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(54) **LAUNDRY DRYER**

(57) The present invention relates to A dryer (1) comprising:
- a casing (10) including a basement (3) having an upper shell (14) and a lower shell (113), said upper (14) and lower shells (13) being apt to be connected together in order to form said basement (3), said casing (10) defining an inner volume;
- a laundry chamber (6) suitable to receive the laundry to be dried;
- a process air circuit (4) for circulating process air into said laundry chamber (6);
- a condensing device (40) for removing moisture from the process air coming from said laundry chamber (6);
- a water collecting housing (12) formed in said basement (3) and located inside said inner volume for the collection of condensation water formed by said condensing device (40);
- A water removing unit (18) associable to said water collecting housing (12) for the removal of water therein comprising a pump unit (22) and a support body (21) to support said pump unit (22), said water removing unit (18) being located inside said inner volume;
- Wherein said support body (21) is integral in a single piece construction with said upper shell (14) or said lower shell (13) and includes at least a pump coupling element (27) for coupling said pump unit (22) onto said support body (21), said coupling element (27) protruding outwardly from said upper shell (14) or from said lower shell (13).

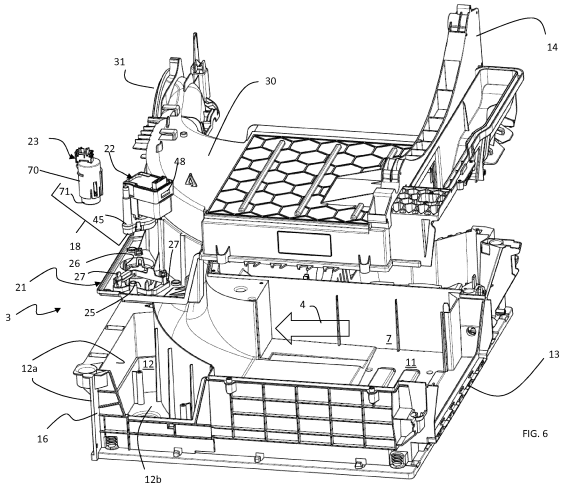


FIG. 6

EP 3 124 684 A1

Description

FIELD OF THE INVENTION

[0001] The present invention concerns the technical field of laundry drying machines. In particular, the present invention refers to laundry drying machines of the condenser type. The laundry machine of the invention has an improved construction so that the maintenance and exchange of parts is easier.

BACKGROUND ART

[0002] Nowadays the use of laundry drying machines, both "simple" laundry drying machines (i.e. laundry machines which can only dry laundry) and laundry washing-drying machines (i.e. laundry washing machines which can also dry laundry), is widespread.

[0003] In the present description the term "laundry drying machine" or "dryer" will refer to both simple laundry drying machines as well as laundry washing-drying machines.

[0004] Dryers capable of carrying out a drying process on laundry generally comprise a casing that houses a laundry chamber, like a rotating drum, where laundry to be dried is received. The dryer comprises a process air circuit for carrying out drying operation by circulating drying air through the laundry chamber. The circulation of process air is obtained for example by means of a fan and preferably also heating means are provided in the air circuit for heating the process air.

[0005] In condenser type dryers, condensing means are further provided in the process air circuit for removing moisture from drying air passing through the laundry thereby allowing said air to be recirculated cyclically in the chamber through the air circuit. Condensing means of the known type are usually arranged in the lower part of the dryer. In known condenser type laundry dryers, said means for condensing the moist air coming from the laundry chamber are configured in many different ways. For example, the condensing means may comprise a heat exchanger - an embodiment of which is an air-to-air heat exchanger - arranged in a basement portion of the dryer. The moist air coming from the laundry chamber flows through the heat exchanger and condensation water is formed therein.

[0006] Other type of dryers belonging to the art may comprise a heat pump which both dehumidifies and heats the process air. The heat pump typically comprises a closed circuit formed by an evaporator, a condenser and a compressor. The heat pump is typically arranged in the basement portion of the dryer and the moist air coming from the laundry chamber passes the evaporator so that moisture of the process air is removed. Like in the case of a single heat exchanger, condensation water is formed therein.

[0007] Condensation water formed in the condensing means is typically collected in a collecting housing, preferably located in the basement. The water in the collecting housing is then conveyed to a moisture tank arranged on the upper portion of the dryer so that it can be easily and periodically emptied by a user. The moisture tank is preferably in the form of a drawer slidably arranged on said upper portion of the dryer. In order to convey the water from the collecting housing to the tank, a water-removing unit is provided at said collecting housing.

[0008] The water-removing unit preferably comprises pumping means which are advantageously activated on the base of the water level inside the collecting housing. For this purpose, as an embodiment, a level sensor may also be provided at the collecting housing. Pumping means typically comprises an electric pump and a conveying pipe connecting the pump to the tank. Furthermore, an overflow pipe is usually provided between the tank and the collecting housing which permits the water from the tank to be re-admit into the collecting housing when the tank is full.

[0009] However, the removing unit above described belonging to the known art poses some drawbacks.

[0010] A first drawback posed by this known technique is constituted by the fact that the removing unit is composed by a great number of pieces. This determines a complex structural construction for the unit which increases the manufacturing costs of the unit and of the dryer.

[0011] A further drawback posed by this known technique is constituted by the relatively long time necessary in case of fault or breakage of any of the components of the water removing unit, such as the pump, for example in order to repair or substitute it. This is due to the location within the laundry drying machine where generally such unit is positioned, which requires to remove many components of the drying machine in order to access it.

[0012] Applicants have already proposed two solutions of the above mentioned problems.

[0013] EP2620541 discloses a laundry drying machine comprising a casing, a laundry container suitable for receiving the laundry to be dried, an air circulating device for circulating hot air through the laundry container, a condensing device for removing moisture of moist air coming from the laundry container, a water collecting housing for the collection of condensation water formed by the condensing device, a water-removing unit is associable to the water collecting housing for the removal of water therein comprising a supporting body suitable for receiving a pumping unit and a water level sensing device, the supporting body may comprise cover element which is obtained in a single piece construction with the supporting body, the supporting body may comprise at least a portion of the water level sensing device which is obtained in a single piece construction with the supporting body and/or a seat for receiving a pipe therein and comprises a fastening device which is obtained in a single piece construction with the supporting body for fixing the pipe in the seat.

[0014] EP2620540 relates to a laundry drying machine

comprising a casing, a laundry container suitable for receiving the laundry to be dried, an air circulating device for circulating hot air through the laundry container, a condensing device for removing moisture of moist air coming from the laundry container and a basement portion comprising a water collecting housing for the collection of condensation water formed by the condensing device. A water-removing unit is associable to the water collecting housing for the removal of water therein and comprises a supporting body suitable for receiving a pumping unit. The supporting body is obtained in a single piece construction with the basement.

[0015] However, in both these documents, the water removing unit is located at the back of the drying machine, thus in case of repair repositioning of the machine is generally necessary because the back is commonly facing a wall or furniture.

DISCLOSURE OF THE INVENTION

[0016] The aim of the present invention is therefore to solve the noted drawbacks and thus providing a dryer having an improved water-removing unit arrangement.

[0017] It is a first object of the invention to implement a dryer that makes it possible to reduce manufacturing time and costs. A further object of the present invention is to provide a dryer that makes it possible to simplify maintenance.

[0018] It is a further object of the invention to implement a dryer that makes it possible to increase reliability of the dryer.

[0019] Applicants have noted that in a dryer in which the basement is formed by the combination of two shells, an upper and a lower shell, which are joined together and defines the outer boundaries of the basement, the optimal place to realize the water removal unit is the upper shell or the lower shell of the basement itself, so that it can be easily accessible and few components of the dryer need to be removed in order to change parts of the water removal unit. Further, the coupling between the parts of the water removal unit and the upper shell is optimized as well.

[0020] According to an aspect, the invention is relative to a dryer comprising:

- a casing including a basement having an upper shell and a lower shell, said upper and lower shells being apt to be connected together in order to form said basement, said casing delimiting an inner volume;
- a laundry chamber suitable to receive laundry to be dried;
- a process air circuit for circulating process air into said laundry chamber;
- a condensing device for removing moisture from the process air coming from said laundry chamber;
- a water collecting housing formed in said basement and located inside said inner volume for the collection of condensation water formed by said condensing device;
- a water removing unit associated to said water collecting housing for the removal of water therein comprising a pump unit and a support body to support said pump unit, said water removing unit being located inside said inner volume;
- wherein said support body is integral in a single piece construction with said upper shell or with said lower shell and includes at least a pump coupling element for removably coupling said pump unit onto said support body, said coupling element protruding outwardly from said upper shell or from said lower shell.

[0021] The dryer of the invention can be either a "single" drying machine or a "combined" washer-dryer machine, therefore including any appliance having laundry drying function. Further, it may be a front-loading dryer, which means that a laundry chamber in which the laundry is located has an axis which is positioned in a horizontal manner or slightly tilted with respect to the horizontal plane, or a top laundry dryer, where the axis of the laundry chamber is substantially vertical.

[0022] In a preferred embodiment, the laundry dryer is a front loading laundry dryer.

[0023] Preferably, the laundry chamber is apt to rotate around its axis, e.g. it is a drum.

[0024] The dryer comprises a casing preferably including a front wall, a rear wall, side walls and a base section or basement. The front wall may comprise a front top panel to command the functioning of the machine by the user. Further, preferably, the casing includes a door hinged to the cabinet, e.g. to the front wall in case of a front loading dryer, which is openable in order to introduce the laundry in the laundry chamber.

[0025] The casing defines the limit between the internal or inner volume of the dryer and the exterior of the dryer. The casing is thus a boundary element dividing the space in an inner volume where the various components of the dryer are placed and the rest. In order to access any component of the dryer located inside the inner volume defined by the casing, the casing itself need to be opened. For example, a component located inside the inner volume enclosed by the casing can be accessed by opening the door or dismounting one of the walls of the casing.

[0026] The basement is divided in an upper and a lower shell. The upper and lower shells define the outer boundaries of the basement, dividing a volume "inside" of the basement and an "outside" to the basement, in an analog manner to the casing. A component located inside the inner volume defined by the basement is also automatically inside the inner volume defined by the casing, being the basement part of the casing. In the basement a front side, a back side and two lateral sides can be defined as well, which are contiguous to the front, rear and lateral walls of the casing, when the dryer is fully assembled.

[0027] According to the invention, a water collecting housing is realized in the basement and furthermore it is located inside the inner volume defined by the casing.

The water collecting housing can be realized in the upper shell, in the lower shell, in both (for example both shells forming superimposing bowl shape portions) or between the two. In the latter case, the water collecting housing is formed also inside the inner volume defined by the basement. The water collecting housing is apt to collect the water which condenses due to the presence within the air process circuit of a condensing device. The condensed water is thus collected into the water collecting housing and preferably it needs to be regularly removed in order to avoid any overflow within the basement.

[0028] The condensing device of the present invention includes preferably a heat exchanger. In an embodiment such a heat exchanger includes an air-to-air heat exchanger. In a different embodiment, the laundry dryer includes a heat pump and the condensing device includes the evaporator of the heat exchanger.

[0029] Preferably, a suitable duct or a plurality of ducts connects the location where the condensed water is formed, for example a surface or basin below the condensing device where water drips, to the water collecting housing.

[0030] Preferably, the condensing device is located inside the inner volume defined by the basement, that is, between the upper and lower shells. Even more preferably, such duct(s) to channel the condensed water to the water collecting housing are realized integral to said lower shell. Preferably, the surface or basin onto which the condensed water drips is also integral to the lower shell. Preferably, also the water collecting housing in realized integral to the lower shell of the basement.

[0031] In the following with the term "realized integral to" means that the element discussed is realized as a single unit together with another element, without discontinuities. A first element realized integral to a second element thus means that the two are a single piece, a unitary body.

[0032] The removal of the water from the housing in the basement takes place by means of a water removing unit.

[0033] The water removing unit includes a pump unit which pumps the water out from the water collecting housing. The water can be pumped from the housing for example to a tank positioned in an upper part of the dryer. This tank in generally realized as a drawer, so that the excess water can be removed by the user. However other possibilities are foreseen as well, for example the removal of the water takes place by the pump and it is discharged directly to the drain. In order to pump the water away from the housing, the pump unit is at least for a portion introduced inside the water collecting housing.

[0034] The water removing unit is also located inside the inner volume defined by the casing. Preferably, it is located for a portion on top of the basement and for a portion inside the inner volume defined by the basement.

[0035] In order to support the pump unit so that a portion of it can be inserted into the water collecting housing, for example immersed in the condensed water when present, a support body is provided. According to the invention, the support body in realized integral to the upper shell or to the lower shell forming the basement. Preferably, the support body is realized integral to the upper shell.

[0036] Support body may support other elements in addition to the pump unit, for example tubing to connect the pump unit to the upper tank above described or a water level sensing device to detect the level of water in the hosing and activate the pump unit consequently.

[0037] In order to couple the pump unit to the support body, a coupling element is provided extending from the upper (or lower) shell. The coupling element extends from the upper (or lower) shell in a direction outside the basement, e.g. towards the exterior of the basement, so that it can be reached easily. The coupling is of a removable type, that is the coupling between the pump unit and the support body is made in such a way that the pump unit can be removed from the support body without breaking or dismounting the latter, in case there is any malfunctioning or breakage of the pump unit.

[0038] Due to the above mentioned construction, few elements are necessary for the realization of the water removal unit. The basement, having the upper and lower shell, integrates within these two shells substantially all elements of the water removal unit. The support body is a portion of the upper (lower) shell to which the components of the water removal unit are coupled, such as the pump unit. Therefore, no additional element is needed in addition to the basement in order to mount the pump unit, simplifying the overall construction of the dryer as well as its assembly.

[0039] Further, the coupling between the pump and the support body takes place by means of at least a coupling element. This element - as said - protrudes outwardly from the upper or lower shell, depending on where the support body is formed, which means that it protrudes outwardly from the basement, it is not extending in the inner volume defined by the basement, but on the contrary it is extending outside the inner volume defined by the basement. The coupling element is however still inside the inner volume defined by the casing. The coupling between the pump unit and the support body therefore takes place outside the basement. In the event of breakage or malfunctioning of the pump, the outer coupling can be decoupled easily without the need of removing or disassembling too many components of the dryer, in particular without dismounting the basement itself. The pump unit can be mounted and decupled from the outside of the basement, thus allowing an easy mounting and maintenance.

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

[0041] Preferably, said pump coupling element is integral in a single piece construction with said support body.

[0042] That is, in order to further limit the number of separated parts to be assembled in the dryer of the in-

vention, the coupling element is an integral part of the support body and thus in turn of the upper or lower shell.

[0043] Preferably, said water collecting housing is integral in a single piece construction with said lower or upper shell.

[0044] A further minimization of the number of dryer's component is preferably obtained using as a single "multipurpose" unit the lower or upper shell of the basement. The water collecting housing where water is collected thus includes a basin directly formed in the lower or upper shell, without a further introduction of a detached/detachable water collecting housing to be inserted in the basement. Preferably the water collecting housing is integral to the lower shell. More preferably, the water collecting housing includes lateral walls and a bottom wall which are preferably integrally formed in a single piece construction with the lower shell.

[0045] Preferably the support body thus defines a cover for the water collecting housing formed in the lower shell or the upper shell and it is located substantially on top of it.

[0046] Preferably, said basement defines a basement plane parallel to the ground on which the dryer stands and said support body is formed in a portion of said upper shell or lower shell which is substantially flat and has a major component parallel to said basement plane.

[0047] In a standard operative position, a dryer in a three-dimensional coordinate system defines a substantially horizontal plane which is the basement plane and a vertical axis, which is the vertical direction along which the dryer extends from the floor. Preferably, the upper shell or lower shell includes a flat region, or a region which is for the majority substantially flat, which is substantially parallel to the basement plane itself and defines the support body. In this case, "substantially parallel" means that a projection of the flat region onto the basement plane is the largest projection among the projections of the flat region on the basement plane and on a plane perpendicular to it.

[0048] This means that the support body includes a flat portion of the upper or lower shell which in turn comprises a surface that "faces upwards" - at least for most of it - in the basement. This adds simplicity in the mounting and dismounting all elements attached/coupled to the support body because it can be more easily reached.

[0049] Preferably, said basement includes a channel for said process air, part of said process air circuit, said channel channeling process air from said condensing device to an exit so that process air can exit said basement, said support body being formed in said upper shell or in said lower shell in a location between said casing and an external wall of said channel.

[0050] The basement generally includes a portion of the air process circuit, so that the humidity contained in the process air coming from the laundry chamber is removed by the condensing device, preferably also heated and recirculated into the laundry chamber. From the condensing device to the laundry chamber, a channel is present, part of the air process circuit, so that the process air exiting the condensing device can be guided outside the basement in order to be transported back into the laundry chamber. Preferably, this channel is integral to the basement. The channel, together with the casing of the dryer, preferably delimits the volume where the support body is formed in the upper or lower shell. The position of the support body is selected being both easily reachable from the exterior of the dryer (which means with a minimum number of dryer's components to be removed) and also in such a way that the outline of the basement does not have to be excessively modified. Indeed, in the basement generally a plurality of "bulky elements" are present and the repositioning of the same is often very complex and cumbersome.

[0051] Changing the outline of the basement, and in particular the positioning of the various components, especially in case of a heat pump dryer, is very complex due to the fact that certain components' dimensions are substantially fixed and the volume of the basement is limited by construction constraints. Therefore, it is preferred to determine the location of the cover so that only minimal changes in the positioning of the components, in particular of the heat pump if present, are needed.

[0052] More preferably, said external wall of said channel is integral in a single piece construction with said upper shell or with said lower shell.

[0053] Advantageously, the channel itself is formed by the basement's shells, and it is defined by joining together the upper and the lower shell. Preferably an upper half of the channel including the external wall is formed integral to the upper shell and a lower half of the channel is formed integral to the lower shell. Again, the number of elements to be assembled in the laundry dryer of the invention is in this way reduced.

[0054] Preferably, said casing includes two lateral walls and a back wall, and said support body is located between said channel and said casing, in proximity of a corner formed by one of said lateral walls and said back wall.

[0055] The basement of the laundry dryer can be considered as divided in four quarters. The quarters are defined by planes perpendicular to the basement plane and passing through two perpendicular centerlines in a top view of the basement itself. The quarters are called first, second, third and fourth in a clockwise manner starting from a first quarter including a portion of the rear side of the basement, that is a side facing the rear wall of the casing, and a portion of the lateral side of the basement. Preferably, the channel is formed in the first and the second quarter, at least for the majority of its volume; thus the support body is also located in either the first or the second quarter. Preferably it is located within the first quarter. This outline is again preferred so that the number of changes in the positions of the elements already present in the basement is minimized. Generally, the channel is formed within the first and second quarter to channel air from the condensing unit, generally occupy-

ing the fourth quarter, to the exit located in the second quarter. Due to the shape of the channel, which is in a preferred embodiment curved with a concavity towards the center of the basement, some volume not yet occupied can remain between the channel external wall and the casing, substantially in proximity of a corner formed by the back wall and the side wall of the casing of the laundry dryer (this corner is also a corner of the basement).

[0056] Further, this position allows access to the support body and housing simply removing one of the side walls of the casing. No further dismounting of the laundry dryer is needed.

[0057] Advantageously, said pump coupling element extends substantially in a vertical direction when said dryer is in a standard operative position.

[0058] The positioning of the coupling element in substantially a vertical direction, that is the coupling element extends along a direction the major component of which is parallel to the vertical axis, allows an easier removal of the pump unit which consists of a simple extraction of the pump unit from the support body, without the need of disassembling the basement. A simple removal of one of the walls of the laundry dryer, such as a side wall, is enough to access the water removing unit and thus the pump unit.

[0059] Preferably, said pump coupling element includes a snap-in coupling element.

[0060] A snap-in element allows a simple attachment and detachment of the pump unit. Preferably more than a single snap-fit element is included. Preferably, two snap-fit elements are present.

[0061] In a preferred embodiment, said upper and lower shells are realized in polymeric material.

[0062] The usage of polymers allows the molding of the shells and realization of many elements integral to the shells in a simple and relatively economical manner. Polymeric materials are very versatile and easy to manufacture, therefore they are a very good candidate for the realization of the shells which preferably integrate different functionalities and components into themselves.

[0063] Preferably the upper and lower shells are molded, more preferably injection molded.

[0064] Preferably, said support body includes an aperture for the introduction of a portion of said pump unit into said water collecting housing.

[0065] The pump is attached to the support body and for at least a portion is introduced within the water collecting housing which is realized within the lower or upper shell (e.g. inside the basement). In order to reach such water collecting housing, an aperture is formed in the support body.

[0066] More preferably, said aperture is so located within said support body that said introduction of said portion of said pump unit into said water collecting housing takes place by means of a downward movement.

[0067] As already mentioned, the pump unit is preferably coupled to the support body by means of a downward movement which means that the support body has at least a substantially horizontal portion where the pump is connected to. This renders the substitution of the pump unit easy.

[0068] Advantageously, said support body is delimited by a pre-marked breaking line, so that it is apt to be separated from the rest of said upper or lower shell by breaking the upper shell along said line.

[0069] In case not only the pump needs to be changed, but further elements of the water removing unit are to be changed or repaired, preferably the upper or lower shell includes a pre-cut line or any other line having lower breaking resistance, so that the water removing unit can be detached from the upper or lower shell without the need of having to remove the whole upper or lower shell itself. The water removal unit can be detached from the rest of the upper or lower shell breaking the shell along the pre-formed or pre-marked breaking line. The so called "line" can have any geometrical shape or contour.

[0070] In a preferred embodiment, the water removing unit includes a water level sensor, said support body including a seat apt to receive said water level sensor.

[0071] In order to remove water from the water collecting housing using the pump unit only when necessary, a water level sensor is preferably provided, so that the level of the condensed water inside the housing is measured and only when such level exceeds a predetermined threshold level, the pump unit is activated and the condensed water removed, for example towards the tank. Preferably, this water level sensor is coupled to the water removal unit by means of the same support body supporting the pump unit, again to minimize the amount of elements forming the water removal unit. The water level sensor is preferably located for at least a portion in the water collecting housing, so that the water level can be measured.

[0072] Preferably, said dryer includes a level sensor coupling element for coupling said water level sensor to said support body.

[0073] The coupling of the water level sensor and the support body can be obtained for example in the same way as the coupling between the pump unit and the support body.

[0074] More preferably, said level sensor coupling element is integral in a single piece construction with said support body.

[0075] A further minimization of the components takes place, so that the upper or lower shell includes all the elements and components to have the water removing unit mounted onto the dryer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0076] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate possible embodiments of the invention and together with the description serve to explain the

principles of the invention. In the drawings, corresponding characteristics and/or components are identified by the same reference numbers. In particular:

- Figure 1 shows a perspective view of a laundry drying machine with a wall removed in order to show a water-removing unit mounted therein according to the invention;
- Figure 2 shows a perspective view of a basement of the laundry drying machine illustrated in Figure 1;
- Figure 3 shows a top view of the basement of Figure 2;
- Figure 4 shows a side view in section of a portion of the basement of Figure 2;
- Figure 4a shows a side view in section in an enlarged scale of a detail of Figure 4 delimited by a circle;
- Figure 5 shows a perspective view of the basement of the laundry drying machine of Figure 2 with the water-removing unit partly removed;
- Figure 6 shows an exploded perspective view of the basement of the laundry machine of Figure 2 in a disassembled configuration;
- Figure 7 shows a perspective view of lower shell of the basement including the heat pump; and
- Figure 8 shows a lateral view in section of the basement of Figure 2.

DETAILED DESCRIPTION OF THE INVENTION

[0077] With initial reference to figure 1, a dryer according to the invention is globally indicated with 1.

[0078] In the present detailed description the term "laundry drying machine" or "dryer" will refer to both simple laundry drying machines and combined laundry washing and drying machines. The preferred embodiment is relative to a heat pump laundry drying machine, however to any type of dryer including a condensing unit the invention can be applied.

[0079] The dryer 1 comprises a casing 10 formed advantageously by a front and a back wall 2a, 2b and a couple of side walls 2c-2d arranged perpendicularly one another. An upper wall 2e closes the top end of the box-like structure formed by the walls 2a-2d. However, some of the mentioned walls need not to be vertical, a one or more tilted wall are foreseen as well. In Figure 1, the lateral side wall 2c has been removed for showing some of the dryer parts accommodated within casing 10.

[0080] Further, the casing 10 includes a basement 3, better detailed below, onto which the walls 2a-2d are connected and it represents the lower portion of the dryer 1. The basement also defines a front side, back side and lateral sides which represent the external boundaries of the basement 3 and correspond to the front, back and lateral walls, respectively, of casing 10.

[0081] The volume delimited by the walls 2a, 2b, 2c, 2d and 2e and the basement 3 is the inner volume of the casing.

[0082] The casing 10 defines in a three-dimensional coordinate system a horizontal plane (X,Y) also called basement plane, and a vertical axis Z, along which the dryer 1 extends from the floor on which is commonly positioned in an operative position.

[0083] A laundry chamber 6, preferably comprising a rotatable drum, is provided within the casing 10. In case of a combined clothes washing and drying machines, the rotatable drum is opportunely contained in a washing tub (not depicted in the attached drawings). A lateral part of the drum 6 is visible in figure 1. The axis of rotation of the drum 6 is called R, and it can be vertical, horizontal or tilted depending on the type of dryer considered. In a preferred embodiment, the rotational axis R is substantially horizontal or slightly tilted from the horizontal plane (X, Y).

[0084] Casing 10 preferably further includes a front door 8 pivotally coupled to the front upright side wall 2a for allowing access to the drum interior region to place laundry to be dried therein. A user control interface 5 is preferably arranged on the top of the casing 10 for input of laundry drying programs and displaying machine working conditions.

[0085] The dryer 1 further comprises a process air circulating circuit 4, depicted as plurality of arrows in figure 1, adapted to circulate a flow of process air in and out of the drum 6. The process air circulating circuit advantageously comprises a fan, not illustrated, which blows a flow of drying air through the drum 6. The air circulating circuit preferably comprises a heating device, adapted to heat up the air at a location upstream of the drum 6. Preferably, in the present embodiment the heating device is included in a heat pump 40, shown for example in figure 7, for example it includes a condenser 42 of the heat pump. Alternatively, an electric heater can be used as well, when a heat pump is not present, or even in combination with the heat pump.

[0086] Circulation of the process drying air inside the drum 6 evaporates the moisture from the wetted laundry so as to form a moisture-laden process air, or moist process air. The moist process air then exits the drum 6 preferably at the front side of the dryer 1, as depicted in figure 1. With reference to figs. 6, 7 and 8, the moist process air enters into the basement 3 where the moisture included in the process air is at least partially removed by means of a condensing device, in this case the evaporator 41 of heat pump 40, or alternatively a heat exchanger, such as an air-to-air heat exchanger. In figures 5 and 8, where the basement 3 of casing 10 is shown only partially, a heat exchanger casing 7 is shown apt to house the condensing device, in the depicted embodiment both heat exchangers (condenser 42 and evaporator 41) of heat pump 40. In the figure 6, the heat exchangers 41, 42 have been removed to show the casing's details.

[0087] In this case moist air passes the evaporator 41 and is cooled by the evaporator itself. The evaporator condenses the water vapor of the moist air and the water formed therein falls in a bottom surface 11, better detailed below.

[0088] The process air conduit 4 then exits the basement 3, preferably from the back of the basement, and the process air is fed again to the drum 6.

[0089] The basement 3, with now reference to figures 2, 3, 5, 7 and 8, includes a lower shell 13 and an upper shell 14, which are coupled together defining the basement. The upper shell 14 forms the upper portion of the basement, while the lower shell 13 forms the lower portion of the basement. Both upper and lower shells form together the front, back and lateral sides of the basement. Preferably, the upper and the lower shell 14, 13 are realized in plastic material and are preferably formed in a molding process. In the basement, thus as internal volume to the shells can be defined as the "interior" to the basement, delimited by the two shells.

[0090] Preferably, the process air conduit 4 includes a basement portion which is formed as a combination of the upper and lower shell 14, 13, that is the basement portion of the process air conduit is divided in two half, a lower half and an upper half, each half realized integral to with the respective shell, defining an air process duct basement portion.

[0091] The basement portion of the process air circuit includes the casing 7 for the heat pump 40 and a channel 30, located downstream of the casing 7 in the direction of flow of the process air, which channels the process air exiting the condenser 42 of the heat pump 40 outside the basement 3. Channel 30 and casing 7 are visible for example in figure 6 and are better detailed below.

[0092] The casing 7 for the heat exchangers 41, 42 includes a bottom surface, which in turn comprises the bottom surface 11 on which the condensed water drips from the evaporator 41.

[0093] Preferably, the bottom surface 11 is realized as an integral part of the lower shell 13.

[0094] Further, dryer 1 includes a water collecting housing to collect the condensed water. By means of duct(s) or channel(s), such as duct 50 visible in figures 7 and 8, from the bottom surface 11 the condensed water is collected in the water collecting housing 12. The collecting housing 12 is arranged in the inner volume defined by the basement 3 of the dryer 1, between upper 14 and lower shell 13. Preferably, the water collecting housing includes lateral walls 12a surrounding the housing and a bottom wall 12b. Water collecting housing 12 is also preferably integral to the lower shell 13, that is bottom wall 12b and lateral walls 12a are a unitary single part with the lower shell 13. More preferably, the water collecting housing 12 is arranged at the rear side of the lower shell 13 of the dryer 1, as illustrated in Figure 1. Preferably, two lateral walls 12a of the housing 12 are adjacent to a corner 16 formed in the basement 3. Preferably, the housing 12 is formed in a corner 16 of the basement 3, so that two lateral walls 12a of the housing 12 are two portions of the back side and of one of the two lateral sides of the basement 3.

[0095] Preferably duct 50 is located substantially parallel to one of the lateral sides of the basement. More preferably it is located in proximity of one of the lateral side of the basement 3; that is, between the heat pump 40 and the boundary of the basement 3.

[0096] With now reference to fig. 8, duct 50 ends in housing 12 defining an inlet 51 for the condensed water. In order to better channel condensed water accumulated in surface 11 to housing 12, preferably duct 50 is slightly vertically tilted, that is a point of a bottom surface 50a of duct 50 at surface 11 is higher in the vertical direction than a point at the inlet 51, so that water flows to water collecting housing 12 by gravity. Further, preferably duct 50 includes a siphon - shaped section 52 which also allows a better channeling of the water inside the housing 12. In the preferred embodiment shown, the siphon - shaped section 52 is realized at inlet 51, so that water can easily enter housing 12 passing lateral walls 12a.

[0097] Furthermore, in addition to the condensing device - heat pump 40 -, on or inside the volume defined by the basement 3 are preferably arranged other operational devices of the dryer, like air pumping means or electric motors. Advantageously, the upper and lower shells 14, 13 of basement 3 are opportunely shaped so as to create air paths wherein the air is opportunely conveyed. Further, in case of a heat pump dryer, the basement 3 also hosts a compressor 43 of the heat pump. These operational devices or components preferably are arranged in a specific outline within the basement 3, as depicted for example in figure 7.

[0098] With reference to the top view of the basement of figure 3, the basement 3 can be divided in four quarters by two substantially parallel centerlines R and H of the basement 3. The centerline R is preferably substantially parallel to the rotational axis of the laundry chamber or drum 6 in case of a front loading washing machine, and is also parallel to the side walls 2c, 2d of the casing 10. Centerline H is preferably substantially perpendicular to centerline H and it is substantially parallel to the front and back wall 2a, 2b of casing 10. The four quarters so visualized are counted in a clockwise manner from the first quarter which includes a portion of the back side of the basement and a portion of one of the lateral sides (the left side when the drying machine is viewed in a front view) and includes corner 16, the second quarter includes the second portion of the back wall and a portion of the opposite lateral side wall to the one included in the first quarter, and so on.

[0099] Further, in a preferred embodiment, preferably the condensing device - heat pump 40 - is located in the fourth quarter of the basement, or at least for the majority of its volume in such fourth quarter, as visible from figure 5. Heat pump 40 might also occupy part of the first quarter. The process air exits the heat pump, preferably the condenser 42 of the heat pump 40 in the first quarter or substantially at the boundary between the first and fourth quarter, and from there it is channeled by means of channel 30 within the basement 3 to an exit 31 of the basement 3, so that it can be returned into the drum 6. The exit 31 is preferably formed in the second quarter and more pref-

erably at the back side of the basement 3 in the second quarter. For this purpose, the channel 30, part of the process air circuit 4 and above mentioned, is formed in the basement 3, half of which is preferably integral to the upper shell 14 (the upper portion of the channel 30) and the other half (the lower portion) integral to the lower shell 13. This channel 30 is disposed preferably for the majority of its volume in the first and second quarter of the basement, as depicted in figure 3, so that it can channel the process air exiting the heat pump 40 to the exit 31. The channel 30 has advantageously a concave shape in a top view, the concavity of which is directed towards the center of the basement. Further, the channel 30 includes an external wall 32 which is the wall in top view closer to the boundaries of the basement 3. Preferably, external wall 32 is integral to the upper shell 14.

[0100] Preferably, the water collecting housing 12 is realized in the first quarter of basement 3 and even more preferably it includes corner 16 of the lower shell 13. More preferably, the water collecting housing 12 is located between the external wall 32 of the channel 30 and the boundary of the basement 3. Therefore, in this preferred embodiment, the form of the water collecting unit 12 is substantially that of a solid the base of which, i.e. the bottom wall 12b, includes two substantially perpendicular lines, the boundaries of the lower shell at corner 16, and a curved line joining the two perpendicular line, which follows the shape in a top view of the external wall 32 of channel 30. From this base, delimiting the bottom wall 12b, the lateral walls 12a extends substantially orthogonal to bottom wall 12b.

[0101] Condensation water from the collecting housing 12 is preferably conveyed to an extractable moisture tank 17 (see figure 1) located at the upper portion of the dryer 1. The moisture tank 17 is preferably in the form of a drawer slidably arranged in a box-shaped housing (not visible) on said upper portion of the dryer 1 so that it can be easily and periodically emptied by a user.

[0102] Condensation water from the collecting housing 12 is conveyed to the extractable moisture tank 17 by means of a water-removing unit 18 associated to the collecting housing 12. The water-removing unit is located inside the inner volume of the casing. The water-removing unit 18 preferably comprises a support body 21, a pumping unit 22 and a water level sensing device 23. The pumping unit 22 and the sensing device 23 are preferably associated to the support body 21 in a removable way so that they can be easily mounted or removed during either manufacturing or maintenance.

[0103] The support body 21 preferably includes a flat-shaped member which is more preferably formed substantially parallel to the horizontal (X, Y) plane. Support body 21 is integral in a single piece construction to upper shell 14, for example is fabricated during the same plastic molding process. Preferably, the support body 21, besides supporting the pump unit 22 and the water level sensing device 23, has also the function of a cover of the water collecting housing 12. Indeed, preferably support body 21 is located above water collecting housing 12 and it engages with lateral walls 12a forming the upper closure of the same.

[0104] The flat shaped member defining the support body 21 thus has a first surface facing the interior of the basement 3 - preferably the housing 12 and more preferably bottom surface 12b - and a second surface, opposite to the first, facing the exterior to the basement and substantially facing upwards.

[0105] Preferably, in order to strengthen the connection between the flat element defining the support body 21 and the remaining of the upper shell 14, so that the support body does not easily bend, ribs 19 are provided on the external wall 32 of the channel 30 and reaching the flat element defining the support body 21.

[0106] The flat element or flap defining the support body 21 includes therefore two substantially perpendicular sides which correspond to the two substantially perpendicular lateral walls 12a of the water collecting housing 12 and a curved side which follows the contour of the external wall 32 of the channel 30, also integral to the upper shell 14. Preferably, external wall 32 of channel 30 and flat element are contiguous one to the other, the support body 21 thus representing substantially a flap departing horizontally from the external wall 32 of channel 30.

[0107] Preferably, one side of the flat element, preferably the curved side, is weakened, so that it can be easily broken and the flat element can be separated from the rest of the upper shell 14, in case the whole water removal unit 18 needs to be removed.

[0108] The support body 21 comprises a first receiving seat 25 for the pumping unit 22 and a second receiving seat 26 for the sensing device 23. Preferably the first and second receiving seats 25, 26 are apertures realized in the support body 21, so that both the pump unit 22 and the water level sensing device 23, respectively, can be introduced, at least for a portion, inside the housing 12 and can come into contact with condensed water which might be present into the housing 12.

[0109] A conveying pipe, not shown in the appended drawings, connects the pump unit 22 to the tank 17. The condensed water which comes from the condensing device 40 and reaches the housing 12 is conveyed in turn to the tank 17 through the conveying pipe by means of the pump unit 22. Further, an overflow pipe might be present, also not shown, which preferably connects the tank 17 to the housing 12. When the tank 17 is full, the water flows from the tank 17 to the housing 12 through the overflow pipe. A "full tank" warning alarm is then advantageously emitted for the user, for example an acoustic and/or a visual alarm, so that he/she can remove the excess water from tank 17.

[0110] In further embodiments, not depicted, the condensed water from the housing 12 may be conveyed by the pump unit 22 outside through a pipe connected to an external waste water drain. In this case, only the conveying pipe is provided and no further overflow pipes.

[0111] With now reference to figs. 4 and 5, the pump unit 22 preferably comprises a water sucking portion 45 suitable to be disposed in contact with the condensation water collected in the housing 12. The pump unit 22 further comprises a motor unit 48 for the sucking portion 45. The motor unit 48 remains preferably outside the housing 12 at least for a portion and it is for example protruding from the support body 21; preferably motor 48 comprises electrical connectors for the connection to respective external power electrical wires, not illustrated.

[0112] The water level sensing device 23 preferably comprises a housing element 70 wherein a floating element 71 is slidably received. The housing element 70 and the floating element 71 are preferably cylindrically shaped. The floating element 71 moves inside the housing element 70 according to the level of the water inside the water collecting housing 12. The position and/or the entity of movement of the floating element 71 is advantageously detected by means of a detection unit (not shown), for example arranged at the top of the housing element 70. The detected signal may be used by a central control unit for the actuation of the motor unit 48 of the pump unit 22.

[0113] Pump unit 22 is connected to the support body 12 by a plurality of coupling elements 27, preferably a first and a second coupling element 27 realized on opposite sides of the first seat 25. The two coupling elements are preferably of the snap-in type, in order to elastically couple the pump unit 22 and at the same allowing an easy removal of the same. The coupling elements 27 are better visible in the enlarged views of figures 4 and 4a. Each coupling element 27 includes a flexible hook 28 in order to be removably coupled with a seat 29 of the pump unit 22.

[0114] Preferably, coupling elements 27 are obtained in a single piece construction with the support body 21.

[0115] The coupling elements 27 and the support body 21 are preferably made with a plastic material and are preferably obtained in a single step by molding, more preferably by injection molding. Preferably, the coupling elements 27 project from the support body 21 substantially in a vertical manner when the dryer 1 is in a standard operative position towards the exterior of the basement 3. This means that these coupling elements extend for their major components along the Z axis.

[0116] It is clear that any other equivalent fastening means may be provided between the pump unit 22 and the basement 3.

[0117] Preferably, in order to couple the water level sensing device 23 to the support body 21, similar coupling elements (not visible in the drawings) can be employed as well, for example also integral to the support body 21. Preferably, such coupling elements are also substantially vertical.

[0118] In the assembly of the dryer 1, the following steps are performed.

[0119] After the molding of the upper and the lower shells 14, 13, in which the channel 30 and the housing 12 are formed, the two are combined in order to form the complete basement 3. In the lower shell, the various dryer components are positioned, for example heat pump 40, as well as engine to rotate the drum (not shown) and a fan (also not shown), as depicted in figure 8. Then the two shells 13, 14 are assembled, for example by means of screws or a snap-fit connection, reaching the configuration of figures 2 and 3.

[0120] The support body 21, covering the housing 12, is preferably substantially flat and, when the basement 3 is positioned in a standard operative position, is substantially horizontal and faces with one of its surfaces upwardly as an integral part of the upper shell (e.g. as a single unit with the upper shell, for example formed in the same molding process). The support body 21 closes as a cover the housing 12 where water condensed from the condensing device 40 can be collected.

[0121] The water removing unit 18 installation is, due to the outline of the basement 3, particularly simple. Due to the fact that the support body 21 is already integrated in the basement 3, e.g. in its upper shell 14, no mounting of the support body is necessary. Further, in a preferred embodiment also the coupling elements 27, as well as more preferably also the coupling elements of the water level sensor 23, are also integral to the support body 21. No additional elements to be mounted are thus present - everything being already integrated in the basement - reducing the assembly time and costs.

[0122] Thus, the assembly of the pump unit 22 and of the water level sensing device 23 simply requires an approaching downward movement of the pump unit and water level sensing device towards their respective seats 25 and 26 formed in the support body 21 till a coupling is obtained. For example, the coupling is obtained when the flexible hook member 28 is fully inserted in the seat 29 of the pump unit 22, so that the sucking portion 45 of the pump unit 22 is located within the housing 12 and the motor 48 remains at least partially visible outside the housing 12 protruding from the support body 21. This further advantageously guarantees a snap-in connection between the pump unit 22 and the basement 3.

[0123] According to the invention, the provision of a completed, integral, unitary member of the support body 21 and of the upper shell 14 makes it possible to reduce manufacturing time and costs of the water-removing unit 18 and, eventually, of the dryer 1. Installation of the water-removing unit 18 is therefore simplified with respect to the known art where the two or more separated elements, namely the support body and the coupling elements, are handled separately.

[0124] Also maintenance of the water-removing unit 18 is simplifies because of reduced handling of parts for the engineer.

[0125] It should to be noted that after the water-removing unit 18 has been placed inside the water collecting housing 12, the situation depicted in figure 1 is reached. In case of malfunctioning of the water removing unit 18, the access of the same and the exchange of any com-

ponent are simple and reliable. Due to the location of the water removing unit 18 on the upper shell 14, a simple removal of one of the side walls 2c or 2d of the casing 10 is required. Due to the presence of at least a coupling element 27 which protrudes outwardly from the basement 3, for decoupling any component of the water removing unit 18 there is no need of disassembling the basement 3 itself. The pump unit 22 or the sensing device 23 can be removed from their respective seats 25, 26 acting on the resilient hook(s) 28 so that they can be removed from the seats 29. A new pump/sensor can be immediately inserted in the same seat 25, 26 without the need to replacing any additional component or using any specific tools. The maintenance of the dryer 1 is therefore particularly simple and the time of repair is greatly reduced. The tools needed are few or none, due to the fact that as soon as the side wall 2c, 2d of the casing 10 is removed, all the other operations do not require specific tools.

Claims

1. A dryer (1) comprising:

- o a casing (10) including a basement (3) having an upper shell (14) and a lower shell (13), said upper and lower shells being apt to be connected together in order to form said basement, said casing defining an inner volume;
- o a laundry chamber (6) suitable to receive laundry to be dried;
- o a process air circuit (4) for circulating process air into said laundry chamber (6);
- o a condensing device for removing moisture from the process air coming from said laundry chamber (6);
- o a water collecting housing (12) formed in said basement (3) and located inside said inner volume for the collection of condensation water formed by said condensing device;
- o a water removing unit (18) associable to said water collecting housing (12) for the removal of water therein comprising a pump unit (22) and a support body (21) to support said pump unit (22), said water removing unit (18) being located inside said inner volume;
- o wherein said support body (21) is integral in a single piece construction with said upper shell (14) or said lower shell (13) and includes at least a pump coupling element (27) for coupling said pump unit (22) onto said support body (12), said coupling element (27) protruding outwardly from said upper shell (14) or from said lower shell (13).

2. The dryer (1) according to claim 1, wherein said pump coupling element (27) is integral in a single piece construction with said support body (21).

3. The dryer (1) according to claim 1 or 2, wherein said water collecting housing (12) is integral in a single piece construction with said lower shell (13) or with said upper shell (14).

4. The dryer (1) according to any of the preceding claims, wherein said basement (3) defines a basement plane (X,Y) parallel to the ground on which the dryer rests and said support body (21) is formed in a portion of said upper shell (14) or of said lower shell (13) which is substantially flat and having a major component parallel to said basement plane.

5. The dryer (1) according to any of the preceding claims, wherein said basement (3) includes a channel (30) for said process air, said channel (30) channeling process air from said condensing device to an exit (31) so that process air can exit said basement (3), said support body (21) being formed in said upper shell or in said lower shell (13) in a location between said casing (10) and an external wall (32) of said channel (30).

6. The dryer (1) according to claim 5, wherein said external wall (32) of said channel (30) is an integral in a single piece construction with said upper shell (14) or with said lower shell (13).

7. The dryer (1) according to claim 5 or 6, wherein said casing (10) includes two lateral walls (2c, 2d) and a back wall (2b), and said support body (21) is located between said channel (30) and said casing (10), in proximity of a corner (16) formed by one of said lateral walls (2c) and said back wall (2b).

8. The dryer (1) according to any of the preceding claims, wherein said pump coupling element (27) extends substantially in a vertical direction (Z) when said dryer (1) is in an operative position.

9. The dryer (1) according to any of the preceding claims, wherein said pump coupling element (27) includes a snap-in coupling element.

10. The dryer (1) according to any of the preceding claims, wherein said upper (14) and lower shell (13) are realized in polymeric material.

11. The dryer (1) according to any of the preceding claims, wherein said support body (21) includes an aperture (25) for the introduction of a portion of said pump unit (22) into said water collecting housing (12).

12. The dryer (1) according to claim 11, wherein said aperture (25) is so located within said support body

(21) that said introduction of said portion of said pump unit (22) into said water collecting housing (12) takes place by means of a downward movement.

13. The dryer (1) according to any of the preceding claims, wherein said support body (21) is delimited by a pre-marked breaking curve, so that it is apt to be separated from the rest of said upper shell (14) or said lower shell (13) by breaking the upper shell along said curve.

14. The dryer (1) according to any of the preceding claims, wherein said water removing unit (18) includes a water level sensor (23), said support body (21) including a seat (26) to receive said water level sensor (23).

15. The dryer (1) according to claim 14, wherein said water removing unit (18) includes a level sensor coupling element for coupling said water level sensor (23) to said support body (21).

16. The dryer (1) according to claim 15, wherein said level sensor coupling element is integral in a single piece construction with said support body (21).

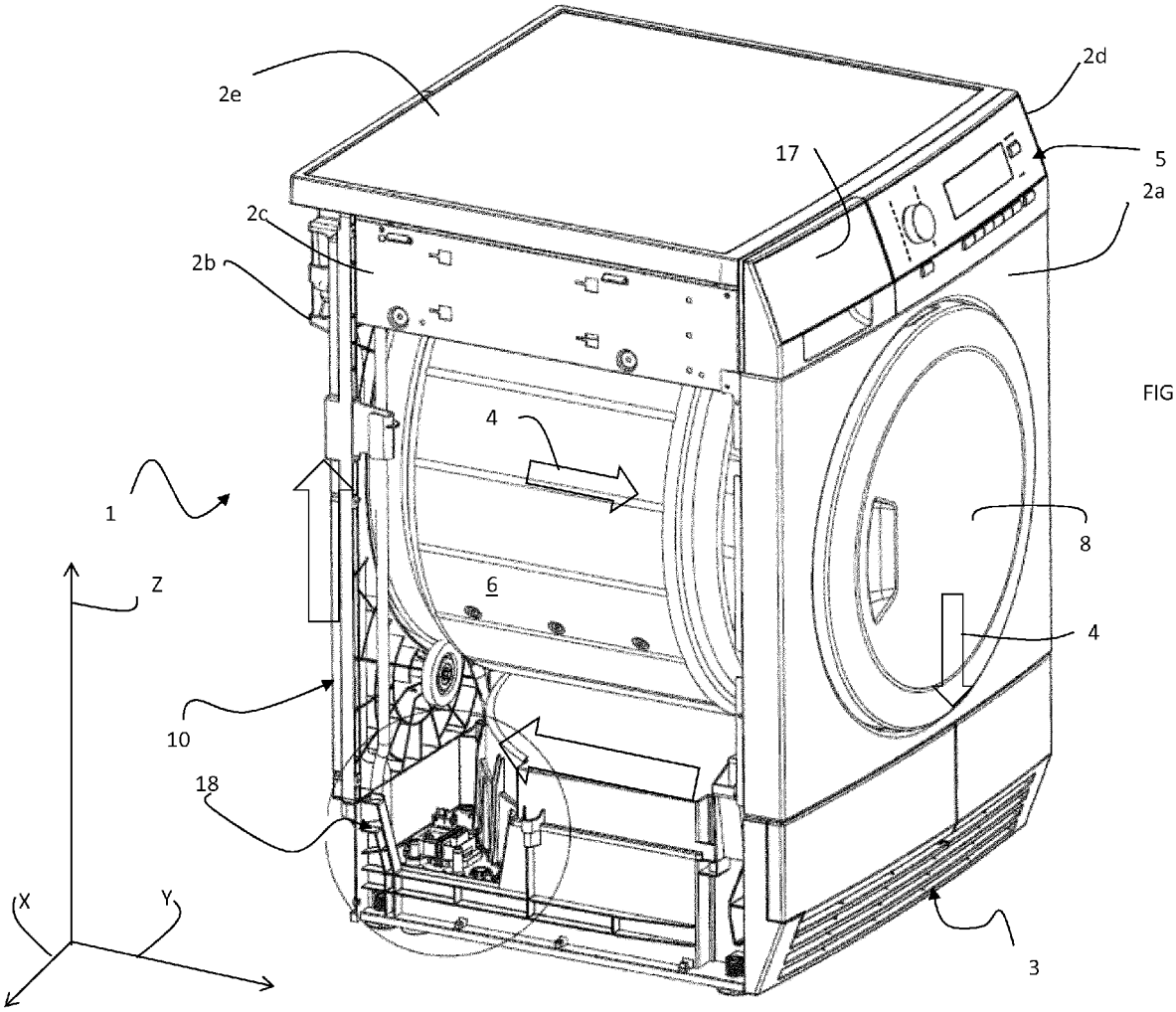


FIG. 1

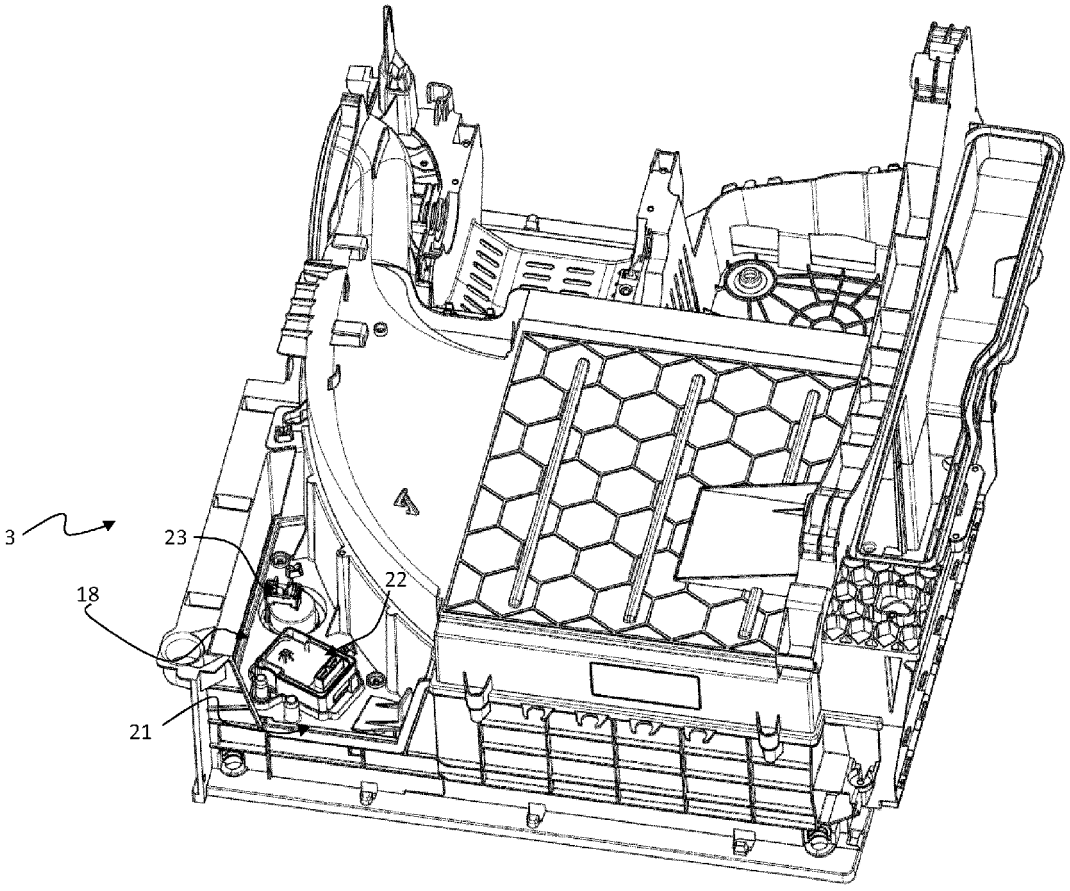


FIG. 2

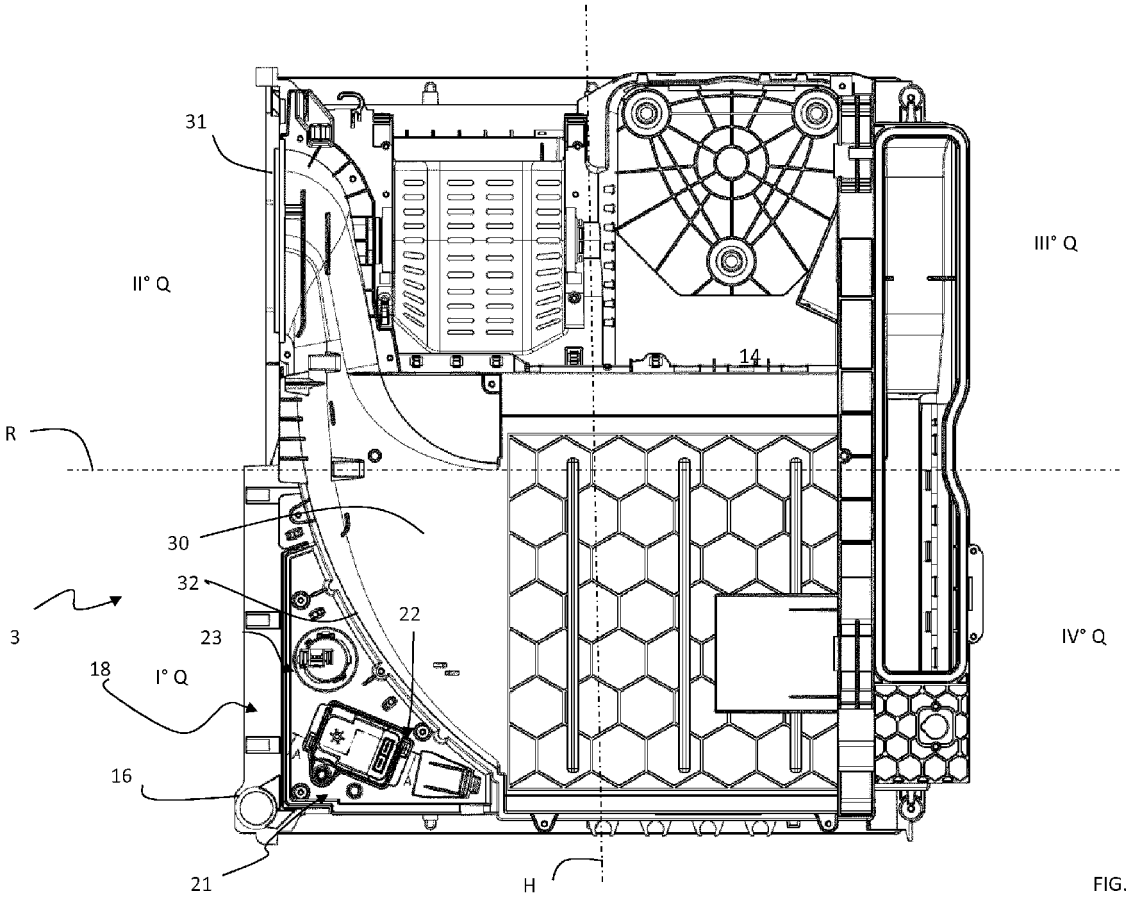


FIG. 3

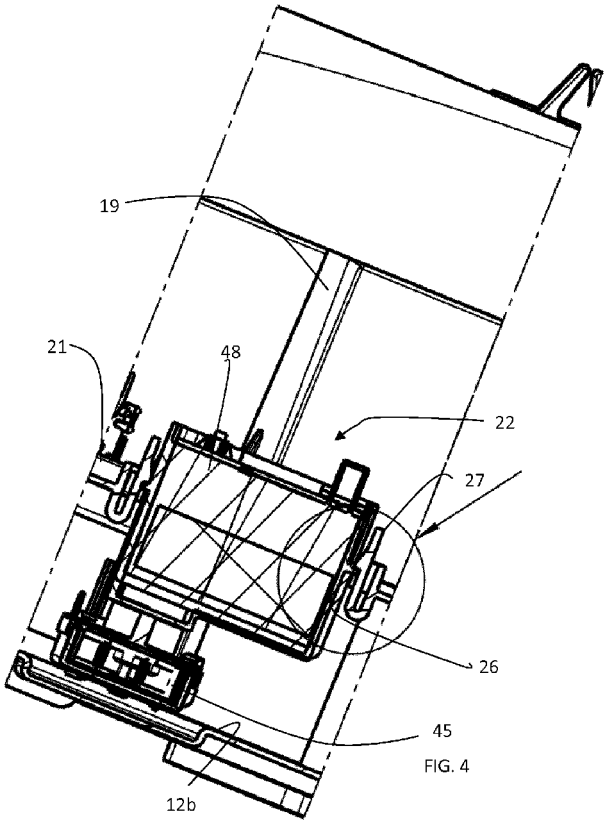


FIG. 4

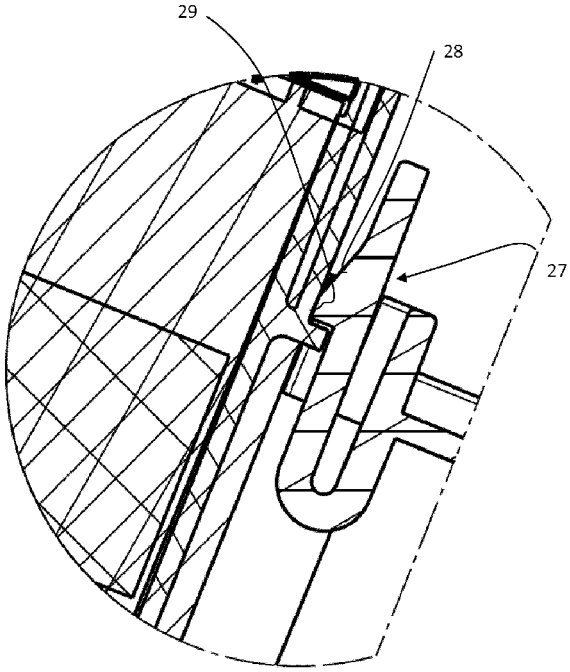


FIG. 4a

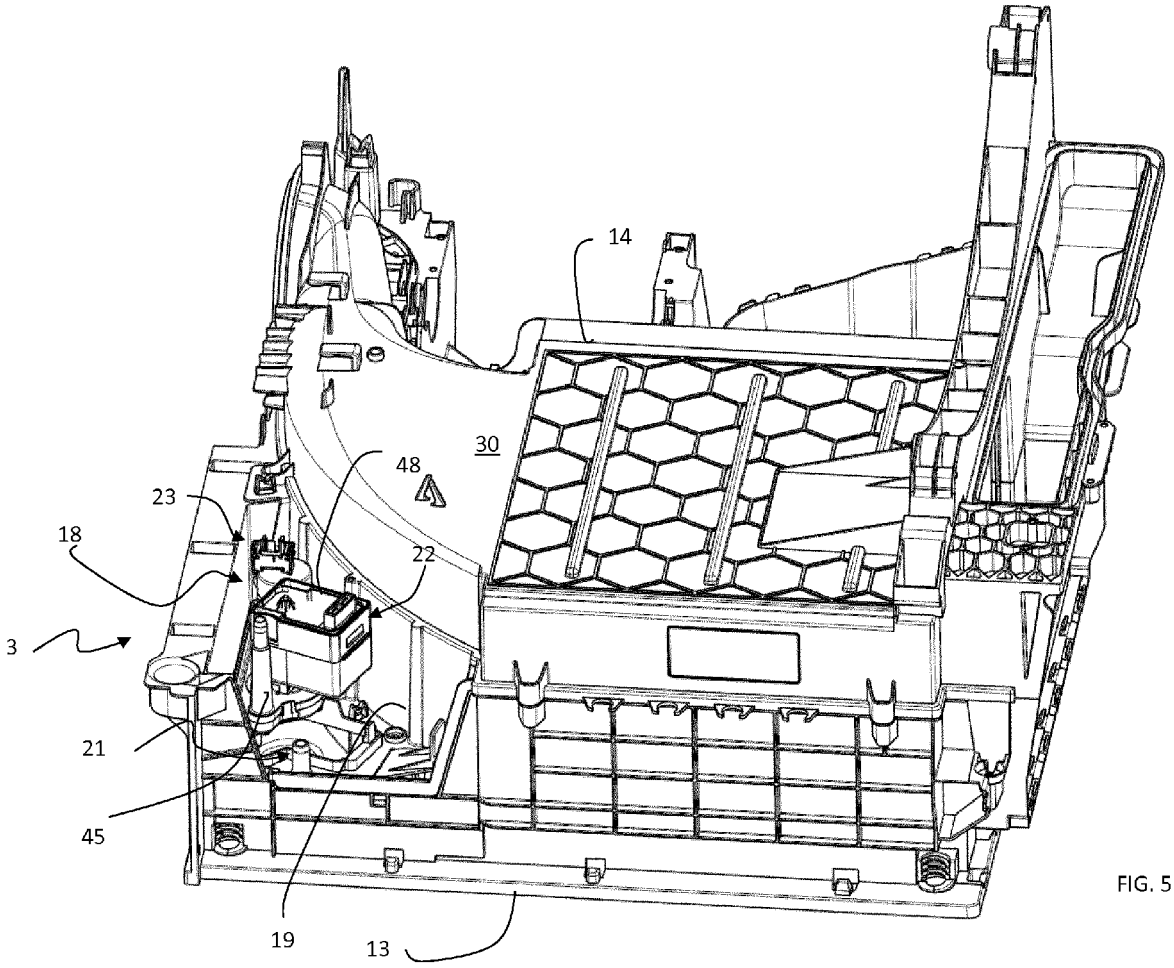


FIG. 5

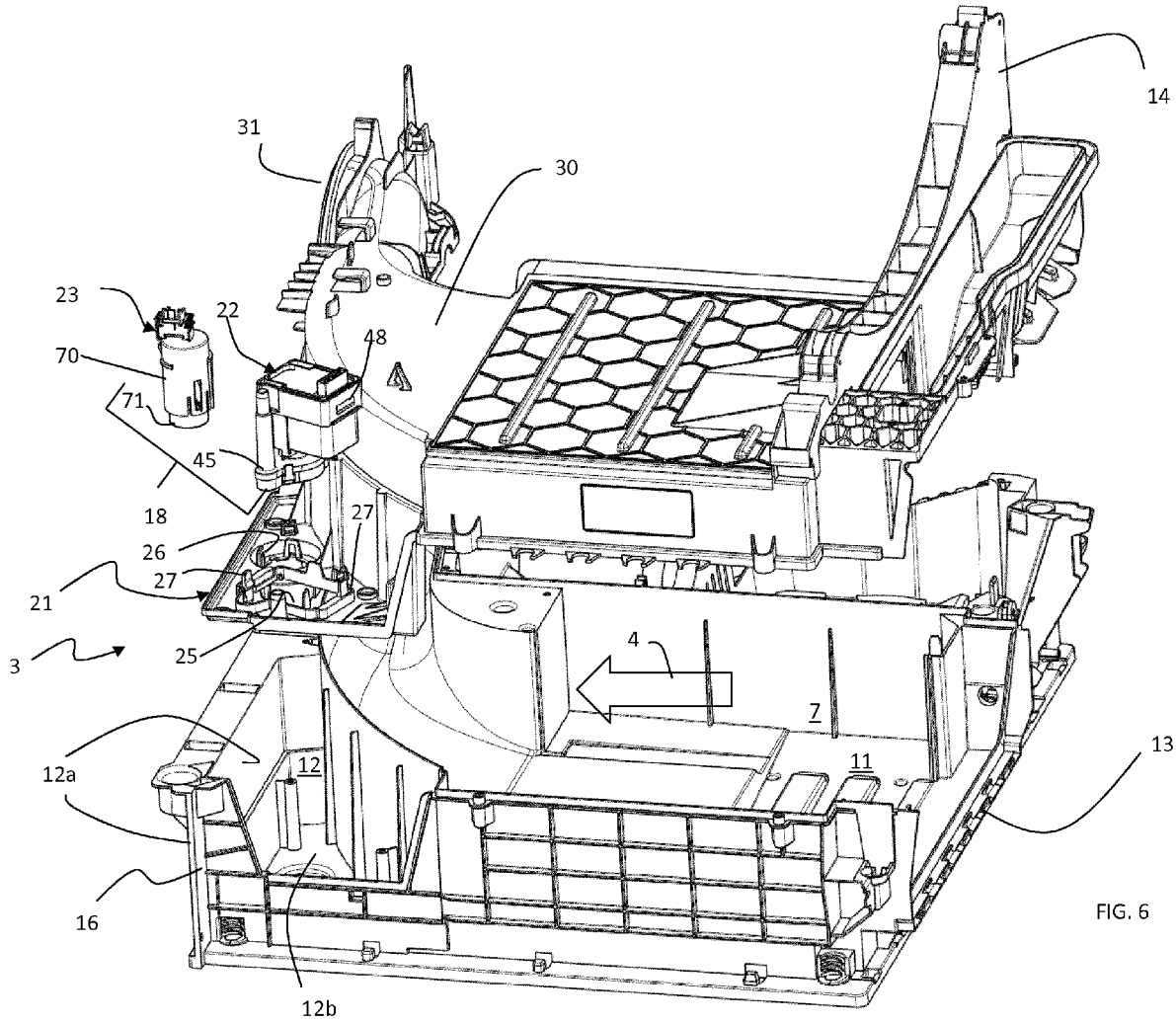


FIG. 6

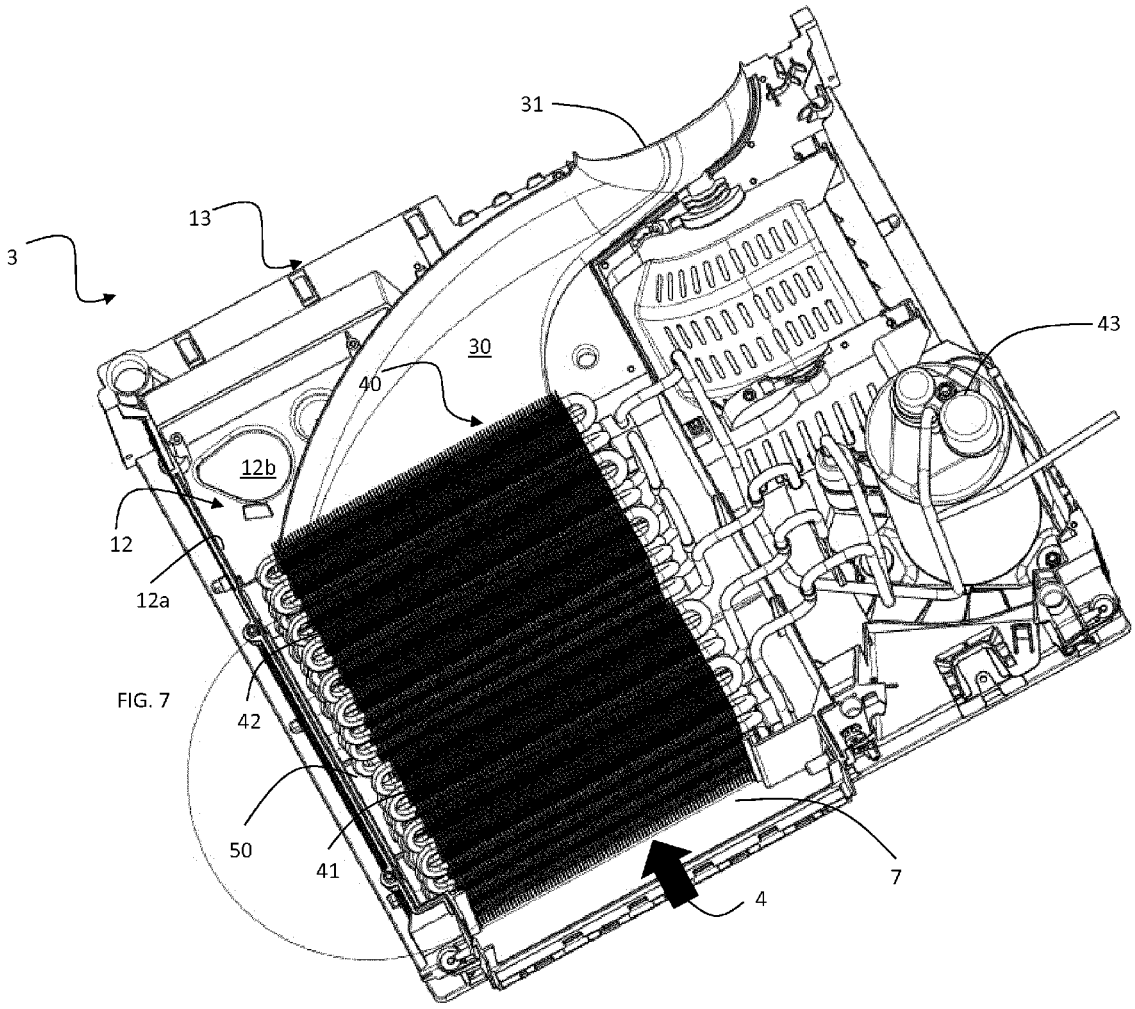
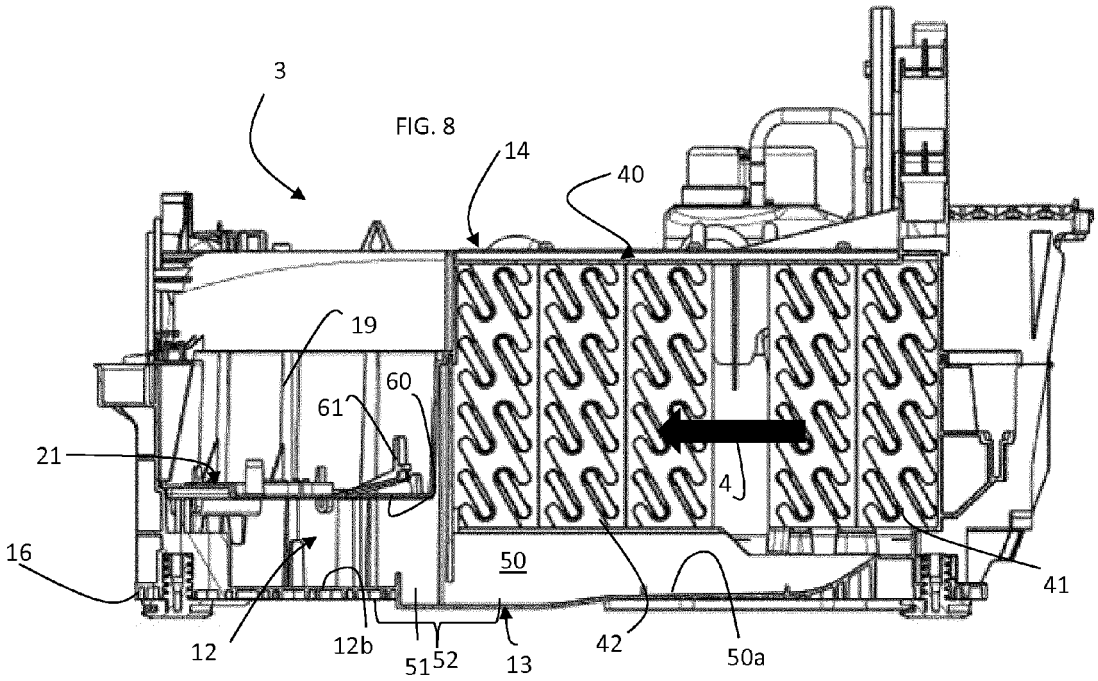


FIG. 7

FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 8418

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	US 2014/013616 A1 (LEE SANG BIN [KR] ET AL) 16 January 2014 (2014-01-16) * paragraphs [0042], [0043], [0048] - [0053], [0055] - [0060], [0069] - [0076]; figures 1-6 *	1-12, 14-16 13	INV. D06F58/24
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A,D	EP 2 620 541 A1 (ELECTROLUX HOME PROD CORP [BE]) 31 July 2013 (2013-07-31) * paragraphs [0055] - [0061]; figures 1-8 *	1-16	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 October 2015	Kirner, Katharina

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