt to rotate around a drum axis (R), said casing (2) including
  - ◦ a rear wall (21) and a front wall (20) defining, respectively, a rear side and a front side of said casing (2), an aperture (4a) being realized on said front wall to access said drum (3);
  - ◦ a basement (24) defining a basement plane (X,Y);

- A process air conduit (18) in fluid communication with the drum (3) where a process air stream is apt to flow, said process air conduit including a drum exhaust process air conduit (18a) having an inlet (17) in which process air exiting said drum (3) is conveyed;
- A heat pump (30) having a heat pump circuit in which a refrigerant can flow, said heat pump circuit including a first heat exchanger (31) where the refrigerant is cooled off and the process air is heated up, and a second heat exchanger (32) where the refrigerant is heated up and the process air is cooled off; said first and/or second heat exchanger (31, 32) being arranged in the process air conduit (18) in order to perform heat exchange between said refrigerant flowing in said heat pump circuit and said process air;

Wherein

- Said drum exhaust process air conduit (18a) includes an inlet edge (17s) surrounding said inlet (17) and defining a front end and a rear end;
- A first portion (32b) of said second heat exchanger (32) is located below said rear end of said inlet edge (17s) and a second portion (32d) of said second heat exchanger (32) is located below said drum (3);
- A filter (14) to filter process air arranged at the inlet (17) of said drum exhaust process air conduit (18a) in such a way that an air flow streaming through said drum (3) enters said drum exhaust process air conduit (18a) passing through said filter (14), said filter (14) having an inner abutment surface (114a) and an outer abutment surface (114b), said inner abutment surface (114a) being the surface more distant from said front wall (20) than the outer abutment surface (114b), said inner and outer abutment surfaces being in abutment with a first and a second edge portions (17a, 17b), respectively, of said inlet edge (17s);
- Wherein said second heat exchanger (32) is located downstream said filter (14) in the direction of flow of said process air in said process air conduit (18); and
- wherein said first portion (32b) of said second heat exchanger (32) is located below said inner abutment surface (114a); and
- wherein said drum exhaust process air conduit (18a) includes a first portion (16) having a substantially vertical component and a second portion (29) having a longer horizontal component, so that said process air passes through said filter (14) in a substantially vertical direction and through said second heat exchanger (32) in a substantially horizontal direction.

2. The laundry dryer according to claim 1, wherein said inlet (17) of said drum exhaust process air conduit (18a) is arranged adjacent to said aperture (4a) to access said drum (3).

3. The laundry dryer according to claim 2, wherein said inlet (17) of said drum exhaust process air conduit (18a) is located at a lower edge of said aperture (4a) to access said drum (3).

4. The laundry dryer (1) according to any of the preceding claims, wherein the process air stream passes the drum (3) in a direction of flow from the rear side to the front side of said casing (2) and it passes the bottom of the laundry dryer (1) in a direction of flow from the front side to the rear side of the casing (2).

5. The laundry dryer (1) according to any of the preceding claims, including a main fan (12) to blow air in said process air conduit (18), said main fan (12) being located downstream said first and second heat exchanger (31, 32) in the direction of flow of said process air.

6. The laundry dryer (1) according to claim 5, wherein said main fan (12) is located at or in proximity to said rear wall (21) and said filter (14) is located at or in proximity to said front wall (20).

7. The laundry dryer (1) according to any of the preceding claims, wherein said filter (14) includes a first and a second openable shells (14a, 14b), said inner and outer abutment surfaces (114a, 114b) being formed on said first and second shells (14a, 14b), respectively.

8. The laundry dryer according to claim 7, wherein said first and second openable shells (14a, 14b) are hinged by means of a hinge (14d), said first portion (32b) of said second heat exchanger (32) being lo-

cated below a portion of filter (14) included between said first abutment surface (114a) and said hinge (14c).

9. The laundry dryer (1) according to any of claims 7 or 8, wherein said first and second shells (14a, 14b) include a net to block lint or fluff contained in said process air coming from said drum (3).

10. The laundry dryer (1), according to any of the preceding claims, including a door (4) to open and close said aperture (4a) and wherein said filter (14) includes a topmost surface (14c) located below a bottom surface (42) of said door (4) when in closed position on said front wall (20).

11. The laundry dryer (1) according to any of the preceding claims, wherein said first and second heat exchangers (31, 32) are located within said basement (24) of said dryer (1).

12. The laundry dryer (1) according to any of the preceding claims, wherein in said basement (24) a first (24 first half) and a second longitudinal half (24 second half) are identifiable by means of a first plane (P1) perpendicular to said basement plane (X,Y) and passing through said drum axis (R); and wherein a majority of the volume of said first and second heat exchanger (31, 32) and at least a portion of said filter (14) are located in said first half (24 first half) of said basement, and an outlet (19) of said air process circuit (18) for process air from said basement (24) is located in said second half (24 second half).

13. The laundry dryer (1) according to any of the preceding claims when dependent on claim 5, wherein said basement (24) includes an outlet (19) for directing process air back to said drum (3), and said main fan (12) is located in front of said outlet (19) of process air from said basement (24).

14. The laundry dryer (1) according to any of the preceding claims wherein said second heat exchanger (32) is located in said basement (24), and wherein said outer abutment surface (114b) is located above a portion of said basement (24) free from said second heat exchanger (32).

15. The laundry dryer (1) according to any of the preceding claims, wherein said second portion (32d) of said second heat exchanger (32) located below said drum (3) includes the majority of the volume of said second heat exchanger (32).

16. The laundry dryer (1) according to any of the preceding claims, wherein said second heat exchanger (32) includes an inlet surface (32a) and a portion of said filter (14) is located in front of said inlet surface (32a).

Patentansprüche

1. Wäschetrockner (1), der Folgendes enthält:

- ein Gehäuse (2), das eine Trommel (3) zum Aufnehmen einer zu trocknenden Ladung drehbar trägt, wobei die Trommel zu Drehungen um eine Trommelachse (R) fähig ist und das Gehäuse (2) Folgendes enthält:
  - ◦ eine Rückwand (21) und eine Vorderwand (20), die eine Rückseite bzw. eine Vorderseite des Gehäuses (2) definieren, wobei eine Öffnung (4a) auf der Vorderwand für den Zugang zur Trommel (3) realisiert ist;
  - ◦ eine Basis (24), die eine Basisebene (X,Y) definiert;
- eine Prozessluftleitung (18) in fluidischer Verbindung mit der Trommel (3), wobei ein Prozessluftstrom zum Strömen fähig ist und die Prozessluftleitung eine Trommelprozessabluftleitung (18a) mit einem Einlass (17), in den aus der Trommel (3) austretende Abluft befördert wird, enthält;
- eine Wärmepumpe (30) mit einem Wärmepumpenkreis, in dem ein Refrigerant fließen kann, wobei der Wärmepumpenkreis einen ersten Wärmeaustauscher (31), in dem der Refrigerant abgekühlt wird und die Prozessluft erwärmt wird, und einen zweiten Wärmeaustauscher (32), in dem der Refrigerant erwärmt und die Prozessluft abgekühlt wird, enthält; wobei der erste und/oder der zweite Wärmeaustauscher (31, 32) in der Prozessluftleitung (18) angeordnet sind/ist, um einen Wärmeaustausch zwischen dem im Wärmepumpenkreis fließenden Refrigerant und der Prozessluft durchzuführen;

wobei

- die Trommelprozessabluftleitung (18a) eine den Einlass (17) umgebende und ein vorderes Ende und ein hinteres Ende definierende Einlasskante (17s) enthält;
- sich ein erster Abschnitt (32b) des zweiten Wärmeaustauschers (32) unter dem hinteren Ende der Einlasskante (17s) befindet und sich ein zweiter Abschnitt (32d) des zweiten Wärmeaustauschers (32) unter der Trommel (3) befindet;
- ein Filter (14) zum Filtern von Prozessluft, der am Einlass (17) der Trommelprozessabluftleitung (18a) so angeordnet ist, dass ein durch die

Trommel (3) strömender Luftstrom in die Trommelprozessabluftleitung (18a) eintritt und hierbei den Filter (14) passiert, wobei der Filter (14) eine innere Stoßfläche (114a) und eine äußere Stoßfläche (114b) aufweist, wobei die innere Stoßfläche (114a) diejenige Fläche ist, die weiter von der Vorderwand (20) entfernt ist als die äußere Stoßfläche (114b), wobei die innere und die äußere Stoßfläche an einen ersten bzw. einen zweiten Kantenabschnitt (17a, 17b) der Einlasskante (17s) stoßen;
- wobei sich der zweite Wärmeaustauscher (32) in der Richtung der Prozessluftströmung in der Prozessluftleitung (18) hinter dem Filter (14) befindet; und
- wobei sich der erste Abschnitt (32b) des zweiten Wärmeaustauschers (32) unter der inneren Stoßfläche (114a) befindet; und
- wobei die Trommelprozessabluftleitung (18a) einen ersten Abschnitt (16) mit einer im Wesentlichen vertikalen Komponente und einen zweiten Abschnitt (29) mit einer längeren horizontalen Komponente enthält, sodass die Prozessluft den Filter (14) in einer im Wesentlichen vertikalen Richtung und den zweiten Wärmeaustauscher (32) in einer im Wesentlichen horizontalen Richtung passiert.

2. Wäschetrockner nach Anspruch 1, wobei der Einlass (17) der Trommelprozessabluftleitung (18a) benachbart zur Öffnung (4a) für den Zugang zur Trommel (3) angeordnet ist.

3. Wäschetrockner nach Anspruch 2, wobei sich der Einlass (17) der Trommelprozessabluftleitung (18a) an einer unteren Kante der Öffnung (4a) für den Zugang zur Trommel (3) befindet.

4. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche, wobei der Prozessluftstrom die Trommel (3) in einer Strömungsrichtung von der Rückseite zur Vorderseite des Gehäuses (2) passiert und den Boden des Wäschetrockners (1) in einer Strömungsrichtung von der Vorderseite zur Rückseite des Gehäuses (2) passiert.

5. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche, der ein Hauptgebläse (12) zum Blasen von Luft durch die Prozessluftleitung (18) enthält, wobei sich das Hauptgebläse (12) in der Richtung der Prozessluftströmung hinter dem ersten und dem zweiten Wärmeaustauscher (31, 32) befindet.

6. Wäschetrockner (1) nach Anspruch 5, wobei sich das Hauptgebläse (12) an oder in der Nähe der Rückwand (21) befindet und sich der Filter (14) an oder in der Nähe der Vorderwand (20) befindet.

7. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche, wobei der Filter (14) eine erste und eine zweite sich öffnen lassende Schale (14a, 14b) enthält, wobei die innere und die äußere Stoßfläche (114a, 114b) auf der ersten bzw. der zweiten Schale (14a, 14b) gebildet sind.

8. Wäschetrockner nach Anspruch 7, wobei die erste und die zweite sich öffnen lassende Schale (14a, 14b) mittels eines Scharniers (14d) miteinander verbunden sind, wobei sich der erste Abschnitt (32b) des zweiten Wärmeaustauschers (32) unter einem Abschnitt des Filters (14), der zwischen der ersten Stoßfläche (114a) und dem Scharnier (14c) enthalten ist, befindet.

9. Wäschetrockner (1) nach Anspruch 7 oder Anspruch 8, wobei die erste und die zweite Schale (14a, 14b) ein Netz zum Auffangen von Fusseln oder Flusen, die in der von der Trommel (3) kommenden Prozessluft mitgeführt werden, enthalten.

10. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche, der eine Klappe (4) zum Aufdecken und Abdecken der Öffnung (4a) enthält, wobei der Filter (14) eine oberste Fläche (14c), die sich unter einer unteren Fläche (42) der Klappe (4) in einer abdeckenden Position auf der Vorderwand (20) befindet, enthält.

11. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche, wobei sich der erste und der zweite Wärmeaustauscher (31, 32) innerhalb der Basis (24) des Trockners (1) befinden.

12. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche, wobei in der Basis (24) eine erste (24 erste Hälfte) und eine zweite längliche Hälfte (24 zweite Hälfte) mittels einer ersten Ebene (P1), die lotrecht zur Basisebene (X,Y) ist und durch die Trommelachse (R) hindurchgeht, identifizierbar sind; und wobei sich ein Großteil des Volumens des ersten und des zweiten Wärmeaustauschers (31, 32) und mindestens ein Abschnitt des Filters (14) in der ersten Hälfte (24 erste Hälfte) der Basis befinden und sich ein Auslass (19) der Luftprozessleitung (18) für Prozessluft aus der Basis (24) in der zweiten Hälfte (24 zweite Hälfte) befindet.

13. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche in Abhängigkeit von Anspruch 5, wobei die Basis (24) einen Auslass (19) zum Lenken von Prozessluft zurück zur Trommel (3) enthält und sich das Hauptgebläse (12) vor dem Auslass (19) für Prozessluft aus der Basis (24) befindet.

14. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche, wobei sich der zweite Wärmeaus-

tauscher (32) in der Basis (24) befindet und wobei sich die äußere Stoßfläche (114b) über einem Abschnitt der Basis (24), der frei vom zweiten Wärmeaustauscher (32) ist, befindet.

15. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche, wobei der zweite Abschnitt (32d) des zweiten Wärmeaustauschers (32), der sich unter der Trommel (3) befindet, den Großteil des Volumens des zweiten Wärmeaustauschers (32) enthält.

16. Wäschetrockner (1) nach einem der vorhergehenden Ansprüche, wobei der zweite Wärmeaustauscher (32) eine Einlassfläche (32a) enthält und sich ein Abschnitt des Filters (14) vor der Einlassfläche (32a) befindet.

Revendications

1. Sèche-linge (1), incluant :

- une caisse (2) supportant de façon rotative un tambour (3) pour recevoir une charge destinée à être séchée, ledit tambour étant apte à entrer en rotation autour d'un axe de tambour (R), ladite caisse (2) incluant
  - ◦ une paroi arrière (21) et une paroi avant (20) définissant, respectivement, un côté arrière et un côté avant de ladite caisse (2), une ouverture (4a) étant réalisée sur ladite paroi avant pour accéder audit tambour (3) ;
  - ◦ une base (24) définissant un plan de base (X, Y) ;

- un conduit d'air de traitement (18) en communication fluidique avec le tambour (3) où un courant d'air de traitement est apte à s'écouler, ledit conduit d'air de traitement incluant un courant d'air de traitement d'évacuation de tambour (18a) ayant une entrée (17) dans laquelle de l'air de traitement sortant dudit tambour (3) est transporté ;
- une pompe à chaleur (30) ayant un circuit de pompe à chaleur dans lequel un réfrigérant peut s'écouler, ledit circuit de pompe à chaleur incluant un premier échangeur de chaleur (31) où le réfrigérant est refroidi et l'air de traitement est chauffé, et un second échangeur de chaleur (32) où le réfrigérant est chauffé et l'air de traitement est refroidi ; ledit premier et/ou second échangeur de chaleur (31, 32) étant agencé dans le conduit d'air de traitement (18) afin de réaliser un échange de chaleur entre ledit réfrigérant s'écoulant dans ledit circuit de pompe à chaleur et ledit air de traitement ;

dans lequel

- ledit courant d'air de traitement d'évacuation de tambour (18a) inclut un bord d'entrée (17s) entourant ladite entrée (17) et définissant une extrémité avant et une extrémité arrière ;
- une première portion (32b) dudit second échangeur de chaleur (32) est située en dessous de ladite extrémité arrière dudit bord d'entrée (17s) et une seconde portion (32d) dudit second échangeur de chaleur (32) est située en dessous dudit tambour (3) ;
- un filtre (14) pour filtrer l'air de traitement agencé à l'entrée (17) dudit courant d'air de traitement d'évacuation de tambour (18a) de manière telle qu'un courant d'air s'écoulant à travers ledit tambour (3) entre dans ledit courant d'air de traitement d'évacuation de tambour (18a) passant à travers ledit filtre (14), ledit filtre (14) ayant une surface de butée intérieure (114a) et une surface de butée extérieure (114b), ladite surface de butée intérieure (114a) étant la surface plus distante de ladite paroi avant (20) que la surface de butée extérieure (114b), lesdites surfaces de butée intérieure et extérieure étant en butée avec une première et une seconde portions de bord (17a, 17b), respectivement, dudit bord d'entrée (17s) ;
- dans lequel ledit second échangeur de chaleur (32) est situé en aval dudit filtre (14) dans la direction d'écoulement dudit air de traitement dans ledit conduit d'air de traitement (18) ; et
- dans lequel ladite première portion (32b) dudit second échangeur de chaleur (32) est située en dessous de ladite surface de butée intérieure (114a) ; et
- dans lequel ledit courant d'air de traitement d'évacuation de tambour (18a) inclut une première portion (16) ayant un composant sensiblement vertical et une seconde portion (29) ayant un composant horizontal plus long, pour que ledit air de traitement passe à travers ledit filtre (14) dans une direction sensiblement verticale et à travers ledit second échangeur de chaleur (32) dans une direction sensiblement horizontale.

2. Sèche-linge selon la revendication 1, dans lequel ladite entrée (17) dudit courant d'air de traitement d'évacuation de tambour (18a) est agencée de façon adjacente à ladite ouverture (4a) pour accéder audit tambour (3).

3. Sèche-linge selon la revendication 2, dans lequel ladite entrée (17) dudit courant d'air de traitement d'évacuation de tambour (18a) est située à un bord inférieur de ladite ouverture (4a) pour accéder audit tambour (3).

4. Sèche-linge (1) selon l'une quelconque des revendications précédentes, dans lequel le courant d'air de traitement passe par le tambour (3) dans une direction d'écoulement depuis le côté arrière jusqu'au côté avant de ladite caisse (2) et il passe par le fond du sèche-linge (1) dans une direction d'écoulement depuis le côté avant jusqu'au côté arrière de la caisse (2).

5. Sèche-linge (1) selon l'une quelconque des revendications précédentes, incluant un ventilateur principal (12) pour souffler de l'air dans ledit conduit d'air de traitement (18), ledit ventilateur principal (12) étant situé en aval desdits premier et second échangeurs de chaleur (31, 32) dans la direction d'écoulement dudit air de traitement.

6. Sèche-linge (1) selon la revendication 5, dans lequel ledit ventilateur principal (12) est situé à, ou à proximité de, ladite paroi arrière (21) et ledit filtre (14) est situé à, ou à proximité de, ladite paroi avant (20).

7. Sèche-linge (1) selon l'une quelconque des revendications précédentes, dans lequel ledit filtre (14) inclut une première et une seconde enveloppes ouvrables (14a, 14b), lesdites surfaces de butée intérieure et extérieure (114a, 114b) étant formées sur lesdites premier et second enveloppes (14a, 14b), respectivement.

8. Sèche-linge selon la revendication 7, dans lequel lesdites première et seconde enveloppes ouvrables (14a, 14b) sont articulées au moyen d'une articulation (14d), ladite première portion (32b) dudit second échangeur de chaleur (32) étant située en dessous d'une portion de filtre (14) incluse entre ladite première surface de butée (114a) et ladite articulation (14c).

9. Sèche-linge (1) selon l'une quelconque des revendications 7 ou 8, dans lequel lesdites première et seconde enveloppes (14a, 14b) incluent un filet pour bloquer les peluches ou moutons contenus dans ledit air de traitement provenant dudit tambour (3).

10. Sèche-linge (1) selon l'une quelconque des revendications précédentes, incluant une porte (4) pour ouvrir et fermer ladite ouverture (4a) et dans lequel ledit filtre (14) inclut une surface la plus élevée (14c) située en dessous d'une surface inférieure (42) de ladite porte (4) lorsqu'elle est dans la position fermée sur ladite paroi avant (20).

11. Sèche-linge (1) selon l'une quelconque des revendications précédentes, dans lequel lesdits premier et second échangeurs de chaleur (31, 32) sont situés à l'intérieur de ladite base (24) dudit sèche-linge (1).

12. Sèche-linge (1) selon l'une quelconque des revendications précédentes, dans lequel, dans ladite base (24), une première (24 première moitié) et une seconde moitié longitudinale (24 seconde moitié) sont identifiables au moyen d'un premier plan (P1) perpendiculaire audit plan de base (X, Y) et passant à travers ledit axe de tambour (R) ; et dans lequel une majorité du volume desdits premier et second échangeurs de chaleur (31, 32) et au moins une portion dudit filtre (14) sont situées dans ladite première moitié (24 première moitié) de ladite base, et une sortie (19) dudit circuit de traitement d'air (18) pour l'air de traitement provenant de ladite base (24) est située dans ledit seconde moitié (24 seconde moitié).

13. Sèche-linge (1) selon l'une quelconque des revendications précédentes lorsqu'elle dépend de la revendication 5, dans lequel ladite base (24) inclut une sortie (19) pour rediriger de l'air de traitement vers ledit tambour (3), et ledit ventilateur principal (12) est situé devant ladite sortie (19) d'air de traitement provenant de ladite base (24).

14. Sèche-linge (1) selon l'une quelconque des revendications précédentes, dans lequel ledit second échangeur de chaleur (32) est situé dans ladite base (24), et dans lequel ladite surface de butée extérieure (114b) est située au-dessus d'une portion de ladite base (24) de façon libre dudit second échangeur de chaleur (32).

15. Sèche-linge (1) selon l'une quelconque des revendications précédentes, dans lequel ladite seconde portion (32d) dudit second échangeur de chaleur (32) située en dessous dudit tambour (3) inclut la majorité du volume dudit second échangeur de chaleur (32).

16. Sèche-linge (1) selon l'une quelconque des revendications précédentes, dans lequel ledit second échangeur de chaleur (32) inclut une surface d'entrée (32a) et une portion dudit filtre (14) est située devant ladite entrée surface (32a).

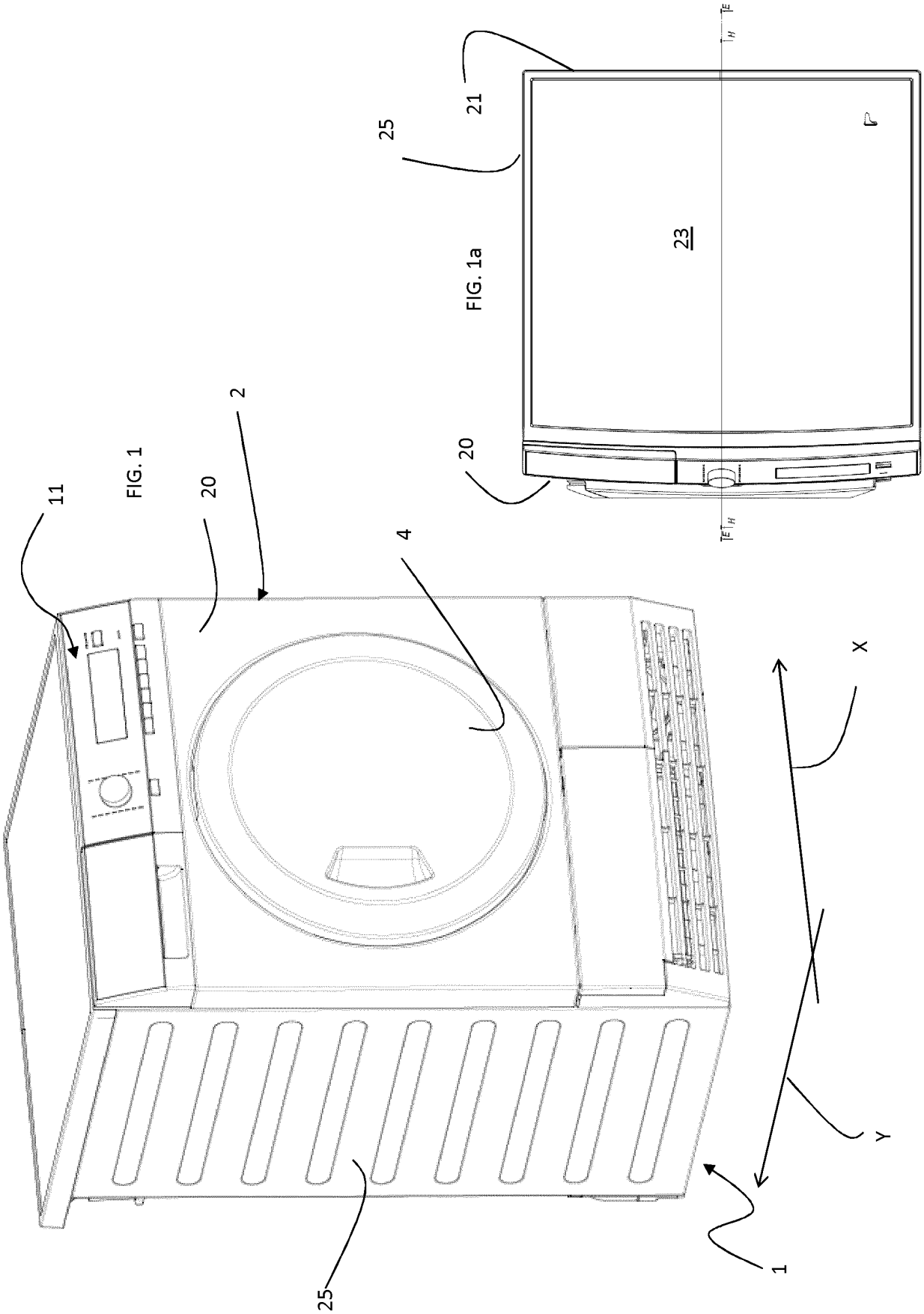
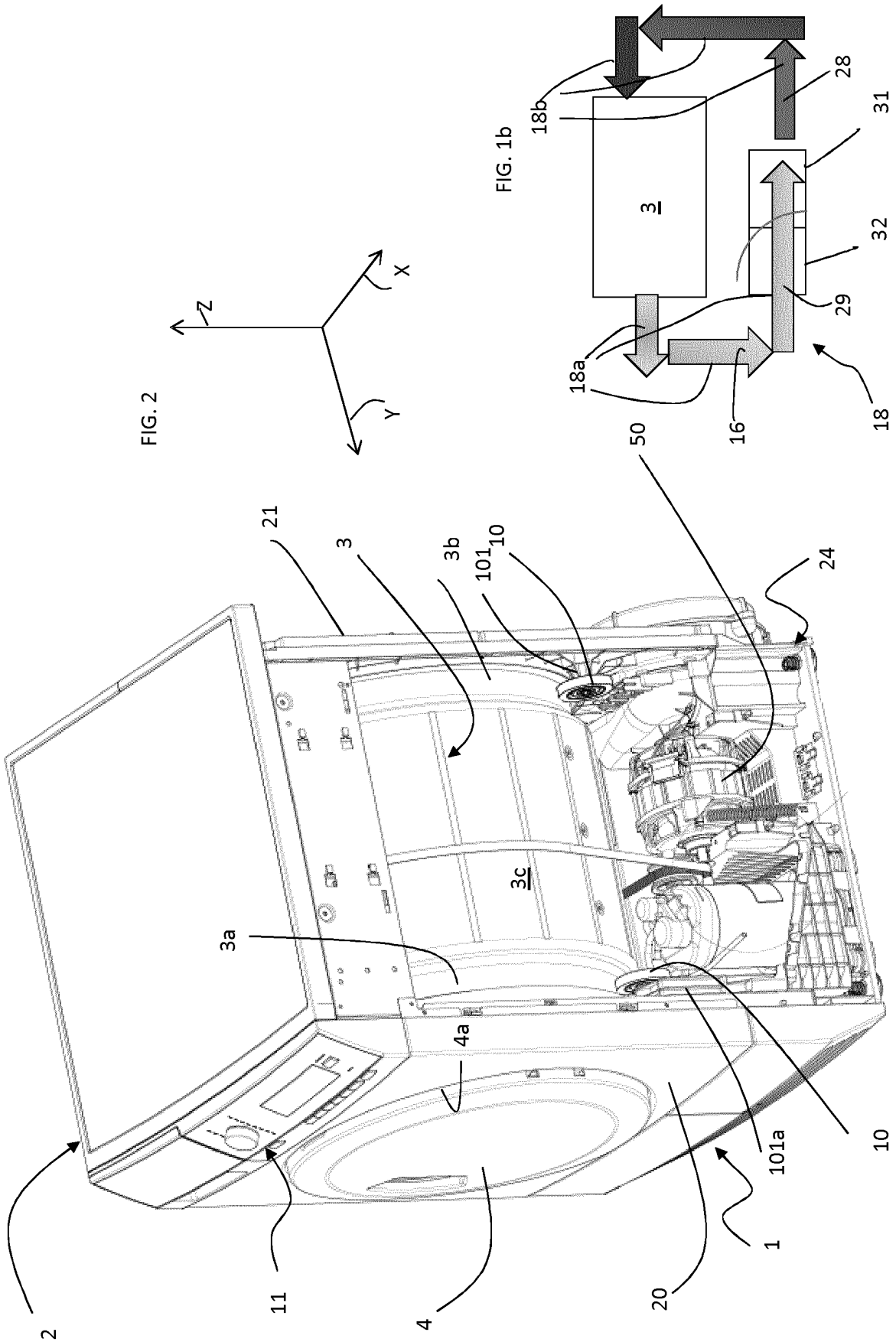


FIG. 1

FIG. 1a


2
11
4
20
1
101a
10
4a
3a
3c
3b
101
10
21
3
24
50
16
18
18a
18b
3
28
31
32
29
FIG. 1b
FIG. 2
Z
X
Y

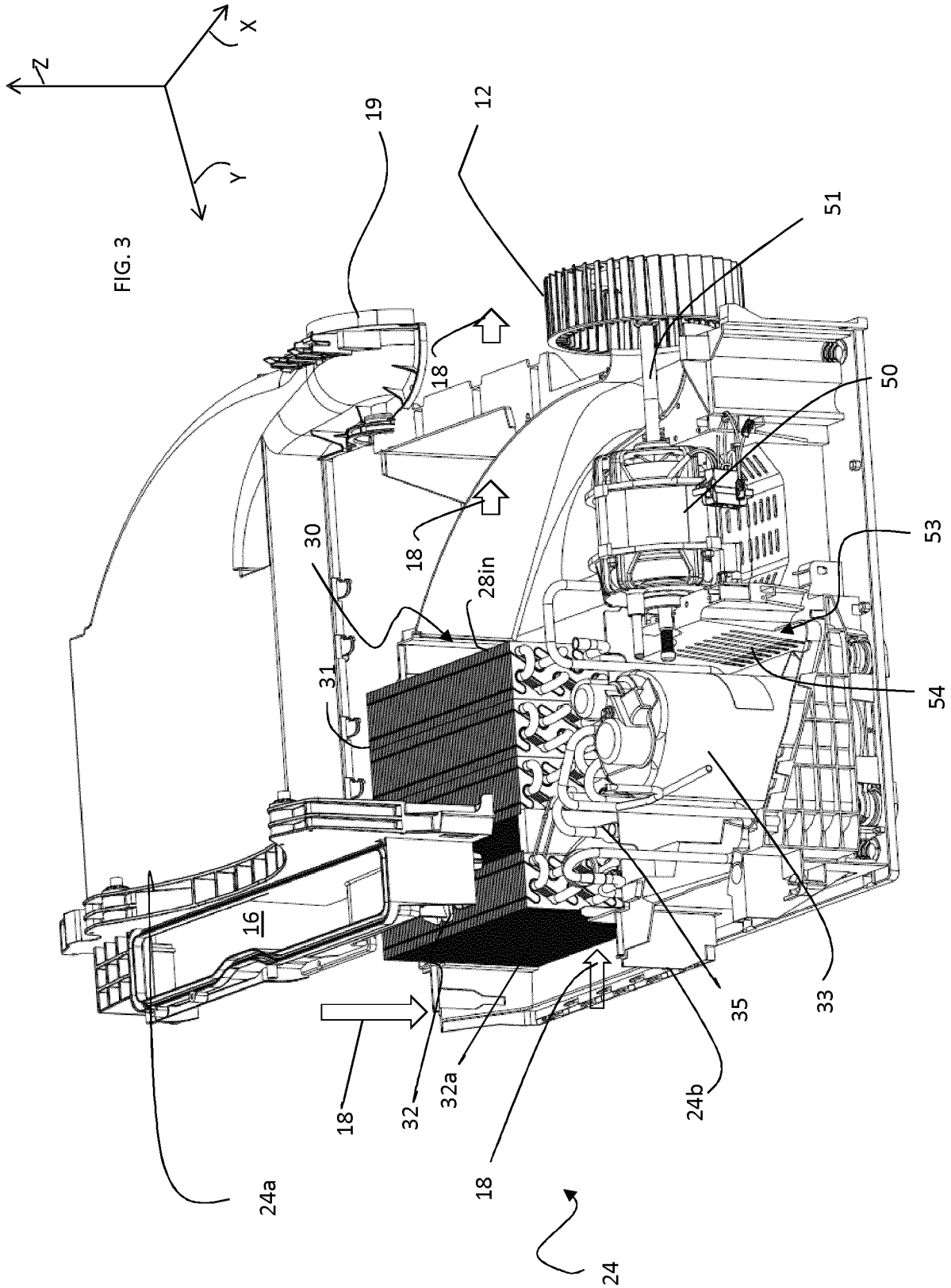

Z
X
Y
19
12
51
18
50
30
18
28in
53
31
54
16
24a
18
32
32a
18
24b
35
33
24

FIG. 3

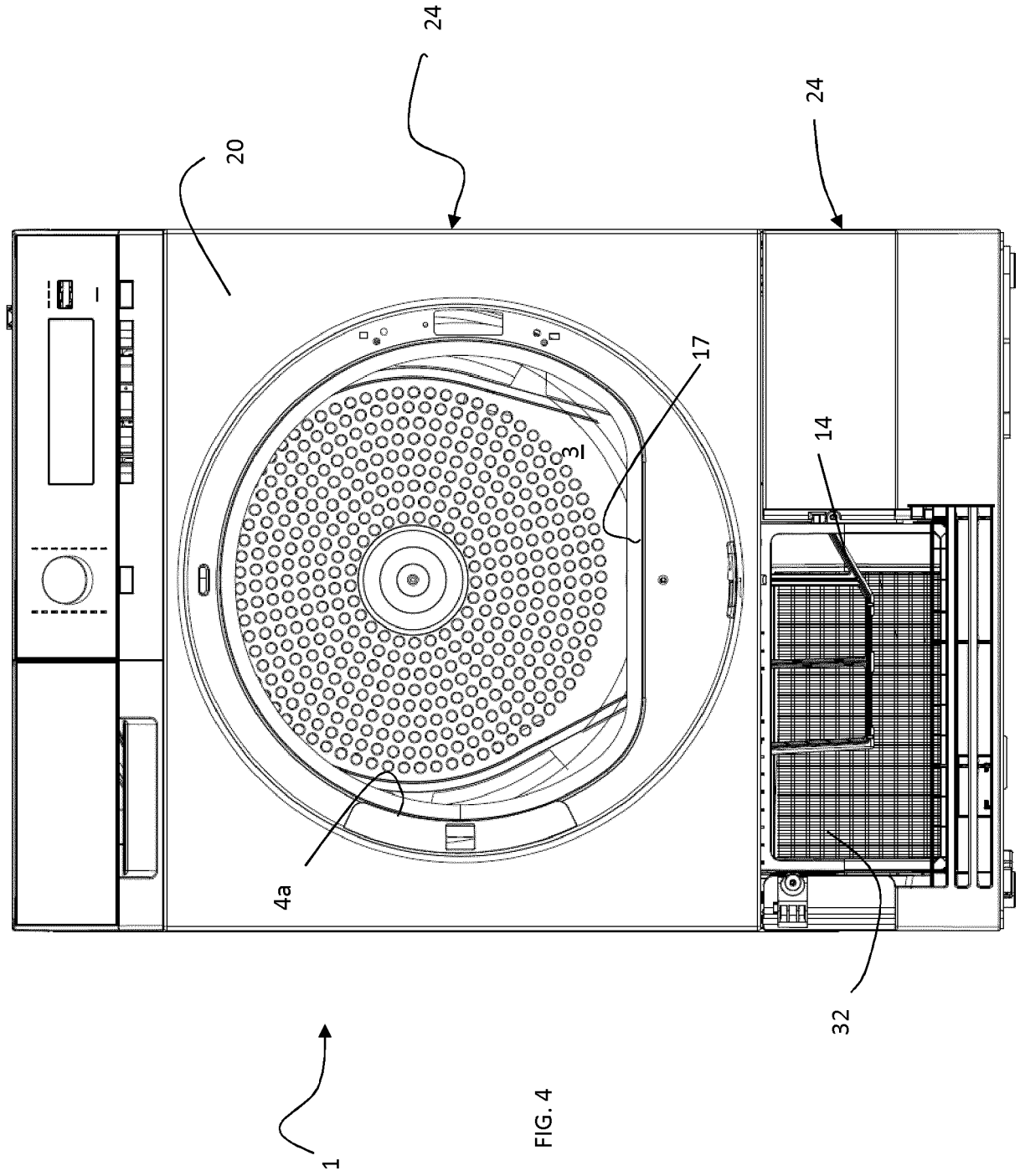
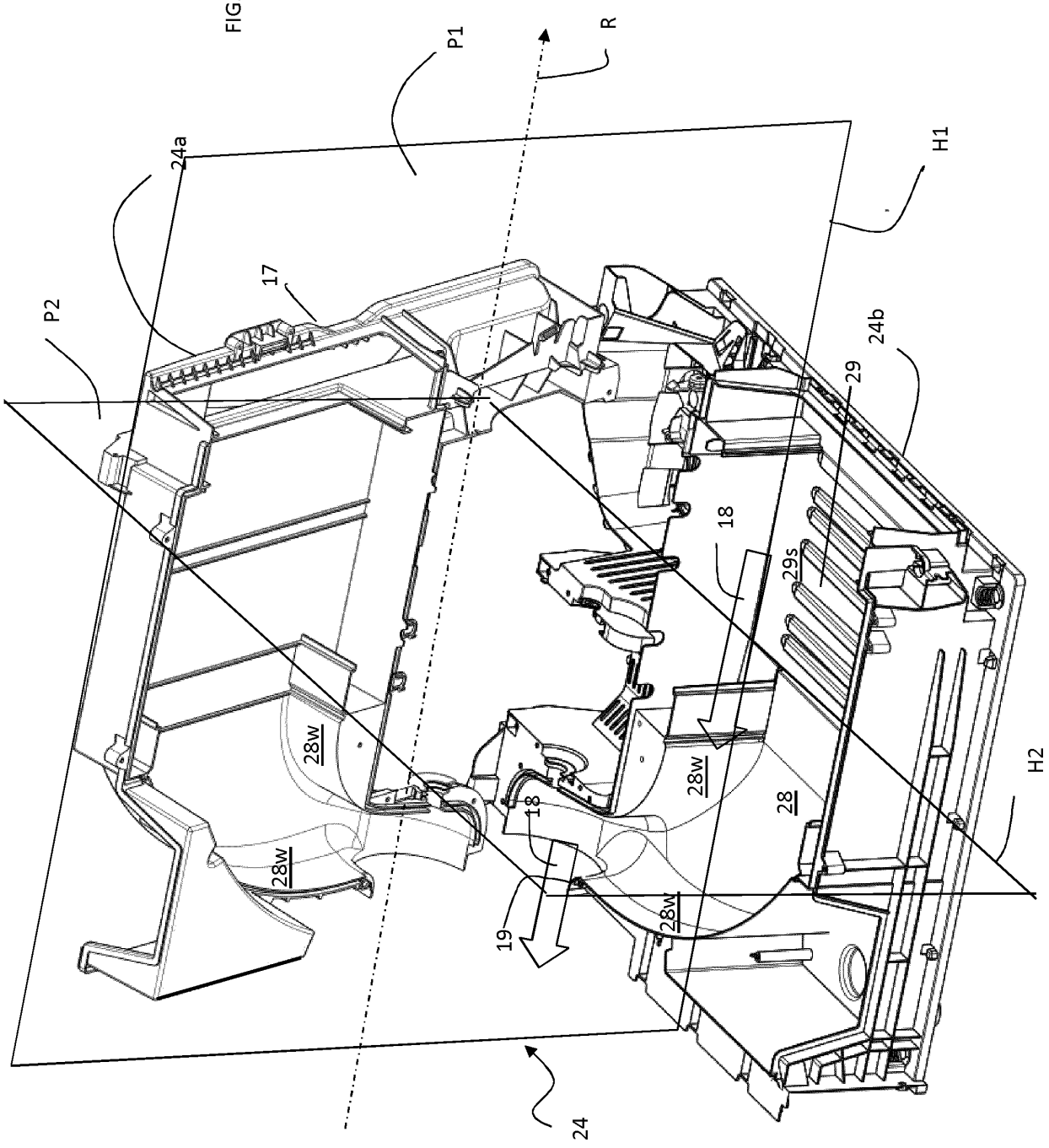


FIG. 4

FIG. 5



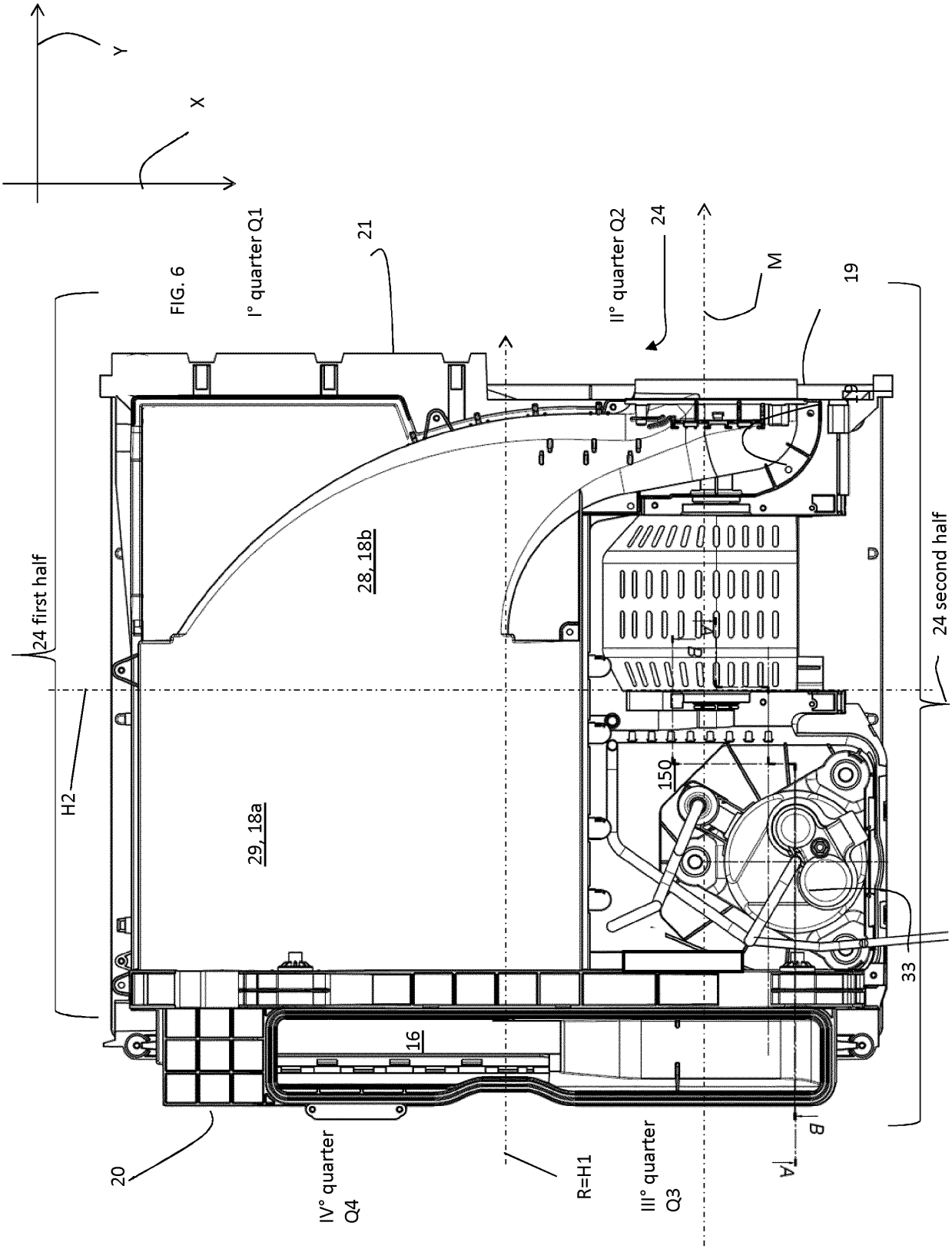

Y
X
I° quarter Q1
21
II° quarter Q2
24
M
19
24 first half
28, 18b
24 second half
H2
29, 18a
150
33
16
20
IV° quarter
Q4
R=H1
III° quarter
Q3
B
A

FIG. 6

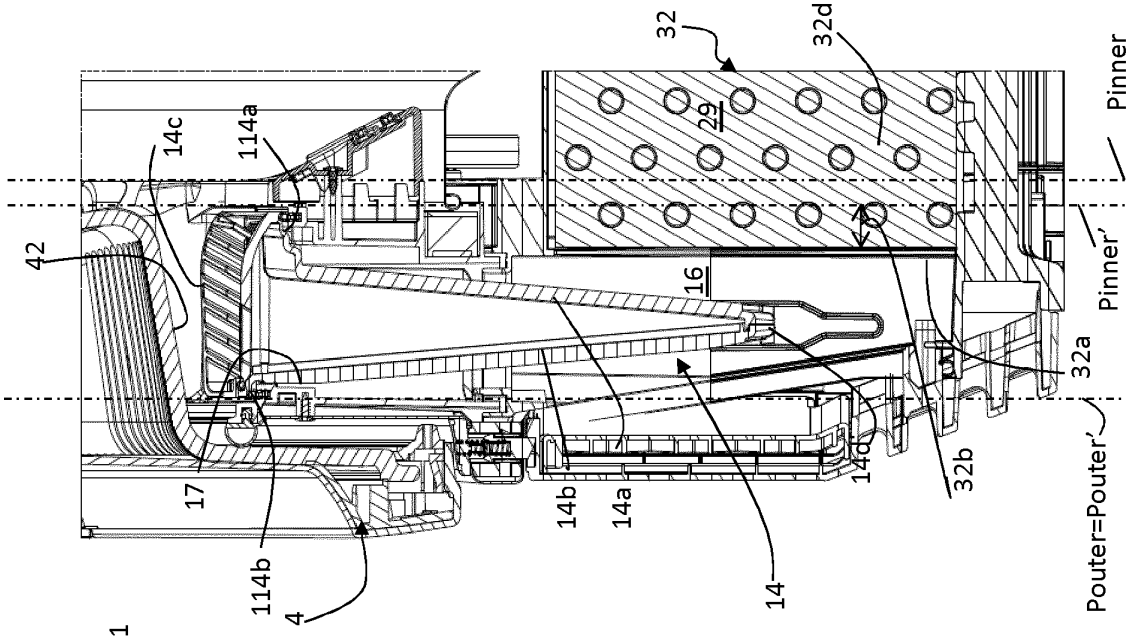

32
32d
Pinner
29
14c
114a
42
16
Pinner'
32a
14d
32b
17
14b
14a
114b
4
14
Pouter=Pouter'

FIG. 7a

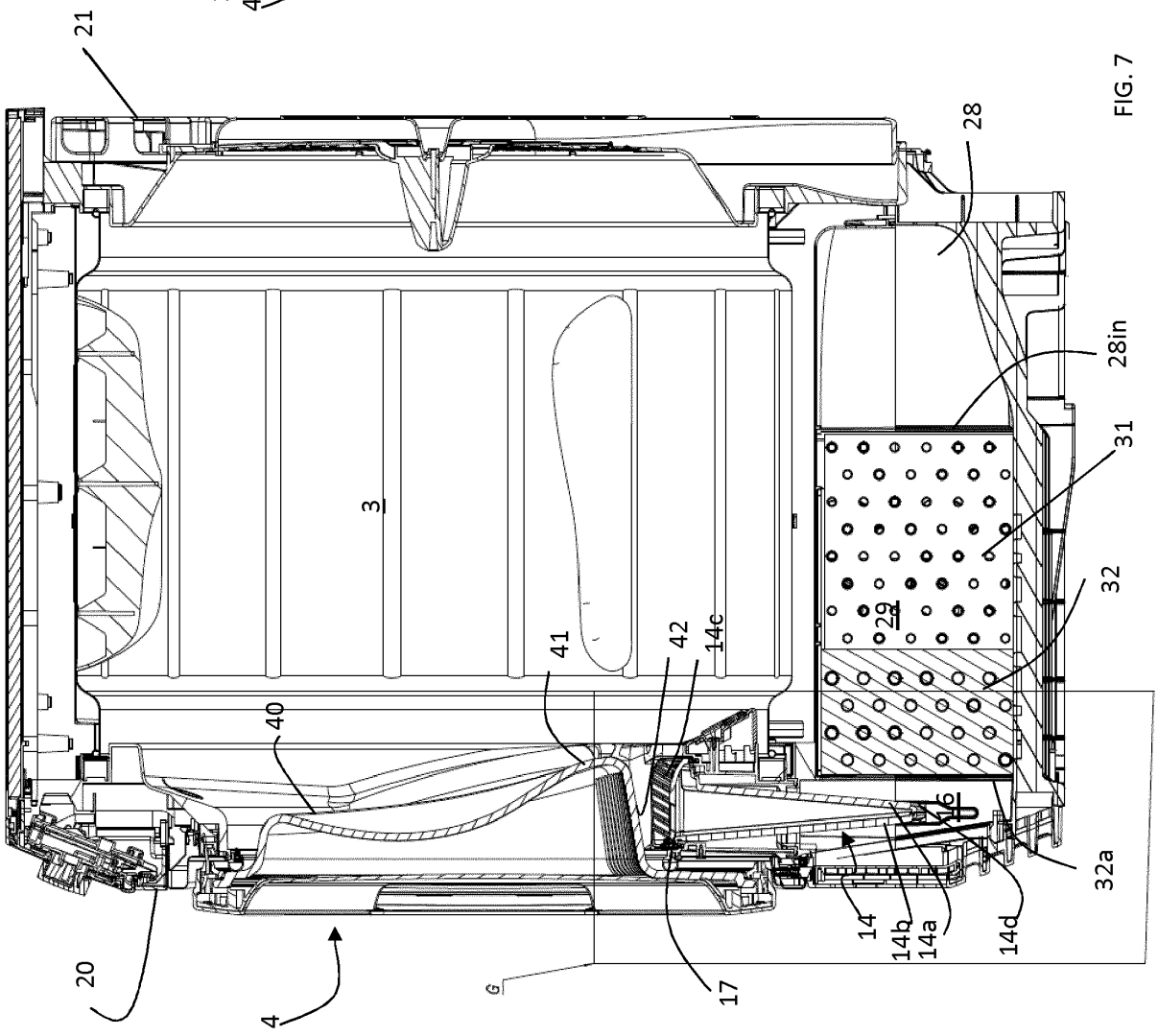

21
28
28in
31
3
32
29
41
42
14c
40
16
32a
20
4
17
14
14b
14a
14d

FIG. 7

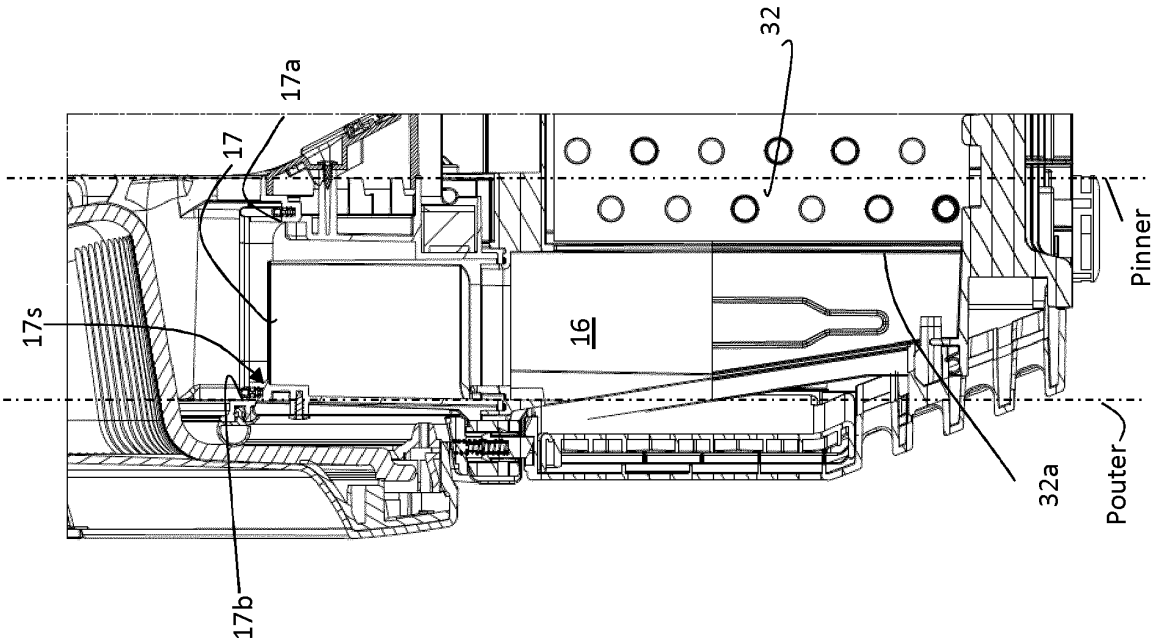

32
17a
17
17s
16
Pinner
Pouter
32a
17b

FIG. 8a

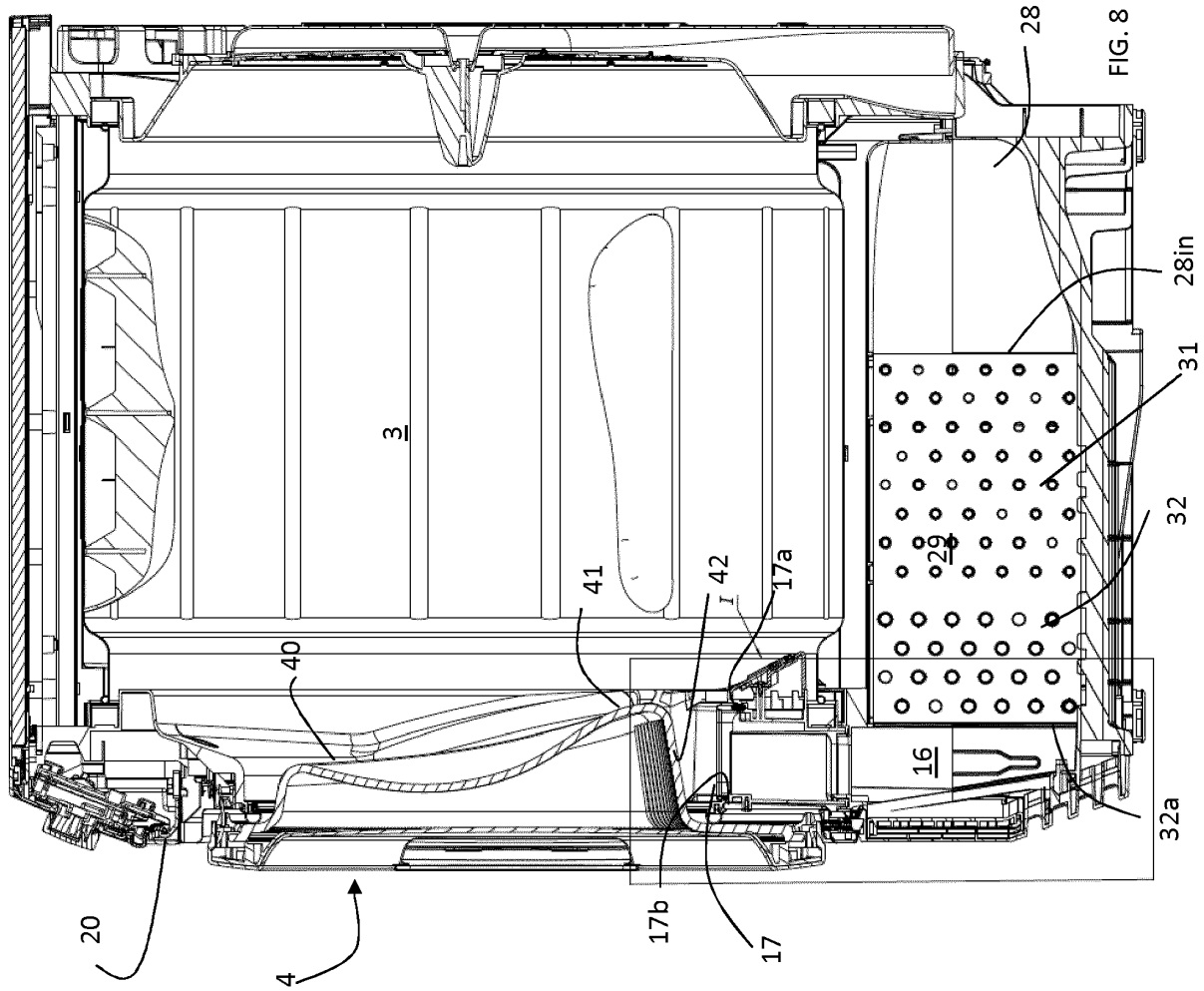

28
28in
31
32
29
3
41
42
17a
40
16
32a
20
4
17b
17

FIG. 8

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2581488 A **[0013]**
- US 2009211309 A **[0015]**
- EP 2230349 A **[0016]**
- EP 2682515 A **[0017]**