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

(11) EP 2 990 522 A1

(12) **EUROPEAN PATENT APPLICATION**

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

(51) Int Cl.:
D06F 58/20 *(2006.01)* ***D06F 58/04*** *(2006.01)*
D06F 58/24 *(2006.01)*

(21) Application number: **14182921.8**

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

(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
Designated Extension States:
BA ME

(71) Applicant: **Electrolux Appliances Aktiebolag**
105 45 Stockholm (SE)

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

(74) Representative: **Petruccelli, Davide et al**
Electrolux Italia S.p.A.
Corso Lino Zanussi 30
33080 Porcia (PN) (IT)

(54) Heat pump laundry dryer

(57) The present invention relates to a laundry dryer including a casing rotatably supporting a drum, and including a basement (24) defining a basement plane (X,Y) and in which a first longitudinal half (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 a drum axis (R); a heat pump system (30) having a heat pump circuit including a first heat exchanger (31) and a second heat exchanger (32); a process air conduit (18) including a basement air duct formed in said basement comprising a basement duct portion (28) channeling said process air between a process air exit (28in) where process air exits from said first heat exchanger and a process air outlet (19) where process air exits said basement, said process air outlet being located within the second longitudinal half of said basement, said basement duct portion including one or more duct walls (28w) which in a section along a sectioning plane (PT) parallel to a basement plane (X, Y) defines an inner curve (28b) and an outer curve (28a); wherein a tangent (T1, T2, T3) to said inner curve in said second longitudinal half of said basement forms an angle different from 90° with an axis (H1) formed by sectioning the first plane with said sectioning plane (PT) for at least between 90% and 100% of the length (L2) of the inner curve in said second longitudinal half.

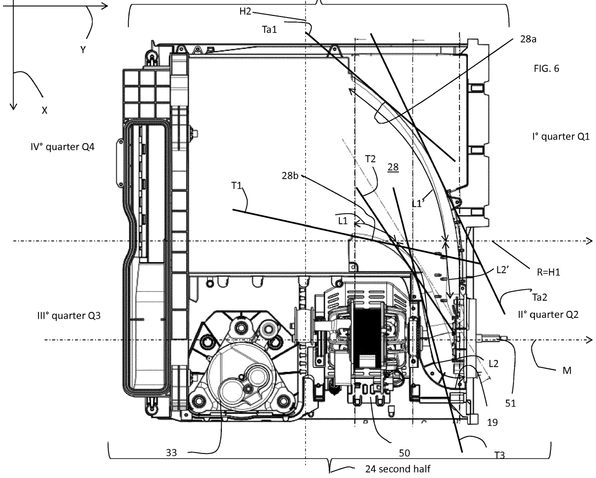

FIG. 6

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Printed by Jouve, 75001 PARIS (FR)

Description

Technical field

[0001] The present invention relates to a laundry dryer including a heat pump having an improved duct 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 an air stream flows in a closed air stream circuit. Further, the heat pump system includes a closed refrigerant circuit. The air stream is moved by a fan, passes through a laundry chamber, which is preferably formed as a rotatable laundry drum, and removes there water from wet clothes. Then, the 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 air stream circuit as well as of the refrigerant circuit. The condenser and the evaporator are heat exchangers between the 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 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 air stream circuit has to pass the basement of the dryer, bringing the humid air to the evaporator and re-introducing 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 together form the basement.

[0006] Fig. 7 illustrates a top view of the open basement of a heat pump laundry dryer according to the prior art. The compressor 140, the evaporator 160, the condenser 180, the 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 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 duct in the basement where a fan is located, the two 90° turns being connected again by a straight duct.

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

[0008] However, it is rather complex to modify the outline and shape of the air duct where process air flows within the basement. The various components of the heat pump, with particular reference to the heat exchangers and the compressor, as well as the motor of the dryer, are rather "bulky" and repositioning of the same are limited due to the confined volume present in the basement of the dryer.

[0009] It is an object of the present invention to provide a laundry dryer with a heat pump system, wherein the flow of the air stream is improved, with particular reference to the air stream flow within the basement of the laundry dryer.

[0010] Applicant has realized via numerous experiments that the efficiency of the heat pump can be improved including in the dryer an air duct which comprises at least one curved portion having a specific shape located between the exit of the drying air from the condenser and the air outlet of the air duct for the outlet of the drying air flow from the basement.

[0011] The core of the present invention is the combination of the curved portion of the air duct in the basement of the laundry dryer on the one hand and the arrangement of the evaporator and the condenser inside said the basement on the other hand. The curved portion prevents the formation of "sharp corners" inside the air duct, so that the pressure drops in the air duct are reduced. The air flow from the condenser to the basement outlet is improved. The heat exchanged between the refrigerant circuit and the air stream circuit increases. The dimensions of the evaporator and condenser may be reduced.

[0012] In addition, the energy consumption of the motors for the compressor and the fan is reduced. Further, the noise of the laundry dryer is reduced.

[0013] 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
  - o a rear wall and a front wall, an aperture being realized on said front wall to access said drum;
  - o a basement defining a basement plane and in which basement a first longitudinal half and a second longitudinal half are identifiable by means of a first plane perpendicular to said basement plane and passing through said drum axis;
- A process air conduit in fluid communication with the drum where a process air stream is apt to flow;

- 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 stream is heated up, and a second heat exchanger where the refrigerant is heated up and the process air is cooled off; said first heat exchanger and/or said second heat exchanger being arranged in the process air conduit within said first longitudinal half of said basement for the majority of their volume to perform heat exchange between said refrigerant flowing in said heat pump circuit and said process air;

- Said process air conduit including a basement air duct formed in said basement, said basement air duct comprising a basement duct portion channeling said process air between a process air exit where process air exits from said first heat exchanger and a process air outlet where process air exits said basement, said outlet being located within said second longitudinal half of said basement, said basement duct portion including one or more duct walls which in a section along a plane parallel to said basement plane defines an inner curve and an outer curve, said outer curve being the curve closer to the rear wall of the casing among the two curves;

- Wherein a tangent to said inner curve of said basement duct portion in said second longitudinal half of said basement forms an angle different from 90° with an axis formed by a section of said first plane made by said sectioning plane for at least between 90 % and 100% of the length of the inner curve in said second longitudinal half.

[0014] 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.

[0015] 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 an air process 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.

[0016] The laundry dryer includes an heat pump system. 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.

[0017] 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.

[0018] 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.

[0019] In an advantageous embodiment, said drum support element includes a drum shaft, said shaft passing through aback 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.

[0020] 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 air conduit both heat exchangers of the heat pump system are located. Furthermore, the basement 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 conduit realized preferably in the rear wall of the cabinet, to the drum so as to dry the laundry therein. The portion of basement air conduit comprised between an exit of the condenser, i.e. a location in 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.

[0021] The location of the exit of the condenser is defined as the location of a section of the basement air duct portion which faces and it is parallel to the surface of the first heat exchanger from which process air exits. Among all possible such sections, the closest to the condenser is considered to be the portion of the basement air duct at the exit of the condenser. Preferably, process air passes through the first heat exchanger in a direction towards said rear wall of the casing.

[0022] The basement air duct portion includes one or more lateral walls depending on its geometry. If the geometry of the duct 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] The layout of the heat pump system located in the basement of the dryer of the invention is the following.

[0029] 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.

[0030] 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 has to include at least one "bend" or "turn".

[0031] According to the invention, the basement duct portion forms a "smooth" duct to channel process air from the condenser to the outside of the basement.

[0032] The presence of a "smooth" duct is particularly relevant in proximity of the outlet of the basement, where abrupt 90°-turns of the duct would cause vortexes and other types of turbulences in the process air flow and a sharp reduction in the efficiency of the heat pump.

[0033] The basement portion duct includes - as described - lateral walls. These lateral walls define, when sectioned by a plane parallel to the basement plane, e. g. by a horizontal plane, an inner curve and an outer curve. This plane parallel to the basement plane is called in the following "sectioning plane". The term "inner" curve and the term "outer" curve are understood to be the curves "more inwardly" and "more outwardly" the casing, i.e. closer to the center of the casing or farer away from the same, respectively.

[0034] The inner curve and the outer curve start at the "exit" of the first heat exchanger or condenser, in other words each curve starts from a point defined by a section of the basement duct portion with a plane passing through the exit surface of the air from the first heat exchanger, and terminate at the outlet of the basement, i.e. each curve terminates at a point defined by a plane containing the outlet area and sectioning the basement duct portion. The inner curve has a tangent which is not perpendicular to projection of the rotational axis to the sectioning plane, at least for a portion of such an inner curve. This projection of the rotational axis can be also defined as the line formed by sectioning the first plane by means of the sectioning plane. This line is preferably substantially the longitudinal median or center line of the basement in a top view.

[0035] This non-perpendicularity between tangent and line is present for all points in "most" of the length of the inner curve in the second longitudinal half of the basement. In other words, for all points included in at least between 90% and 100% of the length of the inner curve in the second half of the basement, a tangent in any of those points of the inner curve is not perpendicular to the line that divides the basement in two. Thus the inner curve is a "smooth curve" in particular in the second half of the basement where the outlet of process air is located.

[0036] The value of 90% is set to allow the potential presence of small grooves or joints which may locally for a very limited length of the inner curve have a perpendicular tangent. Thus there can be "small portions", i.e. an amount of points in the inner curve that in total forms less than 10% of the total length of the inner curve in the second half of the basement, of the inner curve where said tangent is perpendicular to the above defined line, however Applicant has found out that such a very limited length in which the inner curve is perpendicular does not significantly affect the flow of air, in particular because the length is short enough not to change the direction of flow significantly.

[0037] Having a curve with no perpendicular tangent (or with a perpendicular tangent only for a very small fraction of less than 10 % of the total length) means that the curve itself is substantially never (or only for a very small fraction) perpendicular to such a line. This in turn means that there are basically no sharp turns or 90° bends within the basement duct portion at least within the second longitudinal half of the basement, so that the inner curve "gently" reaches the outlet channeling the process air with low friction.

[0038] Preferably, the above is true regardless of the position of the sectioning plane, i.e. for all sectioning plane. In other words preferably the above holds for any sectioning plane at any distance from the basement plane as long as an inner and an outer curve of the basement air duct portion separated from each other are defined.

[0039] Tests of the Applicant have shown that the dryer having such a basement duct portion has a flow of process air greatly improved, increasing the overall efficiency of both the heat pump and of the fan which moves air within the air conduit.

[0040] According to this aspect, the invention may include, alternatively or in combination, any of the following characteristics.

[0041] Preferably, a tangent to said inner curve of said basement duct portion in said second longitudinal half of said basement forms an angle different from 90° with an axis formed by a section of said first plane made by said sectioning plane for at least between 95 % and 100 % of the length of the inner curve in said second longitudinal half (24 second half).

[0042] Preferably, the inner curve in the second longitudinal half is "substantially always smooth", i.e. for all points forming at least between 95% and 100% of the length of the inner curve in said second longitudinal half of the basement, so as to further improve the aerodynamic of the basement duct portion and the efficiency of the heat pump.

[0043] Advantageously, in said basement, a first quarter, a second quarter, a third quarter and a fourth quarter are identifiable by means of the intersection between said first plane and a second plane perpendicular to said first plane passing through a center line of the basement substantially parallel to said front wall of said casing; said process air outlet being realized in said second quarter, the second quarter being the quarter of the second longitudinal half of the basement closest to the rear wall of said casing, said process air exit being located in said first quarter, said first quarter being the quarter of the first longitudinal half of said basement closest to said rear wall of said casing, said basement duct portion connecting said exit to said outlet extending only within said first quarter and said second quarter of said basement.

[0044] As mentioned before, 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 basement can also be considered to be divided in four "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. The four 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 being the rearmost quarter of the first longitudinal half, the second quarter is the rearmost quarter of the second longitudinal half and so on.

[0045] The basement duct portion has a part which extends in the first longitudinal half, starting from the exit of the condenser, and a part extending in the second longitudinal half of the condenser, reaching the outlet of the basement. In this second longitudinal half, the extension of the basement duct portion is limited to the second quarter, i.e. there is no basement duct portion in the third quarter.

[0046] Due to the size of the heat exchangers, normally the exit of the condenser is located within the first quarter, so the basement duct portion extends only within the first quarter and second quarter of said basement.

[0047] Even more preferably, a tangent to said inner curve of said basement duct portion in said first quarter and said second quarter of said basement forms an angle different from 90° with an axis formed by a section of said first plane made by said sectioning plane for at least between 90 % and 100 % of the total length of the inner curve.

[0048] In this advantageous embodiment, the majority of the whole inner curve is smooth, at least for all points of the inner curve forming between 90% and 100% of the inner curve’s length, both in the first quarter and in the second quarter, so as to improve the efficiency of the heat pump. In other words, the whole inner curve has no sharp turns or bends.

[0049] In an embodiment, said first and said second heat exchangers are located within said fourth quarter for the majority of their respective volumes, said fourth quarter being the quarter of the first longitudinal half of the basement closest to said front wall of the casing.

[0050] Due to the better aerodynamic layout of the basement duct portion compared with the prior art, the size of the heat exchangers can be reduced, so that they occupy more or less only the fourth quarter of the basement. This in turn means that further volume is available for other functional parts of the dryer. Alternatively, the heat pump can be made even more efficient keeping the same size of heat exchangers.

[0051] Advantageously, said basement includes an upper shell portion and a lower shell portion, said basement air duct portion being formed by the connection between said upper shell portion and said lower shell portion.

[0052] The basement air duct portion in the basement can be realized for example in an easy and reliable manner joining together the two shell portions so as to form the lateral wall of the duct portion.

[0053] Preferably, said basement is realized in plastic material and said basement air duct portion is formed integrally to said basement.

[0054] It should also be observed that, in the present description and in the attached claims, the terms "plastic material" and the like, are used to indicate any plastic or synthetic material, or based on plastic or synthetic material, possibly added with fillers suitable to improve the functional and robustness characteristics thereof, such as minerals, textile synthetic fillers and so on and so forth.

[0055] The fact that the basement is realized in plastic allows a minimization of the number of elements included in the dryer of the invention. Indeed, with a single producing process, for example with the same molding process, the basement can be realized including a plurality of additional functional elements for the dryer that do not have to be realized separately and then assembled, such as the basement duct portion or others for example the seats for the heat exchangers.

[0056] Furthermore, plastic material can be used in the present dryer of the invention because a heat pump system is present. Heat pump dryers generate temperatures lower than dryers including electrical or gas powered air heating devices. Therefore, any possible melting of the basement due to higher local temperatures at which different hot drying air generators may work is avoided.

[0057] In a preferred embodiment, the dryer includes a fan, said fan being located in proximity of the outlet of said basement downstream said second heat exchanger in the direction of flow of said process air.

[0058] The fan is preferably located just outside the outlet of the basement and blows the process air exiting the basement into the drum.

[0059] Preferably, said basement duct portion includes a first and a second side walls wherein the process air is apt to flow, said first and second side walls being substantially perpendicular to said basement plane and defining said inner curve and said outer curve, respectively, when sectioned along a plane parallel to said basement plane.

[0060] In this embodiment, the basement air duct portion inside the basement has a first and a second lateral or side walls which run substantially perpendicular to the basement plane and which are "smooth" due to the configuration of their cross section. Preferably, the side walls are integrally formed with a bottom and top wall of the duct.

[0061] In an advantageous embodiment, a tangent to said outer curve of said basement duct portion in said second longitudinal half of said basement forms an angle different from 90° with an axis formed by a section of said first plane made by said sectioning plane for at least between 90% and 100% of the outer curve length in said second longitudinal half.

[0062] More preferably, a tangent to said outer curve of said duct portion in said second longitudinal half of said basement forms an angle different from 90° with an axis formed by a section of said first plane made by said sectioning plane for at least between 95% and 100 % of the length of the outer curve in said second longitudinal half.

[0063] Even more preferably, a tangent to said outer curve of said basement duct portion in said first quarter and said second quarter of said basement forms an angle different from 90° with an axis formed by a section of said first plane made by said sectioning plane for at least between 90% and 100 % of the total length of the outer curve.

[0064] In order to further improve the geometry of the duct, both the inner curve and the outer curve of the basement duct portion are "smooth", at least within the second half of the basement, where the meaning of "smooth" has been above defined. In this way in substantially the vast majority of portions of the basement duct portion, 90° corners are avoided and a "gentle" both inner and outer curve connect the exit of the air duct to the outlet of the basement.

[0065] Preferably, the dryer includes a motor having a motor axis, apt to rotate said drum, said motor axis being parallel to said first plane.

[0066] More preferably, said motor is located within said second longitudinal half of said basement for the majority of its volume.

[0067] Due to the location of the heat exchangers within the first longitudinal half of the basement, the motor is preferably located in the second longitudinal half of the basement due to the size of the same. The motor is also preferably driving the fan of the dryer.

[0068] Advantageously, said drum axis and said motor axis are substantially parallel to each other.

[0069] More preferably, said motor includes a motor shaft defining said motor axis, said shaft passing through said duct wall(s), and a tangent in a point where said motor axis intersects said inner curve forms an angle different from 90° with said motor axis.

[0070] The motor shaft intersects the basement air duct portion and in particular passes through the lateral wall that, when sectioned by the sectioning plane, defines the inner curve. Being the motor axis, thus the shaft, substantially parallel to the first plane, the angle formed between the motor axis and the inner curve is substantially always different from 90°, i.e. they are not perpendicular. Thus the tangent to the points of the inner curve located at the intersection between the inner curve and the motor axis forms an angle different from 90° with the motor axis itself.

Brief description of the drawings

[0071] 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. 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 perspective view of the basement of Fig. 3 with all elements removed;
- Fig. 5 and Fig. 5a are a top view of the basement of Fig. 3 and of a detail thereof, respectively;
- Fig. 6 is another top view of the basement of Figs. 3-5; and
- Fig. 7 is a top view of a basement of a laundry dryer according to the prior art.

Detailed description of one or more embodiments of the invention

[0072] With initial reference to Figs. 1 and 2, a laundry dryer realized according to the present invention is globally indicated with 1.

[0073] 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. Access to the drum 3 is achieved for example via a door 4, preferably hinged to cabinet 2, which can open and close an opening 4a realized on the cabinet itself.

[0074] 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. 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, 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).

[0075] 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).

[0076] Laundry dryer 1 also preferably comprises an electrical motor assembly 50 for rotating, on command, revolving drum 3 along its axis inside casing 2. Motor 50 includes a shaft 51 which defines a motor axis of rotation M.

[0077] 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.

[0078] 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.

[0079] 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.

[0080] 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 (drum shaft is not depicted in the appended drawings). In Fig. 2, for example, a roller 10 connected to the rear wall 21 via a boss 101 is depicted. Any support element for the rotation of the drum around axis R is encompassed by the present invention.

[0081] 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 3 and 4). 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 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 (shown in Fig. 3).

[0082] The dryer 1 of the invention additionally comprises a heat pump system 30 including 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.

[0083] 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.

[0084] 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).

[0085] 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.

[0086] 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.

[0087] Further, with now reference to Figures 4 and 6, in the basement, the process air conduit 18 includes a duct formed by the upper and the lower shells 24a, 24b, having an inlet 19in from which process air is received from the drum 3 and an outlet 19 to channel process air out of the basement 24. Between inlet 19in and outlet 19, 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, 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, called basement air duct portion 28, channels the process air exiting from the first heat exchanger 31 towards the basement outlet 19.

[0088] The second portion 28 thus starts at the location of the exit 28in of the first heat exchanger 31, considered as the location of a plane sectioning the duct portion 28 and substantially in front or in contact with a surface of the first heat exchanger 31 from which process air exits.

[0089] Preferably, the exit 28in may be defined on a plane perpendicular to the basement plane, e.g. on a vertical plane.

[0090] Furthermore, preferably also the outlet 19, defined as the area at which the air exits the basement, defines in turn a plane substantially perpendicular to the basement plane, e.g. a vertical plane.

[0091] Considering now a first plane P1 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.

[0092] 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.

[0093] 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.

[0094] Preferably, motor 50 including shaft 51 defining motor axis M has the motor axis substantially parallel to the first plane P1 (see Figures 5a or 6).

[0095] Again with reference to Figs. 4 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.

[0096] 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.

[0097] Motor 50 is preferably contained within the second quarter Q2 as well, and its motor 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. 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.

[0098] The basement duct portion 28 extends from the air exit, 28in, of the condenser which is located within the first quarter Q1 preferably close to the boundary with the fourth quarter Q4, i.e. close to centerline H2, to the outlet 19 of the basement, located in the second quarter Q4.

[0099] Preferably, but not necessarily, the planes containing the exit 28in and the outlet 19 are substantially parallel to each other and even more preferably they are both parallel to P2.

[0100] The duct portion 28 therefore has to comprise 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. Walls 28w include a first and a second lateral wall 28w1 and 28w2. In the depicted embodiment, the lateral walls 28w1 and 28w2 are for at least a part of duct portion 28 substantially locally parallel and facing each other and also locally planar. However the configuration of lateral walls 28w1 and 28w2 can change also along the extension of the duct, for example close to the outlet 19, the section of the duct portion 28 becomes substantially circular and thus lateral walls 28w1 and 28w2 become substantially curvilinear or each of them includes an arch of circumference. Any embodiment of the geometrical configuration of lateral walls 28w1 and 28w2 is encompassed in the present invention.

[0101] Preferably, first and second lateral walls 28w1 and 28w2 are each separated in half and each of the halves is integrally formed with the upper or lower shell 24a, 24b. That is to say, the upper shell 24a includes a part of first lateral wall 28w1 and a part of second lateral wall 28w2, both parts integrally formed with the upper shell 24a, while the lower shell 24b includes the remaining part of first lateral wall 28w1 and remaining part of second lateral wall 28w2, both remaining parts integrally formed with the lower shell 24b.

[0102] Considering now a further plane, called sectioning plane PT (visible in Fig. 5), a section of the duct portion 28 is made as follows. Sectioning plane PT is a plane substantially parallel to the basement plane (X,Y), e.g. it is an horizontal plane. This plane PT is at a given distance from the basement plane so that it sections the lateral first and second walls 28w1, 28w2 at a certain height. For example, such a sectioning plane PT is the one which has been used to form the cross sections of Figs. 5 and 5a; in Fig. 5 sectioning plane PT has been schematically depicted as a dotted rectangle.

[0103] Sectioning plane PT thus sections first lateral wall 28w1 and second lateral wall 28w2 generating - in a top view of such section - an inner curve 28b and an outer curve 28a, respectively. The inner and outer curve 28a, 28b are substantially the curves formed by the edges of the first and second lateral walls - respectively - in the location where they have been sectioned.

[0104] Inner curve 28b is called "inner" being generally closer to the center of casing 2 than the outer curve 28a for most of its extension.

[0105] Each of the inner and outer curve 28b, 28a, due to the fact that the duct portion 28 extends in the first and second half 24 first half, 24 second half of the basement 24, and preferably it is contained within the first and the second quarter Q1 and Q2, extends for a given first length L1 (L1') in the first half 24 first half and for a given second length L2(L2') in the second half 24 second half of the basement 24, preferably the first length L1 (L1') being contained in the first quarter Q1 and the second length L2 (L2') being contained in the second quarter Q2, where L1 + L2 = total length L (not shown in the figures) of the inner curve 28b, and L1' + L2' = L' (not shown in the pictures) total length of the outer curve 28a.

[0106] Considering now the inner curve 28b, and in particular the part of the inner curve contained in the second quarter Q2 having length L2, for each point of this part of the inner curve 28b passes a tangent to the inner curve itself, such tangent lying on the plane PT. Therefore, the part of the inner curve 28b contained in the second quarter Q2 defines a family of tangents, a tangent for each point of the part of the inner curve 28b contained in the second quarter Q2 of length L2. This family of tangents is schematically depicted in Figs. 5a and 6 as tangents T1, T2, T3; it is to be understood that the number of such tangents is infinite. Each of the tangents such as T1, T2, etc. forms an angle with a line formed sectioning the first plane P1 with sectioning plane PT, which in the depicted embodiment coincides with the centerline H1 in a top view of the basement 24.

[0107] Similarly, considering now the outer curve 28a, and in particular the part of this outer curve contained in the first quarter Q1 having length L1', for each point of this part of the outer curve 28a passes a tangent to the outer curve itself. Therefore the part of the outer curve 28a contained in the first quarter Q1 defines a family of tangents, a tangent for each point of the part of the outer curve 28a contained in the first quarter Q1 of length L1'. This family of tangents is schematically depicted in Figs. 5a and 6 as tangents Ta1, Ta2; it is to be understood that the number of such tangents is infinite. Each of the tangents such as Ta1, Ta2, etc. forms an angle with a line formed sectioning the first plane P1 with sectioning plane PT, which in the depicted embodiment coincides with the centerline H1 in a top view of the basement.

[0108] In the following for conciseness only the term centerline H1 is used, however it is to be understood that in this contest centerline H1 means the line defined by the intersection of the first plane P1 with the sectioning plane PT and not the rear centerline of the basement.

[0109] The same above described applies to the part of the inner curve 28b of length L1 included in the first quarter Q1 and for the part of the outer curve 28a of length L2' included in the second quarter Q2.

[0110] Therefore, for each point of inner curve 28b having length L a tangent is present which forms an angle with centerline H1 and for each point of the outer curve 28a having length L' a tangent is present which forms an angle with centerline H1.

[0111] The inner curve 28b is realized as follows.

[0112] All tangents which are tangent to a subsection of all points forming the inner curve 28b which are included in the second half of the basement 24 of length L2, this subsection of points being those points forming at least 90% of the length L2, are - according to the invention - not perpendicular to centerline H1, i.e. the angle between any of those tangents and centerline H1 is different from 90°.

[0113] Preferably, the subsection of points is those points forming at least 90% of the length L2. More preferably, the subsection of points is those points forming at least 95% of the length L2.

[0114] Even more preferably, all tangents which are tangent to a subsection of all points forming the inner curve 28b which are included in the first and in second half of the basement 24 of length L, this subsection of points being those points forming at least 90% of the length L, even more preferably forming at least 95% of the length L, are not perpendicular to centerline H1, i.e. the angle between any of those tangent and centerline H1 is different from 90°.

[0115] Preferably, the outer curve 28a is realized as follows.

[0116] In a preferred embodiment, also all tangents which are tangent to a subsection of all points forming the outer curve 28a which are included in the second half of the basement 24 of length L2', this subsection of points being those points forming at least 90% of the length L2', are not perpendicular to centerline H1, i.e. the angle between any of those tangent and centerline H1 is different from 90°.

[0117] Preferably, the subsection of points is those points forming at least 90% of the length L2'. More preferably, the subsection of points is those points forming at least 95% of the length L2'.

[0118] Even more preferably, all tangents which are tangent to a subsection of all points forming the outer curve 28a which are included in the first and in second half of the basement 24 of length L', this subsection of points being those points forming at least 90% of the length L', even more preferably forming at least 95% of the length L', are not perpendicular to centerline H1, i.e. the angle between any of those tangent and centerline H1 is different from 90°.

[0119] In this way, the duct portion 28 is a "smooth" duct portion, connecting the exit 28in and the outlet 19 without forming any sharp curve or bend. The process air is "gently" channeled towards the outlet 19 from the condenser 31 and turbulences are minimized.

[0120] With now reference to Figs. 5 and 5a, shaft 51 or motor 50 also intersects the duct portion 28 and then exits basement 24 via the outlet 19. A hole is thus formed by the shaft 51 in the first lateral wall 28w1. Sectioning again the lateral wall 28w1 with the sectioning plane PT as depicted in Fig. 5 and 5a, in this preferred embodiment the shaft 51, and more in particular the motor axis M defined by the shaft 51, is not perpendicular to a tangent T to a point P of the inner curve 28b where the motor axis M intersects the inner curve itself. Preferably, motor axis M is parallel to first plane P1 and more preferably motor axis M and rotational axis R of drum 3 are parallel.

Claims

1. A laundry dryer (1) including:

   - a casing (2) rotatably supporting a drum (3) for receiving a load to be dried, said drum (3) being apt to rotate around a drum axis (R), said casing (2) including

     o a rear wall (21) and a front wall (20), an aperture (4a) being realized on said front wall (20) to access said drum (3);
     o a basement (24) defining a basement plane (X,Y) and in which basement (24) a first longitudinal half (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);

   - A process air conduit (18) in fluid communication with the drum (3) where a process air stream is apt to flow;

- A heat pump system (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 heat exchanger (31) and/or said second heat exchanger (32) being arranged in the process air conduit (18) within said first longitudinal half (24 first half) of said basement (24) for the majority of their volume in order to perform heat exchange between said refrigerant flowing in said heat pump circuit and said process air;
- Said process air conduit (18) including a basement air duct formed in said basement (24), said basement air duct comprising a basement duct portion (28) channeling said process air between a process air exit (28in) where process air exits from said first heat exchanger (31) and a process air outlet (19) where process air exits said basement (24), said outlet (19) being located within said second longitudinal half (24 second half) of said basement (24), said basement duct portion (28) including one or more duct walls (28w) which in a section along a sectioning plane (PT) parallel to said basement plane (X, Y) defines an inner curve (28b) and an outer curve (28a), said outer curve (28a) being the curve closer to the rear wall (21) of the casing (2) among the two curves (28a, 28b);
- Wherein a tangent (T1, T2, T3) to said inner curve (28b) of said basement duct portion (28) in said second longitudinal half (24 second half) of said basement (24) forms an angle different from 90° with an axis (H1) formed by a section of said first plane (P1) made by said sectioning plane (PT) for at least between 90% and 100% of the length (L2) of the inner curve (28b) in said second longitudinal half (24 second half).

2. The laundry dryer (1) according to claim 1, wherein a tangent (T1, T2, T3) to said inner curve (28b) of said basement duct portion (28) in said second longitudinal half (24 second half) of said basement (24) forms an angle different from 90° with an axis (H1) formed by a section of said first plane (P1) made by said sectioning plane (PT) for at least between 95% and 100 % of the length (L2) of the inner curve (28b) in said second longitudinal half (24 second half).

3. The laundry dryer (1) according to claim 1 or 2, wherein in said basement (24) a first quarter (Q1), a second quarter (Q2), a third quarter (Q3) and a fourth quarter (Q4) are identifiable by means of the intersection between said first plane (P1) and a second plane (P2) perpendicular to said first plane (P1) passing through a center line (H2) of the basement (24) substantially parallel to said front wall (20) of said casing (2); said process air outlet (19) being realized in said second quarter (Q2), the second quarter being the quarter of the second longitudinal half (24 second half) of the basement (24) closest to the rear wall (21) of said casing (2), and said process air exit (28in) being located in said first quarter (Q1), said first quarter being the quarter of the first longitudinal half (24 first half) of said basement (24) closest to said rear wall (21) of said casing (2), said basement duct portion (28) connecting said exit (28in) to said outlet (19) extending only within said first quarter and second quarter of said basement (24).

4. The laundry dryer (1) according to claim 3, wherein a tangent (T1, T2, T3) to said inner curve (28b) of said basement duct portion (28) in said first quarter (Q1) and said second quarter (Q2) of said basement (24) forms an angle different from 90° with an axis (H1) formed by a section of said first plane (P1) made by said sectioning plane for at least between 90% and 100 % of the total length (L) of the inner curve (28b).

5. The laundry dryer (1) according to any of the preceding claims, wherein said basement (24) includes an upper shell portion (24a) and a lower shell portion (24b), said basement air duct portion (28) being formed by the connection between said upper shell portion (24a) and said lower shell portion (24b).

6. The laundry dryer (1) according to any of the preceding claims, wherein said basement (24) is realized in plastic material and said basement air duct portion (28) is formed integrally to said basement (24).

7. The laundry dryer (1) according to any of the preceding claims, including a fan (12), said fan (12) being located in proximity of the outlet (19) of said basement (24) downstream said first and second heat exchangers (31, 32) in the direction of flow of said process air.

8. The laundry dryer (1) according to any of the preceding claims, wherein said basement duct portion (28) includes a first side wall (28w1) and a second side wall (28w2) wherein the process air is apt to flow, said first and second side walls being substantially perpendicular to said basement plane and defining said inner curve (28a) and said outer curve (28b), respectively, when sectioned along a plane parallel to said basement plane (X, Y).

9. The dryer (1) according to any of the preceding claims, wherein a tangent (Ta1, Ta2) to said outer curve (28a) of said basement duct portion (28) in said second longitudinal half (24 second half) of said

basement (24) forms an angle different from 90° with an axis (H1) formed by a section of said first plane (P1) made by said sectioning plane (PT) for at least between 90% and 100% of the length (L2') of the outer curve (28a) in said second longitudinal half (24 second half).

10. The laundry dryer (1) according to claim 9, wherein a tangent (Ta1, Ta2) to said outer curve (28a) of said basement duct portion (28) in said second longitudinal half (24 second half) of said basement (24) forms an angle different from 90° with an axis (H1) formed by a section of said first plane (P1) made by said sectioning plane (PT) for at least between 95% and 100 % of the length (L2') of the outer curve (28a) in said second longitudinal half (24 second half).

11. The laundry dryer (1) according to any of the preceding claims when dependent to claim 3, wherein a tangent (Ta1, Ta2) to said outer curve (28a) of said basement duct portion (28) in said first quarter (Q1) and said second quarter (Q2) of said basement (24) forms an angle different from 90° with an axis (H1) formed by a section of said first plane (P1) made by said sectioning plane (PT) for at least between 90% and 100 % of the total length (L') of the outer curve (28a).

12. The laundry dryer (1) according to any of the preceding claims, including a motor (50) defining a motor axis (M), apt to rotate said drum (3), said motor axis (M) being parallel to said first plane (P1).

13. The laundry dryer (1) according to claim 12, wherein said motor (50) is located within said second longitudinal half (24 second half) of said basement (24) for the majority of its volume.

14. The laundry dryer (1) according to any of claims 12 - 13, wherein said drum rotational axis (R) and said motor axis (M) are substantially parallel to each other.

15. The laundry dryer (1) according to any of claims 12 - 14, wherein said motor includes a motor shaft (51) defining said motor axis (M), said shaft (51) passing through said duct walls (28w), and a tangent (T) in a point (P) where said motor axis (M) intersects said inner curve (28b) forms an angle different from 90° with said motor axis (M).

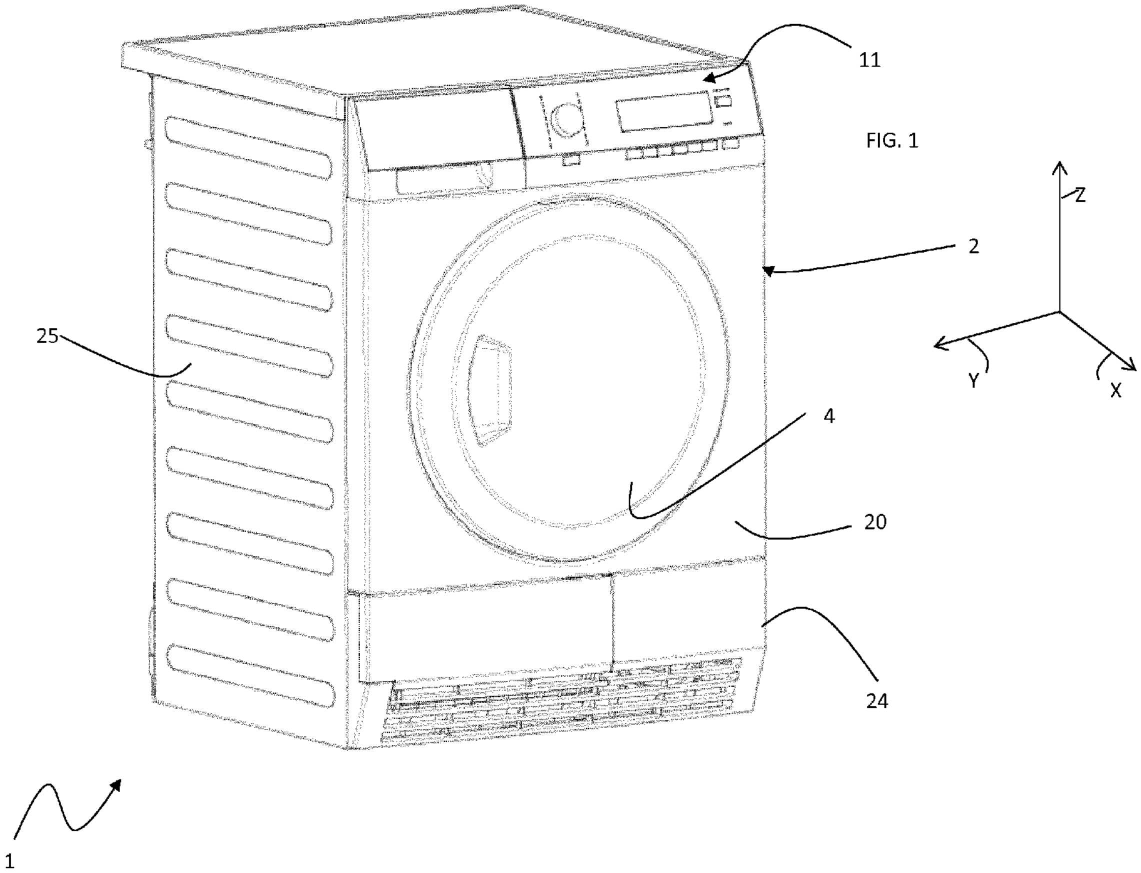

FIG. 1

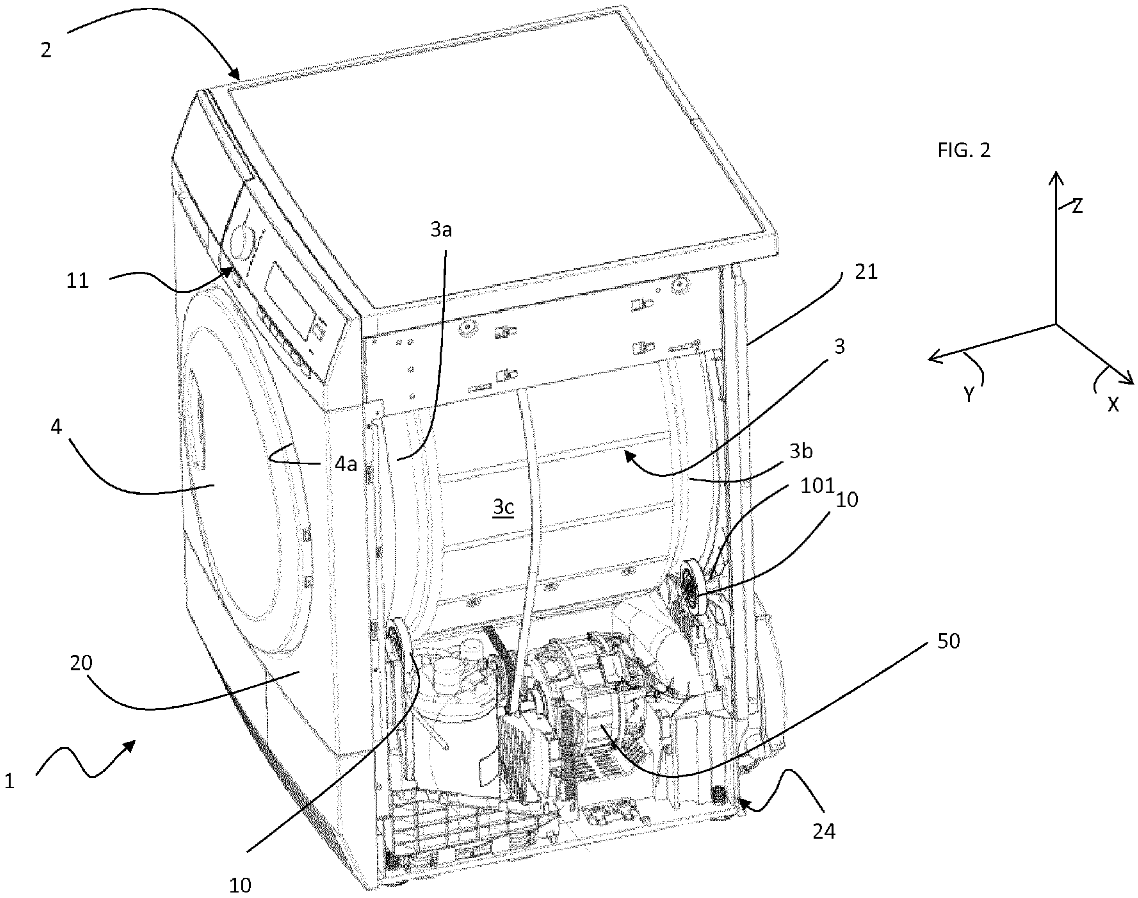

FIG. 2

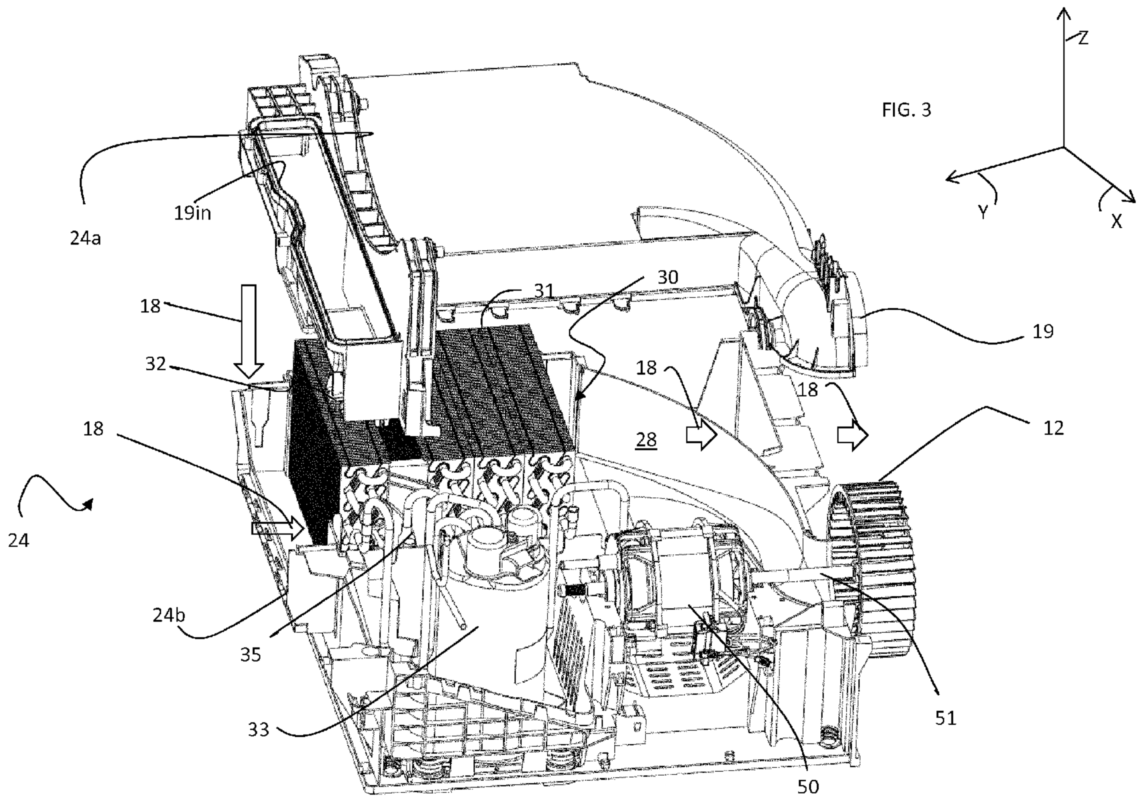

FIG. 3

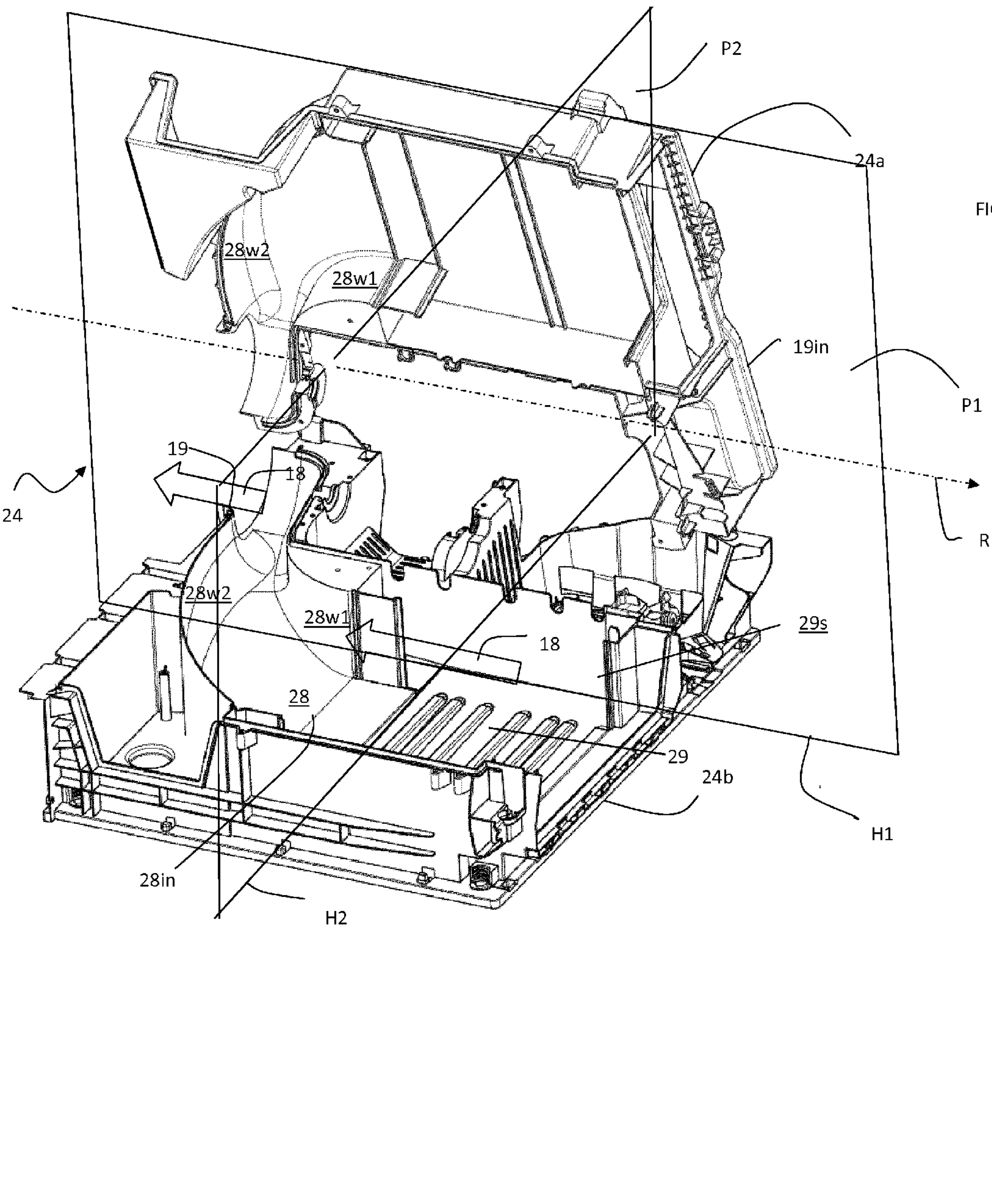
P2
24a
28w2
28w1
19in
P1
19
18
24
R
28w2
28w1
18
29s
28
29
24b
H1
28in
H2

FIG. 4

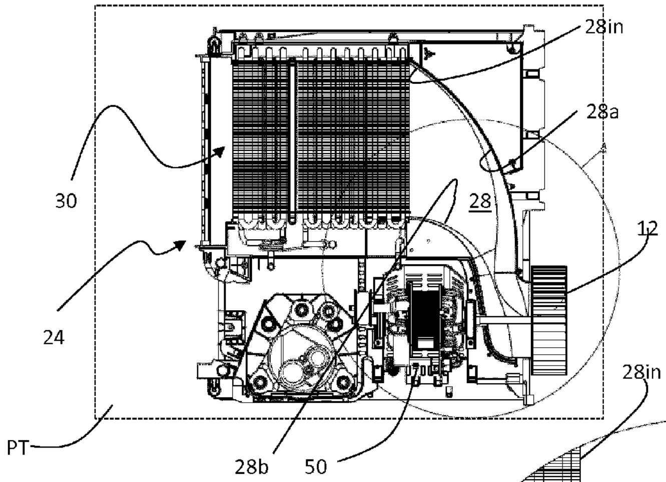
28in
28a
30
28
12
24
PT
28b
50

FIG. 5

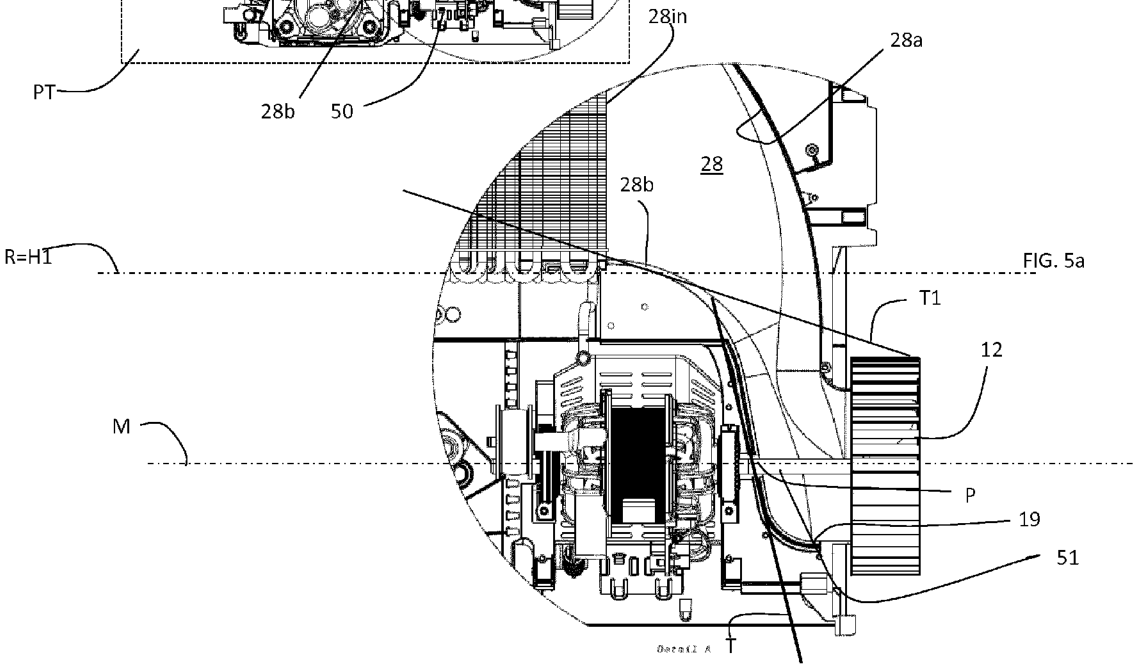
28in
28a
28
28b
R=H1
T1
12
M
P
19
51
T
Detail A

FIG. 5a

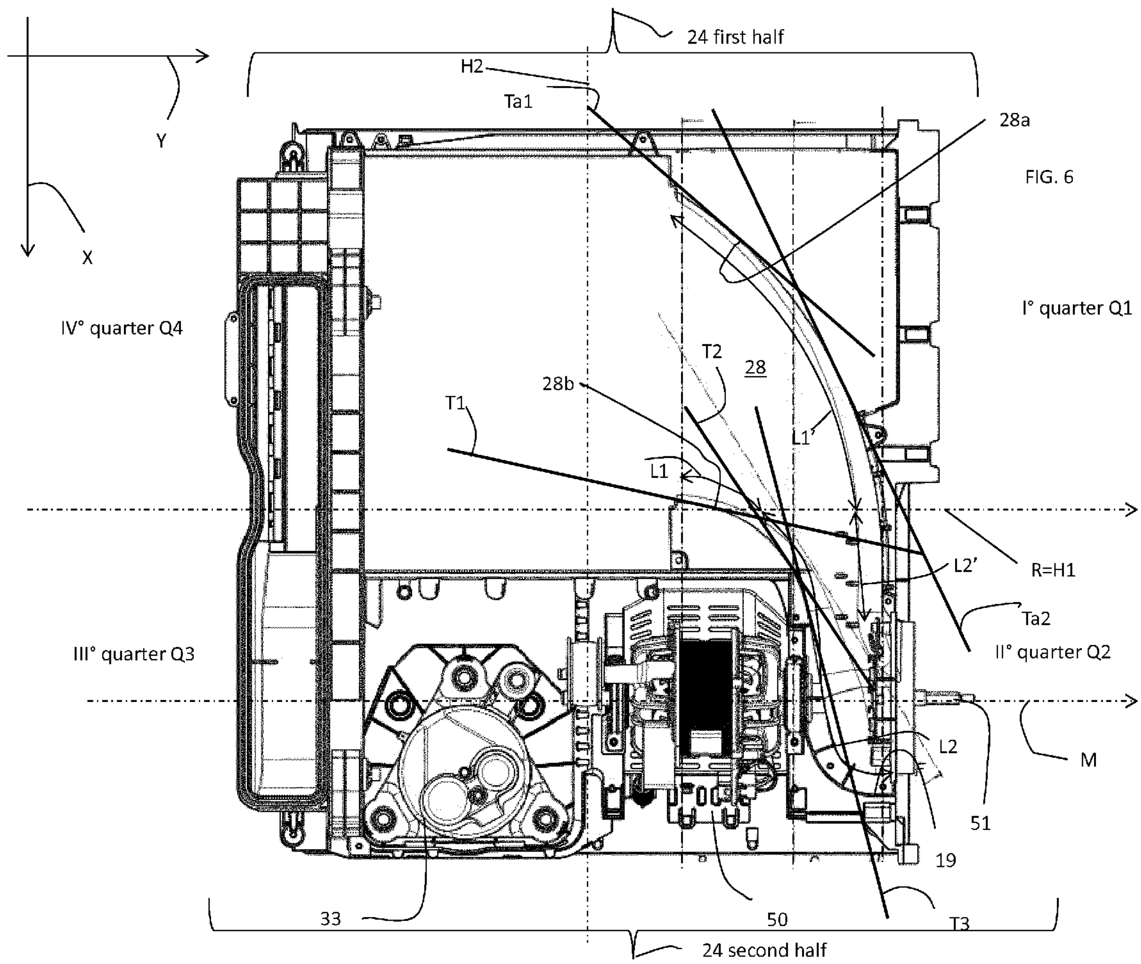
24 first half
H2
Ta1
28a
Y
X
IV° quarter Q4
I° quarter Q1
T2
28
28b
T1
L1'
L1
L2'
R=H1
Ta2
III° quarter Q3
II° quarter Q2
L2
M
51
19
33
50
T3
24 second half

FIG. 6

PRIOR ART

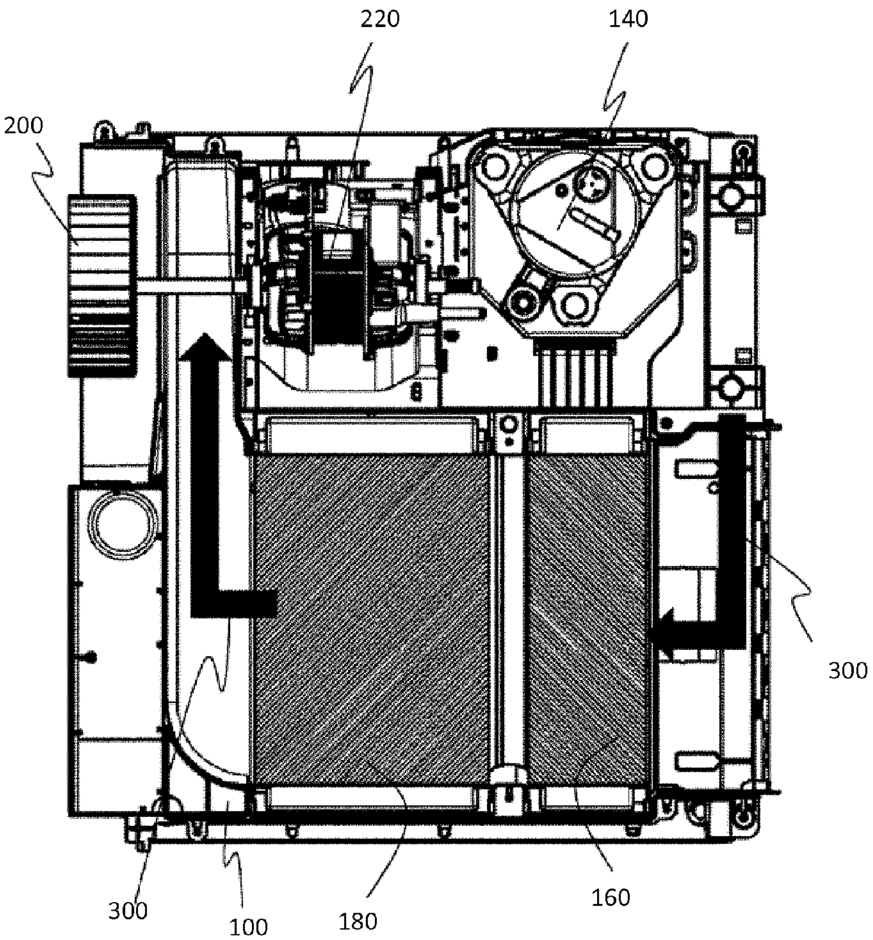

FIG. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 14 18 2921

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 527 528 A1 (ELECTROLUX HOME PROD CORP [BE]) 28 November 2012 (2012-11-28) * paragraph [0008] - paragraph [0010] * * paragraph [0023] - paragraph [0024] * * paragraph [0040] - paragraph [0042] * * paragraph [0049] - paragraph [0051] * * paragraph [0064] - paragraph [0070] * * figures 1-4 * -----	1-15	INV. D06F58/20 D06F58/04 ADD. D06F58/24
A	EP 2 199 452 A1 (SANYO ELECTRIC CO [JP] HAIER GROUP CORP [CN]; QINGDAO HAIER WASHING MA) 23 June 2010 (2010-06-23) * paragraph [0008] - paragraph [0012] * * paragraph [0014] - paragraph [0029] * * paragraph [0043] - paragraph [0048] * * figures 1-10 * -----	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F

The present search report has been drawn up for all claims

3

Place of search	Date of completion of the search	Examiner
Munich	20 February 2015	Bermejo Pasetti, M

CATEGORY OF CITED DOCUMENTS

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