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(54) LAUNDRY DRYER

(57) The invention relates to a dryer (1) comprising:
o a casing (10) including a basement (3) having an upper shell (14) and a lower shell (13), said upper (14) and lower shells (13) being apt to be connected together in order to form said basement (3), said casing (10) delimiting 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 (40) 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 (40);
o a duct (50) to channel condensation water formed at condensing device (40) to said water collecting housing (12) defining an inlet in said water collecting housing (12);
o wherein said upper shell (14) or said lower shell (13) includes a cover (21) to close said water collecting housing (12) and said cover (21) comprises a closable access aperture (60) to access said water collecting housing (12).

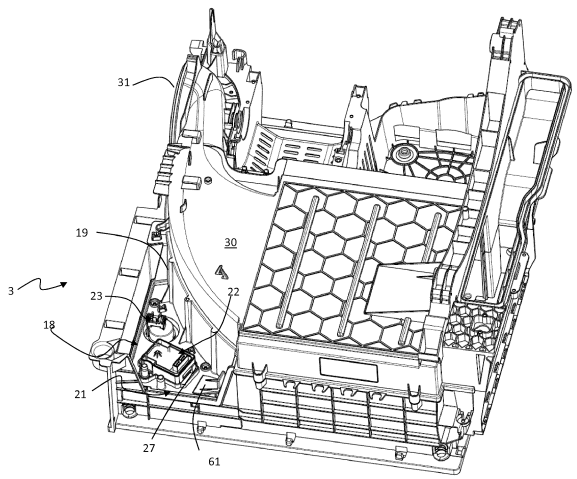

FIG. 2

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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 condensing type. The laundry machine of the invention has an improved construction so that the maintenance of the dryer is easier than in the dryers of the known types.

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 construction 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 housing collecting the condensed water is commonly positioned within the laundry dryer in a location where, in order to access the water collecting housing itself, the dismounting of many components of the dryer is required. This in turn involves a relatively long maintenance time in case of fault or breakage of the housing or of the pumping means in order to repair or substitute it.

[0011] A further drawback posed by this known technique is constituted by the fact that the condensed water which drips from the condensing unit might include fluff or lint which was present in the process air of the dryer. This fluff or lint may block the flow of condensed water to the housing, for example blocking the passage in a channel connecting the process air circuit to the water collecting housing. In order to remove the blockage, a complex and long dismounting of several components of the dryer is generally required.

[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 support-

ing 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 collecting housing is located at the back of the drying machine, thus in case of repair repositioning of the machine is generally necessary because the machine back is commonly facing a wall or furniture. Further, the removal of the possible blockage of the flow of water to the housing by fluff or lint is not addressed.

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 access to the water collecting housing, both for repair or to empty the latter. Further an additional goal is to allow access to duct(s) collecting condensation water from the process air circuit and bringing it towards the water collecting housing in order to remove fluff or lint collected in these duct(s) collecting water formed at the condensing unit towards the water collecting housing.

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

[0018] Moreover, it is an 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 locate the water collecting housing is inside the basement itself. The water collecting housing includes then a cover to avoid spill of the water it may contain. Applicants have understood that having an access aperture realized in the cover, so that the housing is easily accessible after the removal of only few components of the dryer, simplifies the maintenance and solve the above mentioned drawbacks. Further, the aperture could be used to remove fluff or lint, for example by a suitable tool. The fluff or lint possibly present can be either removed or pushed/pulled by the tool introduced via the aperture in a non-blocking position. The tool is introduced via the aperture into the housing in a position such that it can also reach the connecting duct between the housing and the condensing device.

[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 defining 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 duct to channel condensation water formed at said condensing device to said water collecting housing defining an inlet in said water collecting housing;
- wherein said upper shell or said lower shell includes a cover to close said water collecting housing and said cover comprises a closable access aperture to access said water collecting housing.

[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. Advantageously, the laundry chamber is part of a process air circuit where process air to dry the laundry is flowing through the drum. The moist process air exiting the drum is dehumidified and warmed up by the condensing device, which is also preferably part of the process air circuit.

[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 pump.

[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 located below the condensing device where water drips, to the water collecting housing. In a preferred embodiment, the duct(s) extends from the basin or surface under the condensing device to the housing and defines an inlet to the housing, such as a hole in the housing's walls for the introduction of condensation water into the housing. The duct and the inlet can have any preferred geometrical shape.

[0030] Preferably, the condensing device is located inside the inner volume defined by the basement, that is, between the upper and lower shells. More preferably, the upper and lower shells define a housing or casing for the condensing device; advantageously this condensing device housing may be integral to the basement. 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.

[0031] Preferably, the water collecting housing includes a bottom and lateral walls, which are integral in this preferred embodiment to the lower shell. However, in a different embodiment, they can be integral to the upper shell as well.

[0032] In the following, the terms "realized integral to" mean 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.

[0033] According to the invention, the water collecting housing is closed by a cover, so that the condensed water possibly included therein cannot easily come out. The cover is preferably a portion of the upper shell or of the lower shell and it is located substantially on top of the water collecting housing to close the same. Preferably the cover is a portion of the upper shell. The cover comprises a closable access aperture to access said water collecting housing. The aperture can have any desired geometrical shape depending on the position of the same and on the shape of the cover itself. The access aperture can be therefore opened in order to access the water collecting housing, and closed when access is not desired.

[0034] Due to the above mentioned construction, relatively few elements are necessary for the realization of the water collecting housing. The basement, having the upper and lower shell, includes within these two shells substantially all elements of the water collecting housing and its cover. Therefore, no further element is needed in addition to the basement in order to form and mount the water collecting housing, simplifying the overall construction of the dryer as well as its assembly.

[0035] Further, the provision in the cover of a closable access aperture allows an easy access to the water collecting housing when needed without having to dismount the basement. From the access aperture, the water collecting housing can be emptied. Further, from the access aperture the duct bringing water from the condensing device to the water collecting housing can be accessed as well. A tool can be inserted in the access aperture and it is preferably long enough to reach the duct in order to be used to move the fluff or lint that may cause a blockage inside such duct.

[0036] The access aperture is advantageously closed when access to the water collecting housing is not needed, so that no water can be accidentally spilled. The simple access to the water collecting housing and/or duct from the upper shell of the basement allows an easy mounting and maintenance of the dryer of the invention.

[0037] According to the above mentioned aspect, the dryer of the invention may include in combination or alternatively any of the following characteristics.

[0038] Preferably, said access aperture is realized at a distance shorter than 15 cm from said inlet.

[0039] In this preferred embodiment, it is desired that,

from the access aperture, access is gained also to an initial portion of the duct from where water is channeled into the water collecting housing. The ducts connect the process air circuit where water condenses to the water collecting housing. In order to obtain such access in an easy manner, preferably the access aperture is located "in the neighborhood" of the inlet of the duct, that is within 15 cm from the inlet, so that with a finger or a pointed tool, such as a screw-driver, fluff or lint which possibly accumulates in a portion of the duct in proximity of the water collecting housing, e.g. at the inlet of the housing, can be removed or shifted.

[0040] Advantageously, said cover is integral in a single piece construction to said upper shell or to said lower shell.

[0041] That is, in order to further limit the number of separated parts to be assembled in the dryer of the invention, the cover is an integral part of the upper shell or of the lower shell. Preferably, the cover is integral to the upper shell. Therefore, the water collecting housing is closed by the fastening of the upper and lower shell of the basement itself, when the upper and lower shells are coupled together during the dryer mounting, so that the cover faces a bottom wall of the water collecting housing.

[0042] Preferably, said water collecting housing is integral in a single piece construction with said lower shell. Alternatively, it is integral with said upper shell.

[0043] A further minimization of the number of dryer's component is preferably obtained using as a single "multi-purpose" 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 shell, or in a different embodiment in the upper shell, without a further introduction of a detached/detachable water collecting housing to be inserted in the basement. Thus preferably both bottom wall and lateral wall of the housing are integrally formed in a single piece construction with the lower (or upper) shell.

[0044] Preferably, the cover is located substantially on top of the water collecting housing.

[0045] In a preferred embodiment, the dryer includes a shutter hinged on said cover to open and close said access aperture.

[0046] In order to open and close the access aperture, a simple mechanical construction is provided, including a shutter hinged on the cover itself. The solution is simple and robust at the same time. Preferably, at least a portion of the hinge is integral to the cover again to minimize the number of parts of the dryer.

[0047] Preferably, said duct includes a siphon - shaped section.

[0048] More preferably, said syphon - shaped portion is located at said inlet.

[0049] In order to direct the water into the housing, preferably a siphon - shaped section of the duct is formed, so that the water in the duct may flow upward above one of the lateral walls of the housing where it is collected. This allows an easy collection of the water in the water collecting housing minimizing the risk of blockage, because the flow of water "sucked in" by the siphon "flushes" any lint or fluff present in the duct.

[0050] Additionally, preferably also the duct is slightly inclined towards the housing so that the water by gravity flows towards the siphon - shaped portion of the duct and thus towards the water collecting housing.

[0051] In a preferred embodiment, the dryer includes a water removing unit associated to said water collecting housing for the removal of water therein and the water removing unit comprises a pump unit coupled to said cover.

[0052] Advantageously, 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 water collecting 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 sliding out the drawer. However other possibilities are foreseen as well, for example the removal of the water takes place by the pump unit and it is discharged directly to the drain. In order to pump the water away from the water collecting housing, the pump unit is at least for a portion introduced inside the water collecting housing.

[0053] The water removing unit is also preferably 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.

[0054] 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 this embodiment, the support body includes the cover used to close the water collecting housing and it is preferably realized integral to the upper or lower shell forming the basement.

[0055] The cover 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 water collecting housing and apt to activate the pump unit consequently.

[0056] More preferably, said pump unit is removably connected to said cover by means of one or more coupling elements.

[0057] Advantageously, in order to couple the pump unit to the cover, 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 cover is made in such a way that the pump unit can be removed from the cover without breaking or dismounting of the latter in case there is any malfunctioning or breakage of the pump unit.

[0058] Advantageously, in a top view of said basement, said access aperture is located in said cover between said inlet and said pump unit.

[0059] As mentioned, the access aperture is preferably located "in the neighborhood" of the duct so that access to the latter is possible as well. Therefore the aperture is preferably realized on a side of the pump unit closer to the inlet, when the basement is seen in a top view.

[0060] Preferably, said basement defines a basement plane parallel to the ground on which the dryer rests and said cover is formed in a portion of said upper or lower shell which is substantially flat and has a major component parallel to said basement plane.

[0061] 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 extend from a floor in which it is positioned. However, the basement plane can be tilted as well with respect to the horizontal plane in case the ground on which the dryer rests is tilted as well. Preferably, the upper 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 cover. In this case, "substantially parallel" means that a projection of the flat region onto the basement plane is the larger projection among the projections on the basement plane and on a plane perpendicular to it.

[0062] This means that the cover includes a flat portion of the upper or lower shell which in turn includes a surface that "faces upwards" - at least for the most part of it. This adds simplicity in the mounting and dismounting of all elements attached/coupled to the cover because the latter can be more easily reached; reaching the access aperture and operating the same (e.g. opening and closing the same) is facilitated as well.

[0063] 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 cover being formed in said upper or lower shell in a location between said casing and a wall of said channel.

[0064] 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. This channel, together with the casing of the dryer, preferably delimits the volume where the cover is formed in the upper or lower shell. The position of the cover is selected being both easily reachable from the exterior of the dryer (which means that it can be reached 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.

[0065] 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.

[0066] Preferably the wall is an external wall of the channel.

[0067] More preferably, said wall of said channel is integral in a single piece construction with said upper or lower shell.

[0068] 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.

[0069] In a preferred embodiment, in said basement a front side, a back side and two lateral sides can be identified, said duct to channel condensation water being realized substantially parallel to a lateral side of said basement.

[0070] The duct to bring condensed water to the water collecting housing is preferably realized so that it is as short as possible; in order to minimize trapping of water outside the collecting housing, trapping that may increase the humidity inside the basement. Therefore, due to the outline of the basement and the positioning of the usually bulky condensing unit and of the collecting housing, the shortest way is represented by a straight duct parallel to one of the side walls of the casing of the laundry or of the lateral side of the basement.

[0071] More preferably, said duct to channel condensation water is realized at least for a portion between said lateral side of said basement and said condensing device.

[0072] Preferably, said casing includes two lateral walls and a back wall, and said cover is located between said channel and said casing, in proximity of a corner formed by one of said lateral walls and said back wall.

[0073] 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 cover 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 occupying 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 non 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).

[0074] Further, this positioning allows access to the cover and water collecting housing simply removing one of the side walls of the casing. No further dismounting of the laundry dryer is needed.

[0075] In a preferred embodiment, said upper and lower shells are realized in polymeric material.

[0076] The usage of polymeric 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.

[0077] Preferably the upper and lower shells are molded, more preferably injection molded.

BRIEF DESCRIPTION OF THE DRAWINGS

[0078] 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 portion of its interior;
- 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 4a shows a perspective enlarged view of a detail of the basement of figure 2 in a first operative position;
- Figure 4b shows a perspective view of the same detail depicted in figure 4a in a second operative position;
- Figure 5 shows a perspective view of the basement of the laundry drying machine of figure 2 with the upper shell removed;
- Figure 6 shows a side view in section along line A-A of figure 3 of a portion of the basement of figure 3;
- Figure 7 shows a side view in section along line C-C of the basement of figure 3; and
- Figure 8 shows a perspective view of the lower shell of the basement of figure 2 with the internal components removed.

DETAILED DESCRIPTION OF THE INVENTION

[0079] With initial reference to figure 1, a dryer according to the invention is globally indicated with 1.

[0080] 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.

[0081] 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.

[0082] 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.

[0083] The volume delimited by the walls 2a, 2b, 2c, 2d and 2e and the basement 3 is the inner volume of the casing.

[0084] 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.

[0085] 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).

[0086] 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.

[0087] 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 in figure 5, 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.

[0088] 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. 5 and 7, 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 8, the heat exchangers 41, 42 have been removed to show the casing's details.

[0089] 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.

[0090] The process air then exits the basement 3, preferably from the back of the basement, and the process air is fed again to the drum 6.

[0091] 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 polymeric 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.

[0092] 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.

[0093] 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 8 and are better detailed below.

[0094] 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.

[0095] Preferably, the bottom surface 11 is realized as an integral part of the lower shell 13.

[0096] 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 5, 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 interior of 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.

[0097] 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.

[0098] With now reference to figs. 6 and 7, 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.

[0099] Furthermore, in addition to the condensing de-

vice - heat pump 40 -, on the basement 3 other operational devices of the dryer are preferably arranged, 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 5.

[0100] 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 (centerline and rotation axis are named with the same reference number due to the fact that in such top view they overlap) 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 R 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.

[0101] 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 preferably 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.

[0102] 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.

[0103] The water collecting housing is closed by a cover 21 which is preferably part of the upper shell 14. Cover 21 is positioned in such a way that it substantially faces bottom wall 12b with one of its surfaces.

[0104] The cover 21 preferably includes a flat-shaped member which is more preferably formed substantially parallel to the horizontal (X, Y) plane. Cover 21 is advantageously integral in a single piece construction to upper shell 14, for example is fabricated during the same plastic molding process. Therefore, cover 21 is an integral portion of upper shell 14. Preferably, cover 21 is located above water collecting housing 12 and it engages with lateral walls 12a forming the upper closure of the same.

[0105] The flat shaped member defining the cover 21 thus has a first surface facing the interior of the basement 3-preferably facing the housing 12 - and a second surface, opposite to the first, facing the exterior to the basement and substantially facing upwards.

[0106] Preferably, in order to strengthen the connection between the flat element defining the cover 21 and the remaining of the upper shell 14, so that the cover does not easily bend, ribs 19 are provided on the external wall 32 of the channel 30 and reaching the flat element defining the cover 21.

[0107] The flat element or flap defining the cover 21 includes advantageously two substantially perpendicular sides which correspond to the two substantially perpendicular lateral walls 12a of the housing 12 forming corner 16 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 cover 21 thus representing substantially a flap departing horizontally from the external wall 32 of channel 30 and defining the boundary of the upper shell 14 in the corner 16.

[0108] 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.

[0109] 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 18 comprises preferably 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 cover 21, which acts as a support body, in a removable way so that they can be easily mounted or removed during either manufacturing or maintenance.

[0110] The cover 21 in this embodiment 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 cover 21, so that both the pump unit 22 and the water level sensing device 23 can be introduced, at least for a portion, inside the water collecting housing 12 and can come into contact with condensed water which might be present into the housing 12.

[0111] 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 and reaches the water condensing housing 12 is conveyed from the housing 12 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.

[0112] 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.

[0113] Preferably, pump unit 22 is connected to the cover 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. Preferably, coupling elements 27 are obtained in a single piece construction with the cover 21 therefore define an integral, unitary member with cover 21 and thus with upper shell 14.

[0114] The coupling elements 27 and the cover 21 are preferably made of a polymeric material and are preferably obtained in a single step by molding, more preferably by injection molding. Preferably, the coupling elements 27 project from the cover 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.

[0115] It is clear that any others equivalent fastening means may be provided between the pump unit 22 and the basement 3.

[0116] Preferably, in order to couple the water level sensing device 23 to the supporting body, similar coupling elements (not visible in the drawings) can be employed as well, for example also integral to the cover 21. Preferably, such coupling elements are also substantially vertical.

[0117] Cover 21 further includes an access aperture 60, for example realized as a through hole in cover 21, which renders the inside of the housing 12, normally closed by cover 21, accessible. Access aperture 60 is advantageously openable and closable by means of a shutter 61, which is preferably hinged on cover 21. The hinge in the depicted embodiment is formed by a line of thinner material. In the preferred embodiment shown in an enlarged view in figures 4a and 4b, the access aperture 60 is shown in an open operative configuration (see figure 4a) where the shatter 61 is distant from the access aperture 60, rotated along an hinging axis L, so that the interior of the housing can be reached; and in a closed operative configuration (figure 4b) where the shutter 61 is lying on the cover 21 and closes the aperture 60. Preferably, in order to keep the shutter 61 covering the aperture 60 and avoid accidental apertures or rotation along axis L of the same, an elastic lock member is provided, which for example includes a hook 62 protruding from the cover 21 engaging a corresponding seat or tooth 63 protruding or formed in shutter 61, so that the shutter is blocked in the closed configuration. Hook 62 is advantageously elastically disengageable from seat 63.

[0118] Access aperture 60 is preferably located on cover 21 in proximity of the inlet 51, that is, on an area of the cover 21 which is located adjacent to inlet 51. For example, in case the pump unit 22 is also located on cover 21, in a projection onto the basement plane (X, Y) access aperture 60 is located between pump unit 22 and inlet 21. Preferably, a distance between the access aperture 60 and the inlet 51 is less than 15 cm. The distance is preferably calculated between a rim of the access aperture 60 and a rim of the inlet 51.

[0119] In the assembly of the dryer 1, the following steps are preferably performed.

[0120] 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 13, shown in figure 8, 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 5. 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.

[0121] The cover 21, covering the housing 12 and preferably integral to upper shell 14, 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) and with its opposite surface the bottom wall 12b of water collecting housing 12. The cover 21 closes the housing 12 where water condensed from the condensing device 40 can be collected.

[0122] The water removing unit 18 installation is, due to the outline of the basement 3, particularly simple. Due to the fact that the cover 21 is already integrated in the basement 3, e.g. in its upper shell 14, no mounting of a support body for the components of the water removing unit is necessary. Further, in a preferred embodiment, also the coupling elements 27 of the pump unit 22, as well as more preferably also the coupling elements of the water level sensor 23 are also integral to the cover 21. No additional elements to be mounted are thus present - everything being already integrated in the basement - reducing the assembly time and costs.

[0123] According to the invention, the provision of a completed, integral, unitary member of the cover 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 cover and the coupling elements, are handled separately.

[0124] Also maintenance of the dryer 1 is simplified.

[0125] In case of malfunctioning of the water removing unit 18, so that water remains in housing 12 which needs to be emptied or fluff is collected in duct 50 blocking water flow, the access of the housing 12, the water removal or cleaning of any component are simple and reliable. Due to the location of the access aperture 60 on the cover 12 of the upper shell 14, a simple removal of one of the side walls 2c or 2d of the casing 10 is required in order to operate the shutter 61, which can be easily opened, disengaging hook 62 from seat 63, so that the inside of the water collecting housing 12 is reachable.

[0126] Further, due to the fact that preferably aperture 60 and the duct 50 are in proximity one to the other, fluff present in the duct 50, which generally accumulate in the syphon - shaped section 52, can be easily removed either with a finger of the user or service personnel, or with a suitable tool, which can be inserted in the aperture and suitably angled and inserted into inlet 51.

[0127] Maintenance of the dryer 1 is therefore greatly simplified because no additional disassembling of the dryer is needed besides the removal of a side wall 2c, 2d, access via aperture 60 is enough to remove water from housing 12 and/or to clean duct 50.

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 delimiting 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 (40) 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 (40);
- o a duct (50) to channel condensation water formed at said condensing device (40) to said water collecting housing defining an inlet (51) in said water collecting housing (12);
- o wherein said upper shell (14) or said lower shell (13) includes a cover (21) to close said water collecting housing (12) and said cover (21) comprises a closable access aperture (60) to access said water collecting housing (12).

2. The dryer (1) according to claim 1, wherein said access aperture (60) is realized at a distance shorter than 15 cm from said inlet (51).

3. The dryer (1) according to claim 1, wherein said cover (21) is integral in a single piece construction with said upper shell (14) or lower shell (13).

4. 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 said upper shell (14).

5. The dryer (1) according to any of the preceding claims, including a shutter (61) hinged on said cover (21) to open and close said access aperture (60).

6. The dryer (1) according to any of the preceding claims, wherein said duct (50) includes a siphon - shaped section (52).

7. The dryer (1) according to claim 6, wherein said syphon - shaped section (52) is located at said inlet (51).

8. The dryer (1) according to any of the preceding claims, including a water removing unit (18) associate to said water collecting housing (12) for the removal of water therein and comprising a pump unit (22) coupled to said cover.

9. The dryer according to claim 8, wherein said pump unit (22) is removably connected to said cover (12) by means of one or more coupling elements (27).

10. The dryer according to claim 8 or 9, wherein, in a top view of said basement (3), said access aperture (60) is located in said cover (21) between said inlet (51) and said pump unit (22).

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

12. The dryer (1) according to any of the preceding claims, wherein said basement (3) includes a channel (30) for said process air, part of said process air circuit (4), said channel (30) channeling process air from said condensing device (40) to an exit (31) so that process air can exit said basement (3), said cover (21) being formed in said upper shell (14) or in said lower shell (13) in a location between said casing (10) and a wall (32) of said channel (30).

13. The dryer (1) according to claim 12, wherein said 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).

14. The dryer (1) according to any of the preceding claims, wherein in said basement a front side, a back side and two lateral sides can be identified, said duct (50) to channel condensation water being realized substantially parallel to a lateral side of said basement (3).

15. The dryer (1) according to claim 14, wherein said duct (50) to channel condensation water is realized at least for a portion between said lateral side of said basement (3) and said condensing device (40).

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

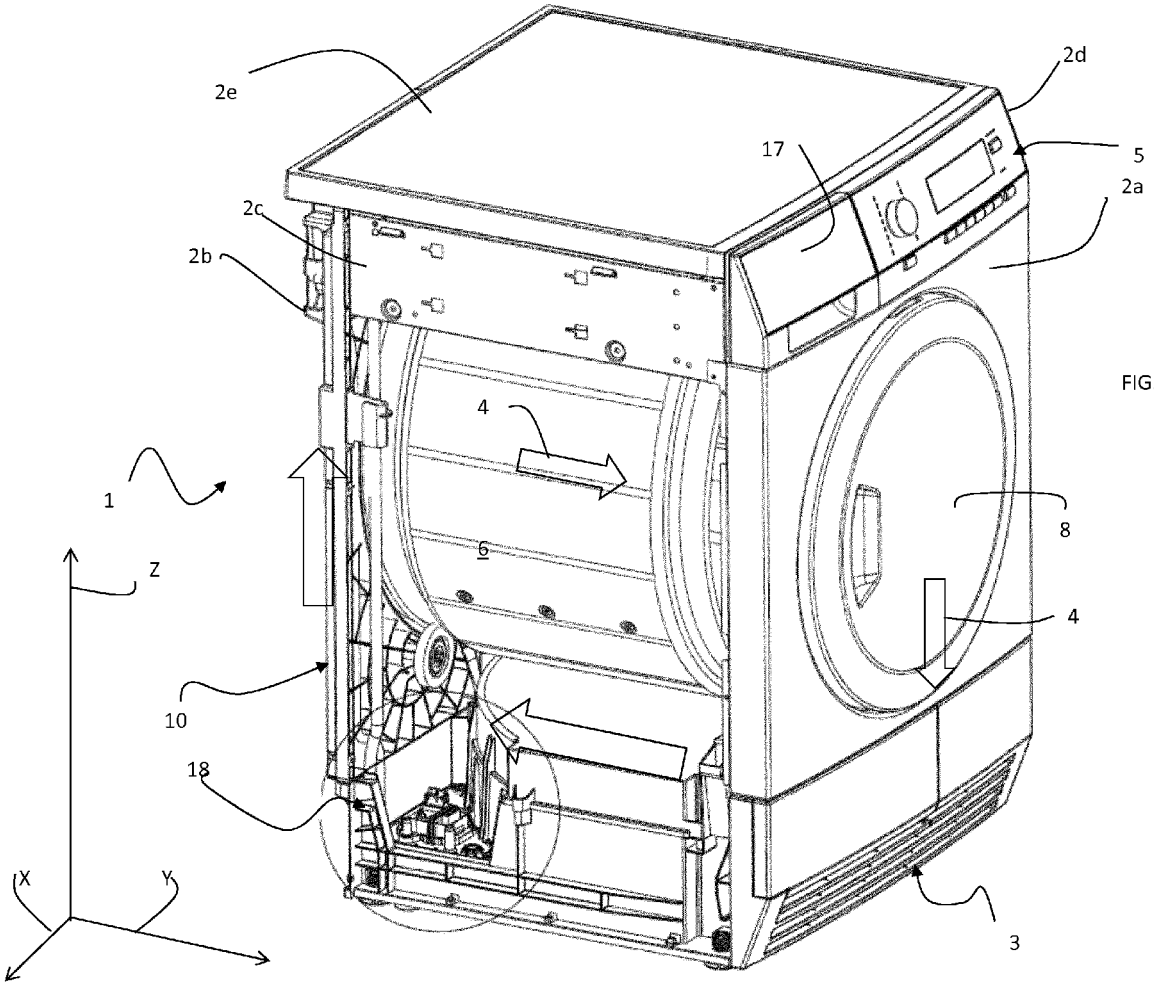


FIG. 1

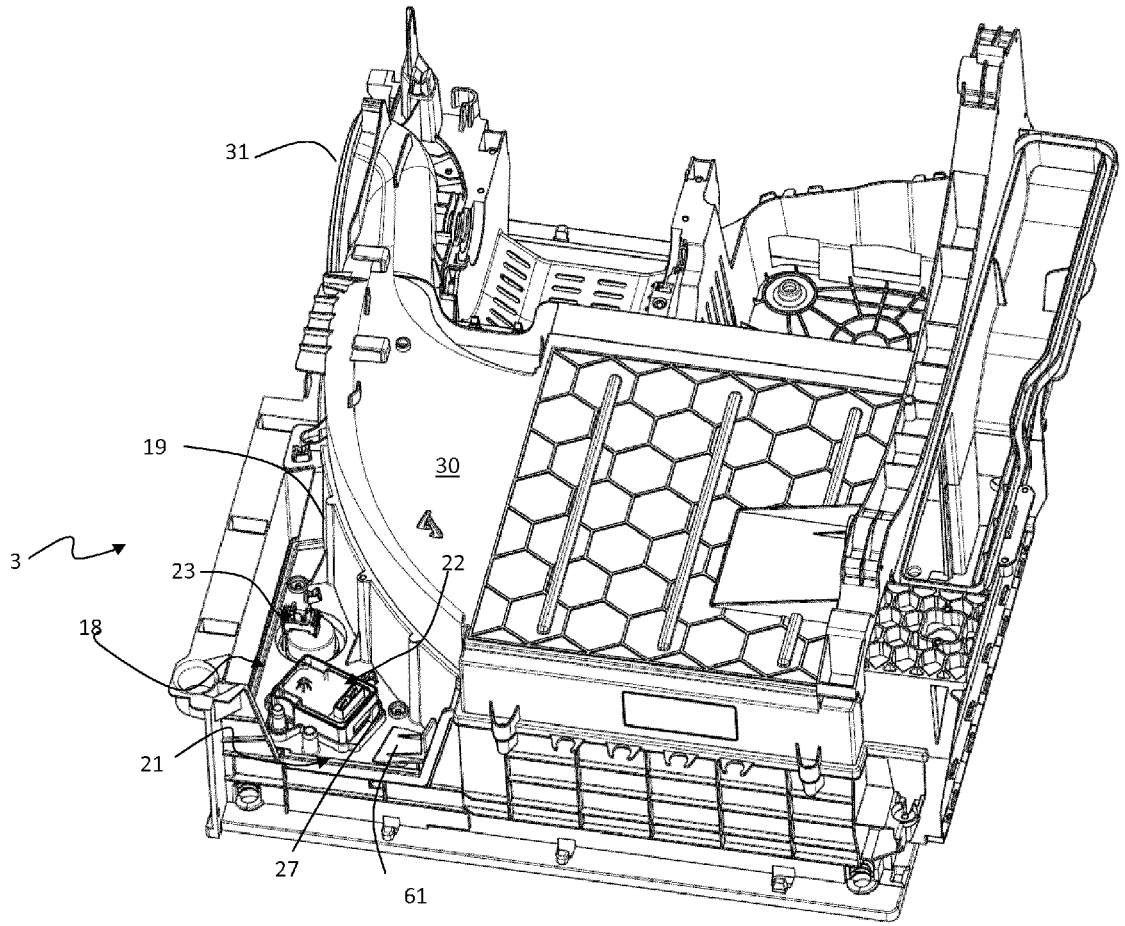


FIG. 2

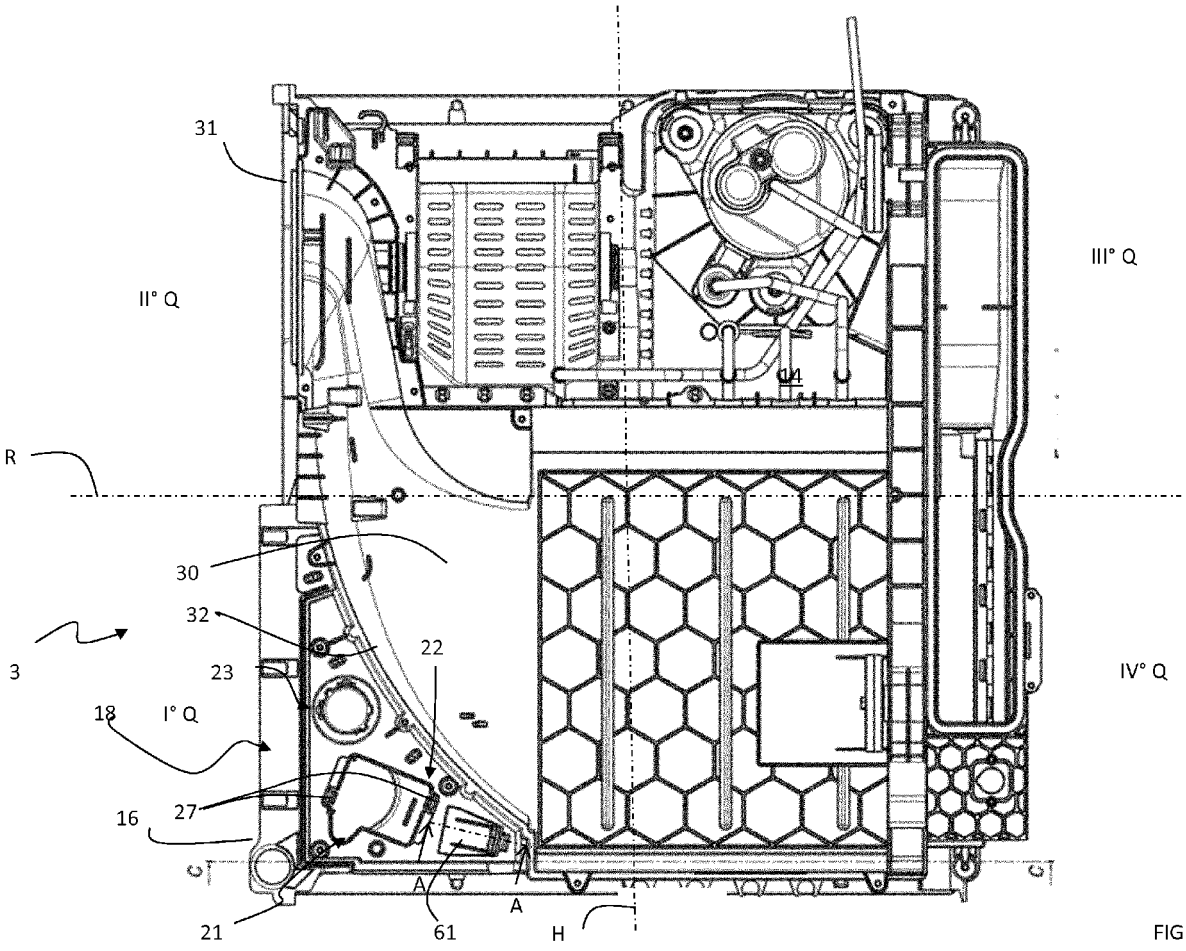


FIG. 3

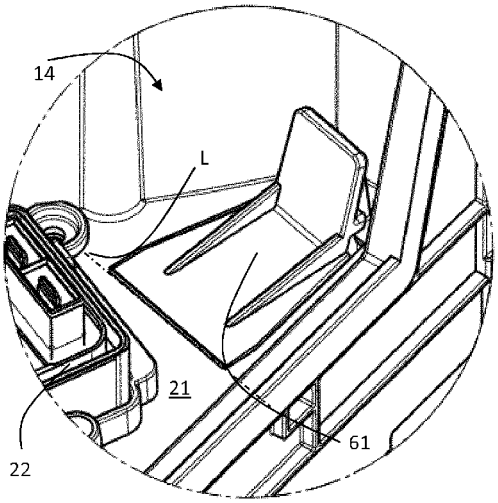


FIG. 4a

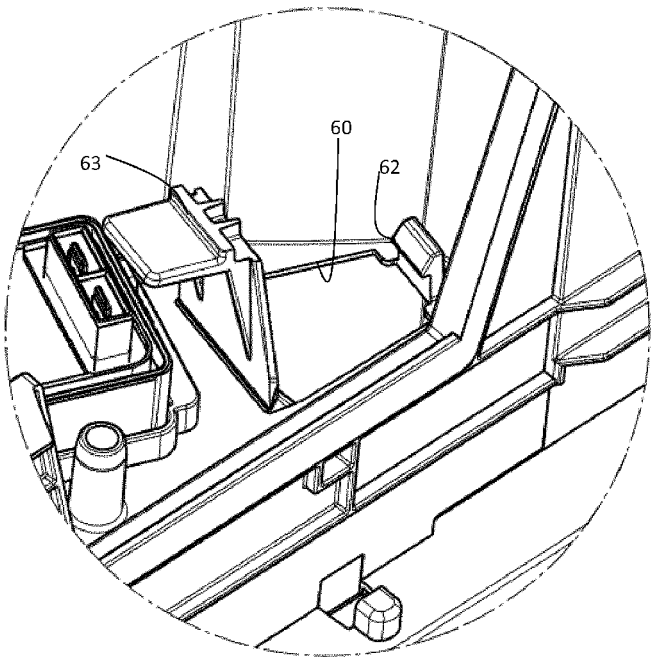


FIG. 4b

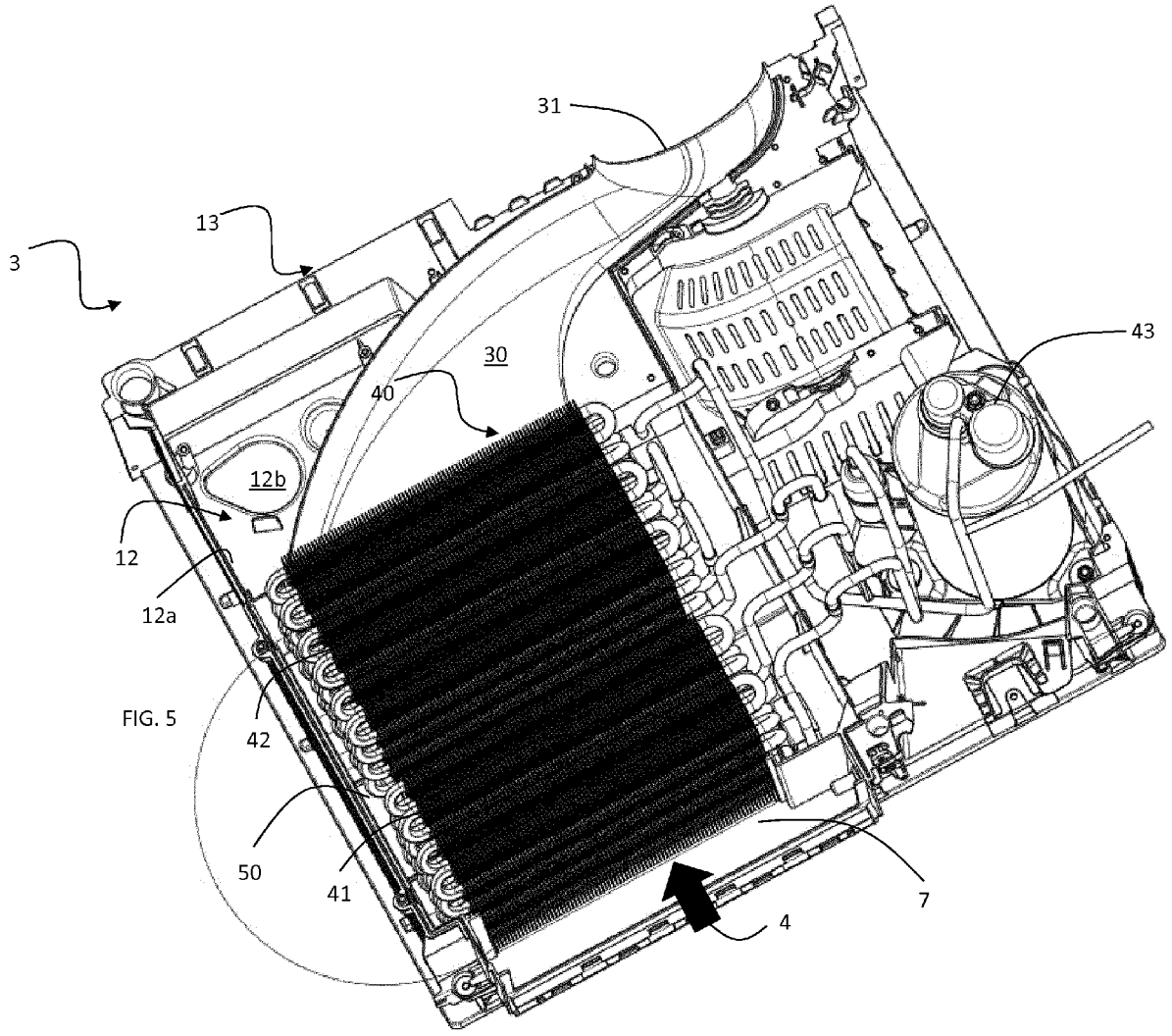


FIG. 5

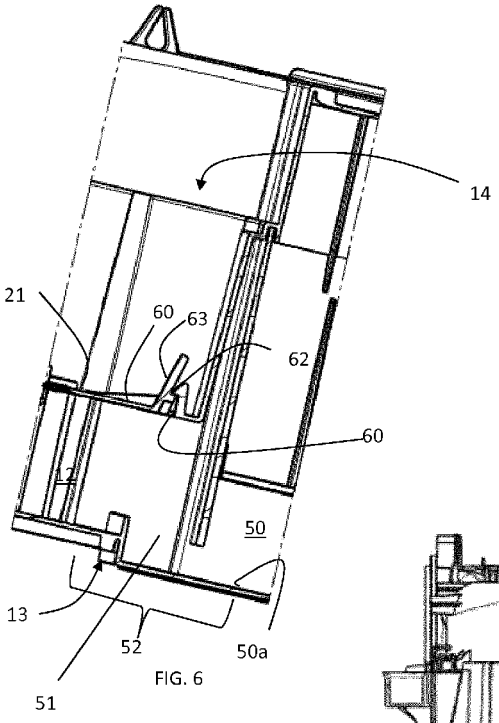

14
21
60
63
62
60
50
13
52
50a
51

FIG. 6

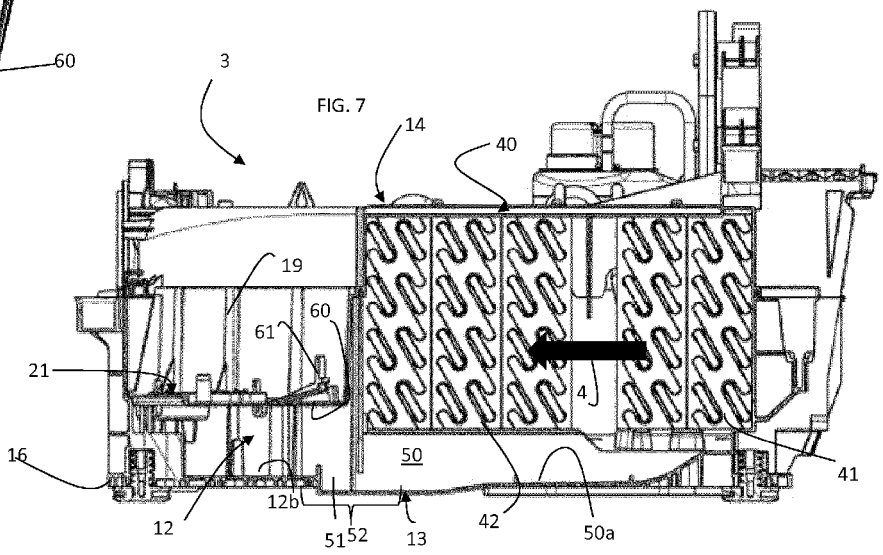
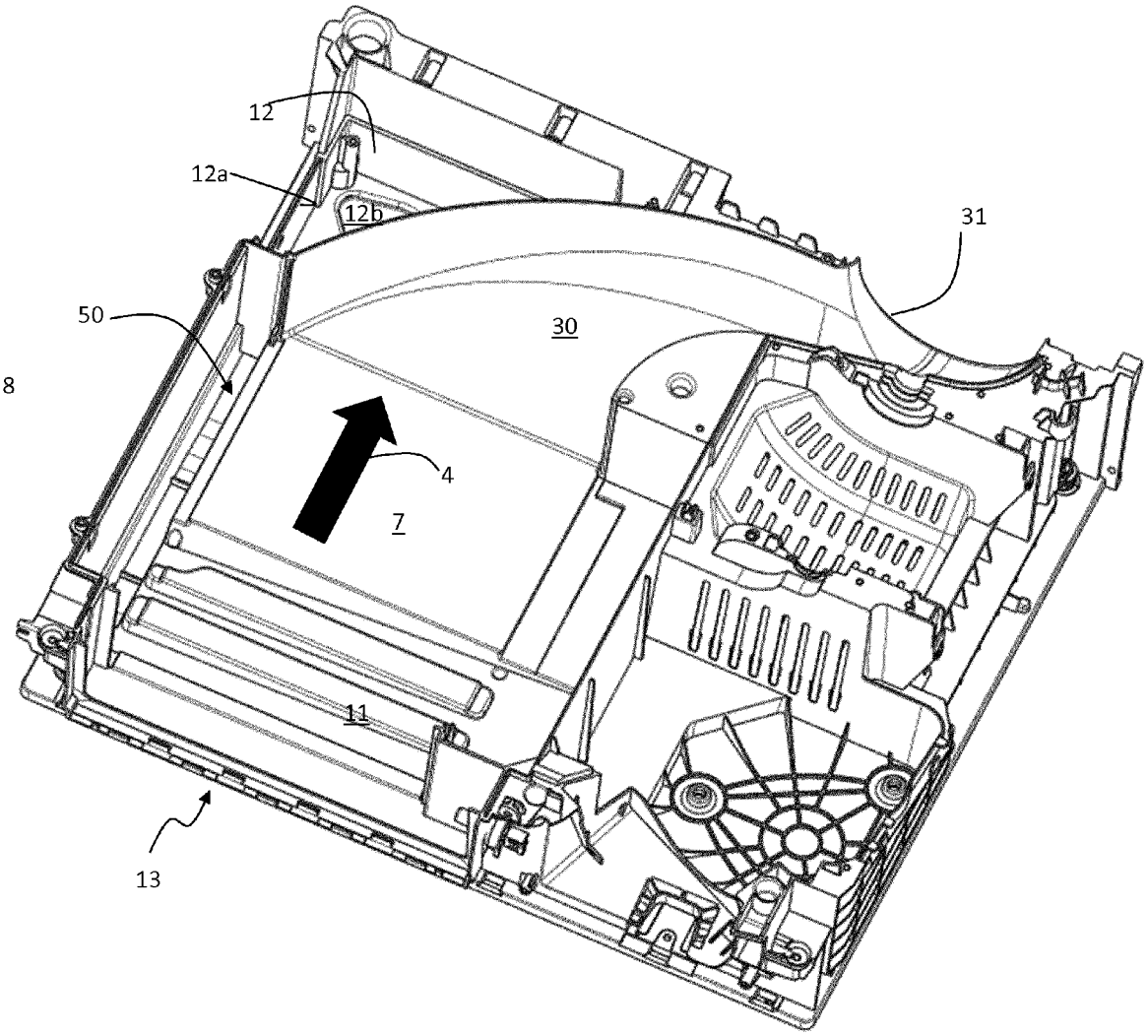

3
14
40
19
60
61
21
4
16
50
41
12b
12
51
52
13
42
50a

FIG. 7

FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 8415

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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	8 October 2015	Kirner, Katharina

CATEGORY OF CITED DOCUMENTS

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- EP 2620540 A **[0014]**