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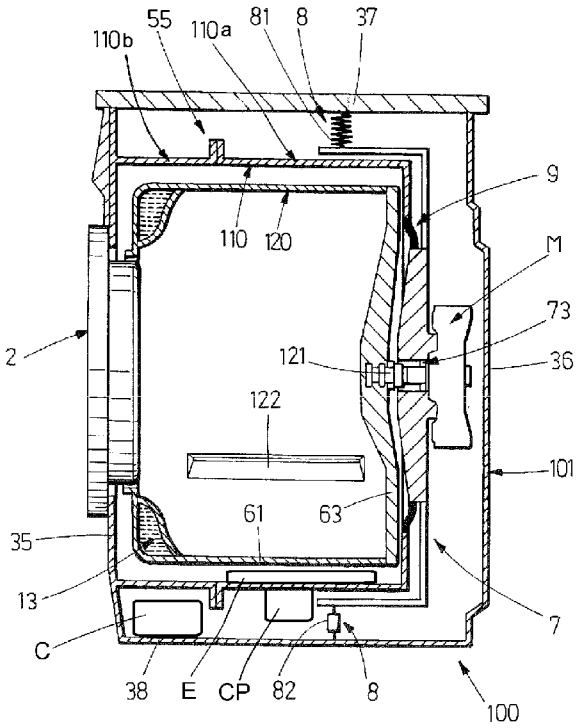

FIG.6

(57) Abstract: Washer dryer (100,) comprising a frame (101) within which is accommodated a tub (110) and a drum (120) accommodated inside the tub (110) with a drum shaft (121) that is rotatable relative to the tub, an air circuit adapted to circulate a flow of air through the tub (110), and a heat pump having at least one compressor (CP) and at least one condenser (C) and one evaporator (E) that can exchange heat at least with the air flow. For a greater compactness of the machine (100), the tub (110) is integral to the frame (101) and in this manner the components of the heat pump can be placed in the tub (110) or in the frame (101) without relative movement there between.

Washer dryer

DESCRIPTION

The present description relates to a washer dryer. The term washer dryer includes the concept of a washer with the function of drying.

PRIOR ART

Washer dryers generally confer the advantage of space savings by incorporating the two functions of washing and drying.

Washer dryers are known in which the drying of wet laundry contained in the washer dryer is achieved by applying a fan-driven stream of air that passes through the laundry and results in the extraction of the moisture contained therein. The air applied to the laundry can be heated, for example, by means of an electric resistance, becoming loaded with evaporated moisture. The moist air can either be discharged to the outside or be condensed, being transformed into dry air that can be recirculated in a closed circuit, with the moisture being recovered from humid air in liquid form. In this way, washer dryers are therefore defined as those that discharge air to the outside and those that effect condensation of the air. The washer dryers that discharge air to the outside have the disadvantage that they can require a system to evacuate the moist air to the outside of the room in which they are located.

Condensation washer dryers are known wherein the condensation of the moist air is achieved through a heat exchanger for cooling the cooling air, which is drawn in from the environment and discharged again to the environment after passing through the exchanger, being driven by an additional fan, as is described for example in the document WO2012053751A1. These washer dryers have the disadvantage of the warming that can be generated in the environment of the room in which they are located upon returning the heated cooling air to the room.

Condensation washer dryers are also known in which the condensation of the humid air is achieved by means of cooling with cooling water directly mixed with the humid air, as described for example in the document DE102008027808A1. These washer dryers have the disadvantage that they consume cooling water.

Washer dryers that effect condensation of air by means of a heat pump are also known, comprising a heat pump with a compressor, a condenser, and an evaporator, as described for example in the documents EP1405946A2 and EP2351883A2. In these washer dryers, the air stream that is applied to the laundry to be dried is heated by means of the condenser and driven by a fan. The condensation is achieved by cooling the humid air by means of the evaporator. These condensation washer dryers have the disadvantage that the configuration of the heat pump, especially the size of same, results in the appliance being undesirably bulky or involves a reduction in the capacity of the washer dryer to accommodate the heat pump inside the housing or the washer dryer unit.

The present invention aims to provide an alternative to the types of washer dryer known in the prior art, or to improve the washer dryers known in the prior art.

DESCRIPTION OF THE INVENTION

With the goal at least to reduce the disadvantages mentioned earlier with respect to the prior art, a washer dryer is proposed with which further advantages can be obtained, as will be seen hereinafter.

The present washer dryer comprises a frame, and a tub inside which a drum is accommodated rotatably relative thereto. The tub and drum are adapted to wash laundry, and the drum is particularly adapted to receive therein the laundry to be washed. To rotate the drum, the machine has a driving means that is coupled to a drum shaft, which functions in the washer dryer to bring the drum into rotation. Said driving means preferably comprises a motor. The driving means can comprise a means for transmitting the rotation of the motor to the drum, which preferably comprises a transmission belt that transmits motion between a motor output shaft and a pulley fixed to a drum rotation shaft, although the motor can be coupled directly to the drum shaft. The term "laundry" includes the concept of clothing.

The frame has the function of providing an external appearance for the household appliance and to give the supporting structure to same. Preferably, the housing has a substantially prismatic shape and comprises walls that form the surfaces of the frame. The term "wall" includes the concept of "panel" and "cover". The frame can be of plastic, in particular plastic that is reinforced, for example, with fiberglass. It is also envisioned that the frame can be metallic, in particular shaped formed from metal sheet or plate. In another embodiment, the frame can comprise a plastic body and a coating of sheet or plate metal of reduced thickness, which gives the housing an improved aesthetic appearance. In addition, the

housing can include an anti-vibration footprint stamped on the sheet or plate of the metal housing or molded into a plastic panel.

The frame of the household appliance has the function of withstanding the loads transmitted by the suspension during operation of the machine.

The present washer dryer further comprises an air circuit. The air circuit can, for example, be a closed circuit, i.e., a recirculable air circuit. At least part of the air circuit can be fixed to the tub, especially at least partially integrated with same. Said air circuit is adapted to circulate through the interior of the washer dryer tub, an air flow for drying the laundry contained in the drum. The air circulation through the interior of tub can be carried out with air supplied by the action of at least one fan, and/or by means of rotation of the drum itself. The air flow can be conducted by means of at least one air duct. In some embodiments, said air circuit is adapted so that the air will flow into the tub through a front region thereof. Also, the air circuit can be adapted so that the flow of air will exit the tub via a lateral and/or a rear region of same. The term "air flow" includes the concept of air current.

The present washer dryer further comprises a heat pump. The heat pump is adapted to exchange heat with the air flow that circulates through the tub, i.e., the heat pump is adapted for heating and/or cooling said air flow. The heat pump includes at least one compressor, at least one condenser, and at least one evaporator. Heating the air flow produces evaporation of moisture from the laundry. Drying takes place through evacuation of the humid air to the outside of the machine and/or by condensation thereof by means of cooling. The heat pump comprises a coolant circuit for circulating a coolant fluid between at least one said compressor, at least one said condenser, and at least one said evaporator, in a manner that is conventional per se. The coolant fluid can be selected to obtain a thermodynamic efficiency and an appropriate rate of drying, for example, from among CO_2, R407C, R134a, R290, and 1234YF. The coolant circuit can comprise at least one expansion valve, in the manner known per se. The expansion valve can be controllable, for example electronically. The coolant circuit comprises at least one coolant duct. The coolant line, in particular at least one valve, can be fixed to the tub. The coolant duct can be of metallic material, e.g., copper, or plastic, e.g., a thermoset. Connecting the coolant lines to the various components of the heat pump can be achieved, for example, by welding.

The addition of a heat pump in the present washer dryer improves the thermodynamic efficiency of drying, and therefore reduces the energy consumption of the washer dryer.

According to an important aspect of the present washer dryer, the tub is integral to the frame, that is, there is no relative movement between the tub and the frame since the tub is

stationary relative thereto. The tub can be fixed directly to at least one inner surface of any of the walls of the frame or by means of interposed elements. The tub is preferably joined to the front wall of the frame. The terms "lateral", "front" and "rear" must be understood to refer to relative positions along a direction of the drum shaft. Thus, in the case of washing machines, dryers, or washer dryers with a horizontal drum shaft, the term "anterior or frontal" includes the concepts of "front" while the term "posterior" includes the concept of "rear".

The tub is then fixed relative to the frame, in particular fixed to the frame, more particularly fixedly connected, more particularly integrated. The tub can be of plastic, at least partially, in particular plastic that is reinforced, for example, with fiberglass. Also, the tub can be obtained via injection molding. The tub can have a cylindrical shape with a cross-section suitable for accommodating the drum, in particular circular or polygonal, for example, hexagonal. Advantageously, the tub laterally contacts the housing such that the capacity thereof can be extended radially. Also, the tub can contact the frame in a front area such that the capacity thereof can be extended axially. A tub of this configuration affords the largest possible drum diameter for machines with a frame of equal size.
The use of the plastic material in the frame and/or tub can provide improved damping, particularly for the loads due to the suspension, oscillations, vibrations and/or noise during operation of the appliance.
The integration between tub and/or the frame can be obtained by means of injection molding of plastic in a single mold. Also, the fixed connection between said elements can be accomplished by interlocking, for example, by clipping or under pressure, or by tractional forces, for example, by adhesive or by welding, especially by ultrasonic welding or heat sealing.

To dampen the vibrations produced, the machine is envisioned to comprise a support body that is rotationally connected to the drum shaft, an annular gasket arranged between the tub and the support body or the drum shaft to contain the wash liquid inside the tub.

The support body can comprise a posterior body located in an area at least partially posterior to the tub, and optionally at least one support arm located in an area at least partially lateral to the tub. Preferably, the support body and the support arms are fixedly connected together, in particular, integrated. The support body can be of plastic, in particular plastic that is reinforced, for example, with fiberglass. Also, the support body can be obtained via injection molding or by overmolding of a reinforcing structure, e.g., of metal. The support body and the support arms integrated with the support body can be obtained via injecting the body and the arms in the same mold. Regarding the shape of the support body, it can have a sectional

shape with a larger vertical extent than horizontal, in particular it can be a plate, and it can be disc-shaped in design. Preferably, the support body comprises a bearing hub that rotatably connects the drum shaft to the support body. Body support arms can have shape that is elongated along a direction parallel to the drum shaft, for example, in the shape of a beam, bar, or channel. In another embodiment example, the arms are extended in a posterior area to the tub substantially in a direction intersecting with the drum shaft in a spider-like shape. The machine further comprises counterweight elements that are arranged in different locations of the body support, particularly in the support arms, to balance an eccentric loading of laundry in the drum and to reduce the vibrations produced during operation of the machine.

Preferably, the drum comprises a single drum shaft through which the support body provides cantilevered support to the drum, preferably via a bearing hub of the support body. In another embodiment, the drum can comprise two coaxial shafts through which the drum is doubly supported in the support body through respective bearing hubs from the support body. The drum shaft can comprise a shaft bushing to facilitate the sliding of the annular gasket with respect to the shaft. The bushing can be of material suitable for reducing friction with the gasket. The shaft is preferably of steel and the bushing of metal, preferably made of galvanized steel, selected to prevent oxidation.

The annular gasket is arranged between a posterior area of the tub and the drum shaft sealing the tub, fixedly connected to the tub and fixedly connected to the support body.
The connection fixing the annular gasket to the tub and the body support can be in positive fit, for example, by clipping, or tractional forces, for example, by adhesive or by welding, in particular by heat sealing. Fixing means can also be employed, for example, by stapling or riveting.

When the annular gasket is fixed to the drum shaft, it must be a dynamic fixing. "Dynamic fixation" is understood to mean in particular that the gasket is rotationally sliding on the drum shaft. Preferably, the gasket is pressed against the drum shaft, i.e., radially compressed. The gasket being dynamically connected to the shaft is possible without the portion of the support body that would be necessary to ensure the leak-tightness of the tub if the gasket were arranged between the tub and the support body.

In this embodiment of the annular gasket, it is dynamically and freely connected to the drum shaft. The term "dynamically and freely connected gasket" includes the concept that the gasket is connected only to the drum shaft (through the dynamic connection), more

particularly that the gasket is not fixedly connected to the bearing hub or the support body. Such a term also includes the concept that the gasket is dynamically connected to the drum shaft both rotatably and longitudinally. When the gasket is connected freely to the drum shaft, the forces transferred to the gasket by the drum shaft will be substantially released, especially forces due to the reaction torque in the gasket caused by the motor torque and cyclic stresses due to the oscillations of the drum with respect to the tub during operation of the appliance.

Optionally, the shaft can comprise a recess in which the gasket is dynamically connected to prevent or limit the longitudinal movement of the gasket on the drum shaft. In particular, the outlet of the gasket when it slides longitudinally on the shaft. Comprised also can be the case wherein the gasket is dynamically and freely connected to the drum shaft. The recess can be contoured in cross-section to prevent or reduce the accumulation of water or liquid from the tub in the recess.

In the case where the support body comprises a bearing hub rotatably connected to the drum shaft, the gasket can be fixedly connected to the bearing hub, and in addition dynamically connected to the drum shaft. In conventional household appliances, the drum shaft is rotatably connected to the bearing hub through a sealing ring fixedly connected to the bearing hub. The present invention enables provision of the retaining function to the gasket. In this manner, one can obtain a double sealing of the bearings, that provided by the gasket and that provided by the sealing ring, and said sealing ring can even be omitted, preventing the water or liquid from escaping from the tub through the dynamic connection between the drum shaft and gasket exclusively by means of the gasket. In this manner, it is possible to reduce manufacturing and maintenance costs as well as to increase the service life of the gasket and the household appliance. In the case that the gasket is fixedly connected to the bearing hub, this connection can be achieved in a positive fit , for example fitted or clipped and/or by tractional forces, for example, by adhesive or by welding. In an advantageous embodiment, the sealing ring and gasket are integrated into a single piece.

The gasket can comprise an element for fixing to a tub, which fixes the gasket to the tub, a body, and a dynamic connection element, for example, such as a dynamic seal, which dynamically connects the gasket to the drum shaft. Preferably, the dynamic connection element is pressed against the drum shaft, that is, radially compressed.

The shape of the gasket and/or the gasket body can be substantially cylindrical. Also, the shape of the element for fixing to a tub and/or the dynamic connection element can be annular. In particular, the element for fixing the gasket to the tub that has an annular shape is fixedly connected to a contour of a circular opening in the posterior area of the tub.

The material of the gasket, in particular the material of the fixing element, body and/or dynamic connection element can be, for example, rubber or silicone. The material of the

dynamic connection element can be selected, at least in a region of contact of the gasket with the drum shaft, to provide reduced friction, such as for example PTFE or fluoroelastomer. It is also envisioned that the gasket can comprise a reinforcing material such as, for example, fiberglass, or a reinforcing structure such as, for example, an internal matrix of resistant material such as, for example, metal.

In a preferred embodiment, the gasket and/or the gasket body are flexible. The term "flexible" in this context includes the concept of easily deformable, particularly deformable in correspondence with the oscillations of the drum with respect to the tub during operation of the household appliance. In particular, the gasket and/or the gasket body can be elastic, that is, once deformed they are able on their own to return to their shape before deformation. Advantageously the gasket and/or the gasket body can have a reduced rigidity. The flexibility of the gasket provides the advantage of releasing internal forces in the gasket, enabling extension of the durability and reliability of the gasket and therefore of the household appliance. Additionally, the flexibility of the gasket allows decoupling the natural frequencies of the oscillating group with respect to the elastic or damping characteristics of the gasket itself. Advantageously, the gasket body can be in the form of bellows, allowing the provision of greater flexibility to the gasket, particularly decreasing rigidity.

The dynamic connection of the gasket to the drum shaft, in particular through the dynamic connection element, provides a sealing of the tub, preventing water or liquid from escaping from the tub through the contact zone of the gasket or dynamic connection element on the drum shaft. In a preferred embodiment, the gasket or dynamic connection element is lubricated, preferably with water or liquid from the tub. In another embodiment, lubrication can be obtained by impregnating the contact surface of the gasket or dynamic connection element with the drum shaft by means of a lubricant, for example grease.

The machine also has a suspension unit oscillatingly connecting the ensemble formed by the support body, the drum, and the motor with the frame such that there is no transmission of the vibrations from the drum during rotation with eccentrically loaded laundry therein.

The suspension unit of the support body can comprise at least one elastic element, such as for example a spring, and at least one damper. The elastic member(s) is/are preferably arranged so that the support body is suspended therefrom, and damper(s) is/are arranged preferably connected to the support body in a lower region of the household appliance. Another embodiment of suspension can comprise at least one block of elastic material, e.g., rubber or natural rubber, connected to the support body. The suspension unit can be connected to the support body, to at least one support arm, and/or the support body. Advantageously, the dampers can be of a rotary type as is disclosed in the publication

WO2011/070092, since the incorporation of such dampers in the suspension allows the freeing up of space around tub to arrange the elements of the heat pump integral to the frame or tub.

The motor can have direct or indirect transmission, in this case the household appliance includes a transmission that can comprise a belt pulley fixedly connected to the drum shaft and a fan belt for transmitting the motor torque. The motor can be fixed to the support body and/or at least one support arm, preferably the support arms located in a lower region of the household appliance.

With an arrangement of the tub integral to the frame, the space between them is kept constant and only the support arms and the dampers have a reduced movement in the lateral volume of the tub which confers a major advantage when arranging the elements of the heat pump that can be fixed to the frame or to the tub with much more space and no relative movement therebetween. That the entire heat pump ensemble is stationary relative to the appliance is an advantage since there is no need to include flexible connections between its components. Furthermore, the heat pump compressor works best in a fixed position. Also, by having the entire heat pump ensemble fixed to the tub, a very compact machine can be achieved since all the space between the frame and tub can be utilized to locate the heat pump. As used herein, the term "fixed" includes the concept of united, fastened, mounted, anchored, secured, or integrated. The term "fixed" means, in particular, that any of the components of the heat pump, i.e., compressor, and/or condenser, and/or evaporator, is fixedly coupled, in particular, is fixedly connected, through fixing means arranged between a part of said component and a part of the tub, or directly between a part of said component and a part of the tub or frame, especially in a stable manner. The term "fixedly coupled" is understood in particular to mean that a fixing means is arranged between the part of said component and the part of tub, or the tub, and optionally, additional means of fixation. The term "a part" includes the concept of an area of an inner surface or of an outer surface. The term "fixedly coupled, or connected" includes the concept of being coupled, or respectively connected, rigidly, firmly, integrally, or directly.

The term "fixing means" is understood to mean means suitable for fixing, especially means with the function of fixing, i.e., to fix said component to the tub or to the frame. The fixing means can include fixing means through tractional forces, such as for example by adhesive, by welding, etc. Alternatively, or in addition, the fixing means can include fixing means through positive fit, such as for example by press fitting, by tongue-and-grooving, by screwing, by riveting, etc. The term "press fit" includes the concept of clipping. Examples of fixing means can be a clamp, a flange, a tab, a stub, a screw, a washer, a rivet, etc.

The term "additional means of fixing" is understood to mean means suitable for supplemental fixing, especially means with a function supplemental to the fixing function, i.e., to supplement the fixing of said component to the tub or to the frame. The supplementary fixing means can include vibration isolation means such as a rubber bushing or "silent block" (e.g., for fixing the compressor), thermal insulation means, such as a blanket of thermally insulating material (for example, for fixing the condenser and/or evaporator), or sealing means, such as a sealing gasket.

In accordance with the present disclosure, the term "fixed" also means that at least part of any of the components of the heat pump, that is, the compressor, the condenser, and the evaporator, can be integral with the tub, in any part thereof, and especially forming a part thereof. This embodiment is applicable, for example, in cases where the tub is of plastic, and cavities or receptacles for receiving one or more of the heat pump components are formed therein. The constituents of the heat pump itself, for example, a housing of any of the components, can be formed at least partially as a single piece, for example, obtained by injection molding with tub.

Due to this important constructive feature of the present washer dryer in which at least one of said compressor, said evaporator, and said condenser is fixed to the tub, it is possible to provide an arrangement in which any component of the heat pump can be positioned substantially near or adjacent to the tub, allowing better use of the available space around tub, and especially being able to obtain an extremely compact ensemble. In addition, the compactness of the ensemble advantageously allows for an increase in the capacity of the drum to accommodate more laundry, and particularly for drying wet laundry.

Furthermore, many additional advantages are obtained with said characteristic, such as allowing a reduction in the length of the air circuit ducts or of the coolant circuit, with the consequent advantage of reducing energy consumption by reducing load losses or friction of the fluid, especially air, in the ducts. Even the use of flexible ducts can be avoided or reduced, especially with flexible air ducts. Furthermore it becomes possible to fix a larger number of components to the tub, especially compressors, condensers, and/or evaporators.

Preferably, the present washer dryer has a horizontal shaft, i.e., with the drum rotation shaft being substantially horizontal. However, embodiments in which the drum rotation shaft is arranged at a substantially upward angle are also envisioned.

In the present washer dryer, at least one component from among the compressor, the evaporator, and the condenser is fixed to the tub. Embodiments are anticipated wherein at least two of said components are fixed to the tub independently from each other. For this, fixing means that are independent from each other can be provided for each of said components. The expression "components are fixed to the tub independently from each other" includes the concept that the fixing of one of said components to tub does not require the fixing of another of said components to tub, and also includes the concept that the fixing of one of said components doesn't imply the fixing of any other of said components. At least two of the components of the heat pump that are not fixed to tub independently of one another, especially at least two of the components that are not fixed to the tub, can be configured into the same module, for example fixed to the same structure or support.

The evaporator of the present washer dryer, as indicated above, can be fixed to the tub, can be, for example, a finned pipe, or a tube and fins. One embodiment considers that the evaporator has a substantially prismatic shape, configured so that the air flow passes through the condenser along a direction along an edge of the prismatic shape. Alternatively, the evaporator can be a roll-bond type, obtainable for example by joining, especially by welding, two metal sheets, for example of aluminum, superimposed with the coolant duct formed between the two plates, the coolant duct being obtainable, for example, by blow molding. The evaporator can be provided with suitable coatings, such as for example ceramic coatings or paint intended to prevent the formation of oxide, the adhesion of lint, etc. The evaporator can be fixed in an air duct of the air circuit, which can be fixed to the tub. The evaporator can comprise a housing fixable to the tub or to the air duct. Alternatively, the evaporator can comprise a metal tube overmolded in plastic from the tub.

In one embodiment, the evaporator of the present washer dryer can be arranged on an inner surface of the tub, especially in a lateral position thereof, between the tub and the drum, to exchange heat effectively with the interior of the tub. In this way, the moist air flow can pass adequately through the evaporator which is arranged on said surface of the tub. The evaporator can be fixed to the inner surface of tub, for example, by overmolding at least partially, by screwing, by riveting, welding, press fitting, gluing, etc. In this particular embodiment, in which the evaporator is in thermal contact with the inside of tub, the evaporator can be a roll-bond type, formed from sheet metal with an appropriate curvature to conform to the curved inner surface of the tub.

In embodiments in which the evaporator is adapted to cool the air flow, moisture in the hot air condenses on the lateral wall of the tub and falls to a drain outlet, being easily evacuated.

This avoids the need for an additional pump to drain the condensed water. Furthermore, the lint that can accumulate in the evaporator during drying can be easily removed, for example, by means of the water from previous washing cycles, which avoids the need to use filters, simplifying assembling and reducing costs.

As noted above, there are embodiments wherein the air circuit is adapted so that the air that flows through the tub exits the tub in a lateral area thereof. In this way, the air circulation through the tub is facilitated advantageously to favor condensation, especially in an area outside the drum in which the evaporator is in thermal contact with the interior of tub.

Embodiments are also envisioned in which the air flow exits through a back part of the tub, in particular, a rear lower part. This configuration favors condensation by improving the passage of moist air flow through the area between the drum and the tub, and moreover the tub being stationary and having no motion relative to the air circuit reduces the problems caused by vibrations and movements that occur in machines of the prior art. While the annular gasket connects the tub with the support body or the drum shaft, it can also be part of the air circuit.

The condenser of the present washer dryer, as indicated above, can be fixed to the tub, and can be, for example, a finned pipe, or a tube and fins. One embodiment considers that the condenser has a substantially prismatic shape, configured so that the air flow passes through the condenser along a direction along an edge of the prismatic shape. The condenser can be fixed in an air duct of the air circuit, in particular it can be fixed to the tub. The condenser can comprise a housing fixable to the tub or to the air duct.

The condenser can be adapted to heat the air flow and/or the evaporator can be adapted to cool the air flow. The heating of the air flow can evaporate moisture from the laundry while its cooling of the moist air flow allows the moisture in the air to condense in form of condensed water. In this sense, embodiments are envisioned in which only the condenser (not the evaporator) is adapted to exchange heat (warming) with the air flow and/or embodiments wherein only the evaporator (not the condenser) is adapted for exchanging heat (cooling) with the air flow.

The compressor of the present washer dryer can be fixed to the tub or to the frame by means of fixing means comprising tabs and corresponding tongue-and-grooved stubs. For this, the compressor can comprise a housing with integrated tabs. At least part of the housing and the tabs can be obtained via injection molding in one piece, for example, of plastic. The tub can

comprise integrated stubs, and at least part of the tub and the stubs can be obtained by injection molding in one piece. The compressor can be fixed by means of complementary fixing means, such as vibration isolation means, such as for example "silent blocks".

The compressor can be of a rotary type, although other types of compressors are not ruled out. In this regard, alternative types of compressors can be used, although they are not as preferable. In particular, it is preferred to use a rotary compressor of the rolling piston type and of the displaceable piston type. More preferably, the present washer dryer includes a rotary type compressor with a horizontal rolling piston, fixed or controllable speed, powered either by alternating current or by direct current. This type of compressor is preferred due to savings in energy, cost and space.

The washer dryer described can include means for heating the air flow. These means for heating the air flow can be selected from the group consisting of at least one electrical resistance, at least one bulb, such as a halogen bulb or infrared, bulb and/or a combination thereof. These means for heating the air flow can be complementary or alternative, or activated complementarily or alternatively, to the heat pump. The present washer dryer can also include means for cooling the air flow. These auxiliary means for cooling the air flow can be selected from the group consisting of cooling water, such as fresh water from the mains, cooling air such as ambient air drawn in from and expelled to the atmosphere, and a combination thereof. These means for cooling the air flow can be complementary or alternative, or activated complementarily or alternatively, to the heat pump. Incorporating a heat pump in combination with other means for heating and/or cooling can increase the speed of drying, in particular, by making it possible to increase the amount of evaporated moisture and/or the amount of condensed water.

Preferably the tub can be formed from a single piece joined to the frame through the interior of the front or side walls and through its rear opening part, being closed with the annular gasket that closes same with the support body. However, the tub can also be formed via a plurality of parts, especially by two half-tubs. These parts or half-tubs can be fixed together, in particular, hermetically. The mutual coupling of the half-tubs can be disassemblable. Then at least one of the parts of the tub is joined to the frame, preferably the front part of the tub closest to the front wall of the machine. One or both of the half-tubs can be made of plastic, for example, by injection molding. These parts or half-tubs can be fixed together by any suitable conventional means known in the art, such as screwing, welding, preferably by ultrasonic welding. In a disclosed embodiment of the washer dryer in which the tub is formed by two half-tubs hermetically fixable together, at least one of the compressor, the evaporator

and the condenser is fixed to one, or the other, or both of said half-tubs. It is also anticipated that if the tub is plastic, at least a portion thereof can comprise at least one coolant duct overmolded with the tub, or integrated therewith, or by means of anchoring of the coolant duct.

In any case, embodiments are anticipated in which at least one of the compressor, the evaporator, and the condenser have a shape complementary to the shape of the outer surface and/or inner surface of the tub. This allows a good adaptation of the compressor, and/or evaporator, and/or condenser to obtain a still more compact ensemble.

With the washer dryer described, numerous advantages can be obtained besides those mentioned above regarding the high degree of compactness by fixing the components of the heat pump in the tub, improvements in the thermodynamic efficiency, and speed of drying of the laundry.

For example, the aforementioned distribution of the components of the heat pump in the tub can provide interesting dynamic improvements since no element of the heat pump ensemble is in motion, making the ensemble more compact. This advantageously results in no relative movement between these elements, thereby reducing vibrations and consequently increasing the service life of the ensemble by producing less wear between the parts.

Another advantage is that a great simplification of the ensemble can be obtained, especially as it relates to the construction, manufacture, gasket, repair or maintenance, especially because it enables improved accessibility to the various components of the pump heat and/or to the coolant circuit. Many operations can be simplified such as the connection between the various components of the heat pump and the coolant ducts, as well as coolant leak detection, for example. These operations can be brought about separately for, at least, various parts of the coolant circuit, in particular coolant ducts and/or various components of the heat pump, which are at least partially fixed to the tub or to the frame.

In addition, integration or fixing of the components of the heat pump in the tub or to the frame also allows great flexibility and adaptability of design because the various embodiments of washer dryers can be obtained with characteristics different from a common module comprising at least part of the tub fixed to the frame, in particular a half-tub, with the heat pump at least partially fixed thereto. The flexibility and adaptability of design is evident also in the possibility of obtaining various models of washer dryers with a suitable thermodynamic efficiency and/or rapidity of drying.

DESCRIPTION OF THE DRAWINGS

Various specific embodiments of the present washer dryer will be described below. The description of said embodiments is given as a non-limiting example with reference to the accompanying drawings.

In said drawings:

Figure 1 is a general partial frontal elevational view schematically showing an embodiment of the present washer dryer with heat pump integrated into the tub;

Figures 2 and 3 are side elevational views of the present washer dryer with heat pump integrated into the tub fixed to the frame in its front wall, wherein are respectively shown an example in which the air exits through a rear part of the washer dryer and an example in which the air exits through a lateral part of the washer dryer;

Figure 4 is a perspective view of the front of the tub and a part of the machine frame;

Figure 5 is a perspective view respectively showing an embodiment of a first half-tub with air outlet through a lateral part of the half-tub, and an alternative embodiment of said first half-tub with air outlet through a rear part of the half-tub;

Figure 6 is a schematic cross-sectional view of a washer dryer with direct drive motor;

Figure 7 is a schematic cross-sectional view of another washer dryer with an indirect drive motor;

Figures 8 give a perspective view of a support body with fixing of an indirect drive motor and body for connection to an annular gasket;

Figure 9 is a detail of the annular gasket for dynamic connection to the drum shaft;

Figures 10 through 12 are schematic perspective views of various embodiments of the condenser that can be mounted on the present washer dryer;

Figure 13 is a schematic perspective view of an embodiment of an evaporator adapted to be integrated into the inside part of the tub of the present washer dryer; and,

Figure 14 is a frontal cross-sectional view of the washer dryer machine according to the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

In the figures are illustrated some particular non-limiting examples of the present washer dryer. The washer dryer as an ensemble is designated in the drawings by reference 100. In

the non-limiting illustrated example, the washer dryer 100 has its axis of rotation substantially horizontal and is of the oscillating type by means of springs and dampers (not shown).

In general, the washer dryer 100 comprises a structure 101 supported on support legs 102. As shown in the general view in Figure 1 of the drawings, the washer dryer 100 includes, at the top, a water inlet 111. The water inlet 111 passes through a solenoid valve 111a, towards the interior of the drum 120, which will be described below, the water being provided from the mains and which then passes through the detergent compartment 112, which is shown schematically in Figures 2 and 3.

At the bottom of the washer dryer 100 is arranged a water outlet tube 115 that provides for the drainage of water 116 from the tub 110 of the washer dryer 100. The water is expelled to the outside by means of a pump 117 and passes through a filter 118a of the pump appropriate for use before the pump body 118b.

The washer dryer 100 illustrated comprises a wash tub 110. The tub 110 accommodates in its interior the cited drum 120, which is rotatable relative to the tub 110. As indicated for the embodiment illustrated, the drum 120 has its shaft 121 arranged substantially horizontally, and is adapted to receive therein fabrics to be washed 200. Figures 8 and 9 show the drum 120 rotatably mounted within the tub 110. The drum 120 has a perforated surface inside which several wash drum baffles 122 are arranged. The baffles 122 have the function of beating against the laundry 200 that is accommodated inside the drum 120 while same rotates during the washing. Conventionally, the washer dryer 100 achieves the washing of laundry 200 through the combined action of mechanical beating by these baffles 122, the chemical action of the washing product, such as detergent or softener provided from the detergent compartment 112, and the action of temperature, by heating the wash water. Figures 8 and 9 also show that the tub 110 includes a bellows seal 124 for coupling the tub 110 to the frame 101 of the washer dryer 100 in a watertight and flexible manner.

The perspective view of Figure 4 shows the tub 110 fixedly connected to the two side panels of the frame 101. The frontal front frame panel 35 incorporates a loading opening 30, and can also include various holes for control elements of the machine 100 as well as for the compartment for washing product. The tub 110 and the frame 101 can be made of plastic. The side panel of the frame includes an anti-vibration footprint that provides an effect of damping of vibrations and/or noises.

Referring to Figure 6, the household appliance 100 with horizontal shaft and front loading comprises a frame 101 that provides an external appearance, a tub 110, a drum 120, a support body 7, a suspension 8, a motor M, and a counterweight 13. The tub 110 is fixedly connected to or integrated with the frame 101. The drum 120 is accommodated within the tub 110 and comprises a drum shaft 121, substantially horizontally arranged in a rear region of the drum 120, a lateral drum strip 61, a rear drum support 63, and at least one baffle 122 fixedly connected on an inner surface of the drum 120. The support body 7 of the drum 120 comprises a bearing hub 73 provided at a rear area of the support body 7. The suspension 8 comprises at least one spring 81 and at least one damper 82. The motor M is direct drive and is fixed to the support body 7 in a rear area of the support body 7. The drum 120 is rotatably connected to the support body 7 via the drum shaft 121 and the bearing hub 73, such that the drum 120 is rotatable with respect to the tub 110 about the drum shaft 64 by the action of the motor M, and the support body 7 is oscillating with respect to the tub 110 in tandem with the drum 120 and the motor M. The counterweight 13 provides static and/or dynamic balance to the oscillating group, which comprises the drum 120, the support shaft 7, and the motor M. The suspension 8 is connected between the frame 101 of household appliance 100 and the support body 7. The front frame 100 comprises a frontal front housing panel 35, a frontal rear housing panel 36, a top housing panel 37 and a bottom housing panel 38. The tub 110 is fixedly connected to the frontal front housing panel 35. A frontal loading door 2 closes and seals the tub 110 in a front area of the tub 110. Additionally, the household appliance comprises a flexible rear gasket 9 arranged in a rear area of the tub fixedly connected to the tub 110 and to the support body 7, and sealing the tub 110. The tub 110 comprises a front portion 110b and a rear portion 110a joined together, for example, by means of welding, by a joining flange 55 located in a plane perpendicular to the extension of the drum shaft 110. The joining flange 55 particularly facilitates the welding operation by providing support for clamping the welding pins.

As shown in Figures 4 and 5 from the drawings, the wash tub 110 is formed by two parts or half-tubs 110a, 110b. Both half-tubs 110a, 110b are made of plastic and are designed to be coupled together hermetically through ultrasonic welding. The front half-tub 110 is joined to the frame 101 by the front panel 35 of same. The rear half-tub 110a includes an air outlet 113 formed in a lateral part. Moreover, on a bottom part of the half-tub 110a is formed a cavity 114a such that in mounting position with the half-tubs 110a, 110b hermetically coupled together, the cavity 114a of the half-tub 110a is closed by a complementary part 114b of the other half-tub 110b defining an accommodation for the drain 116. This accommodation formed by the cavity 114a of the half-tub 110a and the complementary part 114b of the half-

tub 110b can be adapted to receive at least one electrical resistance 171 as shown schematically in Figures 2 and 3 of the drawings.

The washer dryer 100 also comprises a closed air circuit. The closed air circuit can be fixed to the tub 110 of the washer dryer. In this air circuit, the air recirculates by the combined action of the rotation of the drum 120 and the action of the fan 140. The fan 140 is mounted at the top of the washer dryer 100, as can be seen in Figures 1, 2, and 3. The hot air that dries the laundry 200 contained within the drum 120 passes through the tub 110, passing through the front region of the tub 110 and exiting through the lateral region thereof.

A heat pump is provided to exchange heat with the air flow. In the embodiment shown, the heat pump includes a compressor CP, a condenser C, and an evaporator E. In the example shown in Figure 1, all the components of the heat pump, that is, the compressor CP, the evaporator E, and the condenser C, are fixed to the tub 110. In this particular example, the compressor CP, the evaporator E, and the condenser C are fixed in one of the half-tubs 110a via their own fixing means, which are independent of each other. In the example shown, the evaporator E is fixedly connected to a lower lateral surface of the tub 110a, the compressor CP is fixed to the tub 110 through several tabs 150 integrated into a compressor housing CP, which can be tongue-and-grooved to corresponding stubs (not shown) of the tub 110, being able to provide fixing appropriate "silent blocks" to reduce vibration or noise during the operation. To ensure the tongue-and-groove fixation, for example, threaded screws can be incorporated in the direction of the stubs or expandable stubs, in a manner known per se. As shown in Figure 1, the components C, CP, E of the heat pump are fixed to the surface adjacent to the tub 110, that is, in a region very close thereto. In this way, an extremely compact ensemble is obtained.

Continuing with the reference to Figure 1 of the drawings, the CP compressor intended for pressurizing a coolant fluid that circulates within to raise the pressure and temperature thereof, is fixed as indicated in an upper lateral position of the tub 110, as is shown for example in Figures 1 and 5.

The coolant circuit of the heat pump is configured by connecting the coolant ducts between the inlet connections 125a and the corresponding outlet connections 125b.

The air ducts and/or the coolant ducts represented, particularly in Figures 2 and 3, can be at least partially rigid or flexible, but since the heat pump is stationary, it is preferable to use more reliable rigid coolant ducts.

While the condenser C is shown in the figures as being arranged before the fan 140 along a direction of the air flow in the air circuit, it is also envisioned that it can be arranged after the fan 140. In the first case the fan 140 operates by sucking in air, while in the second case the fan 140 operates by driving air from/to the condenser.

A preferred embodiment uses a hermetic rotary-type compressor CP with its own incorporated motor, independent from the motor that drives rotation of the drum. Other options can include, however, a hermetic rotary-type compressor without an incorporated motor having means for magnetic coupling to a motor. It is also envisioned that the compressor can be driven by the motor that drives the drum, for example, by means of a transmission mechanism with a suitable transmission ratio that can include transmission means and clutch means. Together with the compressor CP is arranged a suction accumulator 190, such as is shown in Figures 1 and 5.

The condenser C receives the pressurized coolant fluid from the compressor CP where it transfers heat to the process air. The condenser C can be fitted into the air duct of a closed air circuit. The air flow can exit the tub via an air outlet 113 that is located on a lateral part of the tub 110 as in Figure 5, or the air outlet can be located in a rear portion of the tub 110. The air circuit can be fixed to the tub, at least in part, or fixed to the frame of the washer dryer, at least in part. In the case where the air ducting is fixed to the tub, the fixing of the condenser C to the tub 110 can include one or more elements of thermal insulation between the condenser C and the tub 110.

Figure 7 shows an embodiment in which, unlike the embodiment shown in Figure 6, the motor M has indirect transmission. For driving the rotation of the drum 120 relative to the tub 110, the household appliance 100 comprises a belt pulley 22 connected to a transmission belt 21 driven by the motor M. The motor is fixed to the support body 7 in a support arm 72 at the bottom of the appliance 100. In addition, the counterweights 13 of the oscillating group are fixed to the support arms 72. In this embodiment, the annular gasket connects the tub 110 to the drum shaft 121.

Figure 8 shows a perspective view of a support body 7. The support body 7 comprises a body 71 intended to be arranged in an area to the rear of the tub 110, and four support arms 72 intended to be arranged in an area lateral to the tub 110, two in an upper region and two in a lower region. In the embodiment shown, the support arms 72 are fixedly connected to the body 71 by means of screws. Each of the two arms of body 72 comprises a connecting

element 17 from support body to spring. Each of the lower arms from body 72 comprises at least one connection element from support body to damper 15, preferably one of the lower arms from body 72 incorporates connection elements from support body to damper 15, while the other lower arm of body 72 incorporates a single connection element from support body to damper 15 (not shown). The motor M having indirect transmission is fixed to the support shaft 7 in a rear region thereof by means of corresponding female fixing elements 19 and male fixing elements 20 and, additionally, fixing screws. This support body 7 is configured especially so that the gasket 9 is connected to the outer perimeter of the body 71 and to the tub 110 as shown in the embodiment of Figure 2.

Figure 9 shows a cylindrical gasket 9 arranged between a rear part of the tub 110 and the drum shaft 121, being fixedly connected to the tub 110 by means of a fixing element gasket to the tub 91 and dynamically connected to the drum shaft 121 by means of a dynamic connection element 93. The drum shaft 121 is fixedly connected to the drum support 63 showing same having a bushing 65 to facilitate sliding of the dynamic connection element 93 over the shaft. Moreover, the drum shaft 121 is covered by a bushing 65 and rotatably connected to the bearings 24 of the bearing hub 73. Additionally, the element for fixing to the tub comprises an annular reinforcement framework 911, for example metallic, that reinforces the fixing the gasket 9 to the tub 110. The gasket 9 can be flexible. The gasket 9 is also fixedly connected to the bearing hub 73 or the body 71 in the area of the rotational connection of the drum shaft 121 with the support body 7. The gasket 9 has the form of bellows.

The present washer dryer 100 can utilize various types of condenser C. Figures 10-12 illustrate examples of condenser C that can be used in the present washer dryer 100, although other types of condenser C are not ruled out provided that they are suitably adapted for air to pass through the condenser, particularly to cross the condenser C or make contact therewith. For example, Figure 10 shows an embodiment of a finned pipe condenser C, Figure 11 shows a condenser C with tube and fins, and Figure 12 shows an embodiment of a microchannel condenser C. As can be seen, the embodiments of condenser C shown in Figure 10 have a substantially prismatic shape, adapted for air flow passing through the condenser along a direction along an edge of the prismatic shape (vertical direction in the drawings).

Figure 13 illustrates a particular embodiment with an example of an evaporator E. In this embodiment, the evaporator E is of a metallic roll-bond type, for example, of copper, aluminum, or stainless steel. The evaporator E has a curved shape that is complementary to

the curved shape of the inner surface of the tub 110, as previously indicated. A coolant duct is formed through the interior of the evaporator E. Externally, the metal support plate 124 of the evaporator E can have a cut-out 126, to accommodate elements of the tub, such as an air outlet 113 or water outlet 116 from the tub 110.

The evaporator E of the heat pump receives the coolant fluid from the condenser C. Having transferred heat to the process air flow in the condenser C, the coolant fluid reaches a cooler temperature and passes into the liquid state. After passing through an expansion valve V, as shown in Figure 3, the coolant fluid returns to its initial pressure, being lower than that in the condenser C. As discussed previously and can be seen in Figure 5, the evaporator E, particularly an evaporator of the roll-bond type, can be fixed to the inner surface of the tub 110, particularly in a lower region of the tub 110, between this tub and the drum 120 in a suitable position to allow heat exchange with the interior of the tub 110.

The evaporator E is used in the embodiment shown to condense water from the humid hot air by cooling it. However, one cannot rule out embodiments in which, alternatively or complementarily, the evaporator E is used to heat air or water in the tub 110 by operating the heat pump in reverse. In the latter case, an open air circuit with valves and specific conduits for the discharge of cold air can be provided. The condensed water 160, as noted, can be discharged from the tub 110 through the water drain 116. Neither can embodiments be ruled out wherein, alternatively or complementarily, the condenser C of the heat pump is used to heat water in the tub 110, particularly for washing.

In the embodiment of the washer dryer 100 shown in Figure 2 and also in Figure 3 of the drawings, auxiliary means are provided that are intended, alternatively or additionally, for cooling the air flow 220. These means for cooling the air flow 220 can comprise a flow of cooling air, or of cooling water, or a combination of both. In said Figures 2 and 3, the means for cooling the air flow 220 through cooling water is shown as a cooling water duct that allows for a water inlet passing through a solenoid valve 111b toward the tub 110. The means for cooling air flow can be achieved by means of cooling air that enters the washer dryer through a frontal bottom part, and that intersects with the flow of process air in a heat exchanger arranged in a region to the rear of the tub before being expelled through the rear part of the washer dryer. Said heat exchanger can be an evaporator E of the heat pump. It is also envisioned that the means for cooling can be arranged before or after the evaporator, along a direction of the air flow in the air circuit. Auxiliary means for cooling the air flow can be activated complementarily or alternatively to the evaporator E, according to requirements.

As with the means for cooling air flow described previously, means can be arranged for heating the air flow, such as is illustrated schematically in the embodiment shown in Figures 2 and 3 of the drawings. In some embodiments, the auxiliary means for heating the air flow are formed by at least an electrical resistance 170 although, alternatively or additionally, the auxiliary means for heating the air flow can be formed by at least one halogen bulb 180, for example, fixed to the tub or a door of the washer dryer, or even a combination of electrical resistance and halogen bulb. It is also envisioned that the means for heating can be arranged before or after the evaporator, along a direction of the air flow in the air circuit. Auxiliary means for heating the air flow 170, 180 can be activated complementarily or alternatively to the condenser C, according to requirements.

The washer dryer 100 illustrated also comprises means for driving the rotation of the drum 120. The means for driving the drum 120 comprises a motor M. The motor M is fixed to a rear support body in a posterior rear thereof, as shown in Figures 2 and 3 of the drawings. The motor M is adapted for directly driving the rotation of the drum shaft 121 of the drum 120. In another embodiment not shown, the motor M is fixed to a support arm and drives the drum shaft via a transmission formed by a rubber belt adequate for rotationally driving a pulley that is connected to the output shaft of the motor M and a corresponding pulley that is fixed to the drum shaft.

Water that has condensed in the process can be reused since it is clean water. In particular, the condensed water can be stored in a suitable tank or reservoir to be reused in other washing cycles of the present washer dryer 100.

Figure 14 shows a frontal cross-sectional view of the household appliance 100. The dampers 82 shown in these figures are of a rotary type, where these dampers provide the advantage of enabling a capacity gain in the tub 110, and additionally allow enlargement in the size of the tub radially towards the lower area of the household appliance 100 due to the inherent compactness of this type of damper.

The support body 7 comprises four support arms 72 joined to the body 71. The suspension 8 comprises two springs 81, each one connected between the frame 101 and a support arm 72 located in an upper region of the household appliance 100. Furthermore, suspension 8 comprises at least one damper 82 connected between the frame and each support arm 72 located in a lower region of the household appliance 100. It is preferable that at least one of the arms 72 positioned in the lower region of the household appliance is connected to exactly two shock absorbers 82 (not shown). The suspension 8 is connected between the frame 101 and the support body 7 via the corresponding connecting elements from support body to

damper 15, elements for connecting from frame to damper 16, elements for connecting from support body to spring 17, and elements for connecting from frame to spring 18. In this figure can be seen the drum 120, accommodated within the cylindrical tub 110, with the support drum 63 to which is fixedly connected the drum shaft (not shown). Fixed to the outer bottom part of the tub 110 is the compressor CP and the condenser C. Fixed in the inside surface of the tub 110 is arranged the evaporator E embodied as a roll-bond type as in Figure 13.

Several specific embodiments and examples of the present washer dryer have been described here. Nevertheless, one skilled in the art will understand that alternative embodiments thereof are possible, and that obvious modifications and equivalent elements are also possible.

Although this description is therefore intended to cover all possible combinations of the specific embodiments which have been described here, the scope of the claims to the specific embodiments disclosed is not limited in any way thereby, but should be determined only by a proper reading of such claims.

Numerical symbols relating to the drawings and placed between parentheses in a claim are only intended to amplify the understanding of the claim. They should in no way be construed as limiting the scope of protection of the claim.

CLAIMS

1. Washer dryer (100,) comprising a frame (101) within which is accommodated a tub (110) and a drum (120) accommodated inside the tub (110) with a drum shaft (121) that is rotatable relative to the tub, an air circuit adapted to circulate a flow of air through the tub (110), and a heat pump having at least one compressor (CP) and at least one condenser (C) and an evaporator (E) that can exchange heat at least with the air flow, **characterized in that** the tub (110) is integral to the frame (101).

2. Washer dryer according to claim 1, characterized in comprising a support body (7) that is rotationally connected to the drum shaft (121), an annular gasket (9) arranged between the tub (110) and the support body (7) or the drum shaft (121) for containing the washing liquid inside the tub, a motor (M) integral to the support body (7) for driving the rotation of the drum (120) through the drum shaft and a suspension unit (8) that oscillatingly connects with the frame (101) the ensemble formed by the support body (7), the drum (129) and the motor (M).

3. Washer dryer according to claim 2, characterized in that the support body comprises a plurality of arms (72) extending through the outside of the tub (110) in the axial direction of the drum and a plurality of dampers (81, 82) from the suspension unit connecting at least two of the plurality of arms (72) with the frame (101).

4. Washer dryer according to one of the preceding claims, wherein the tub has an essentially cylindrical shape and a front portion is fixed to the frontal inner wall (35) of the frame (101).

5. Washer dryer according to claim 1, **characterized in that** said at least one compressor (CP), the evaporator (E), and the condenser (C) are fixed to the tub (110) or to the frame (101) independently of each other.

6. Washer dryer according to any of the preceding claims, **characterized in that** at least one of said evaporator (E) and said condenser (C) which is fixed to the tub (110) can exchange heat within the tub (110).

7. Washer dryer according to claim 6, characterized in that said evaporator (E) is arranged on an inner surface of the tub (110)

8. Washer dryer according to claim 7, characterized in that said evaporator (E) is of the roll bond type and is formed to conform to the inner surface of the tub (110).

9. Washer dryer according to one of the preceding claims, characterized in that the air circuit is adapted to circulate the air flow through the condenser (C), and the heat pump is adapted to heat the air flow by means of said condenser (C).

10. Washer dryer according to one of the preceding claims, characterized in that the air circuit is adapted to circulate the air flow through the evaporator (E) and the heat pump is adapted to cool the air flow by means of said evaporator (E).

11. Washer dryer according to any of the preceding claims, characterized in that at least part of the air circuit is formed in the exterior wall of the tub.

12. Washer dryer according to one of claims 2 through 11, characterized in that the annular gasket (9) forms part of the air circuit.

13. Washer dryer according to one of claims 2 through 12, characterized in that the suspension unit (8) comprises at least one radial damper (82) arranged below the tub connected to the support body (7).

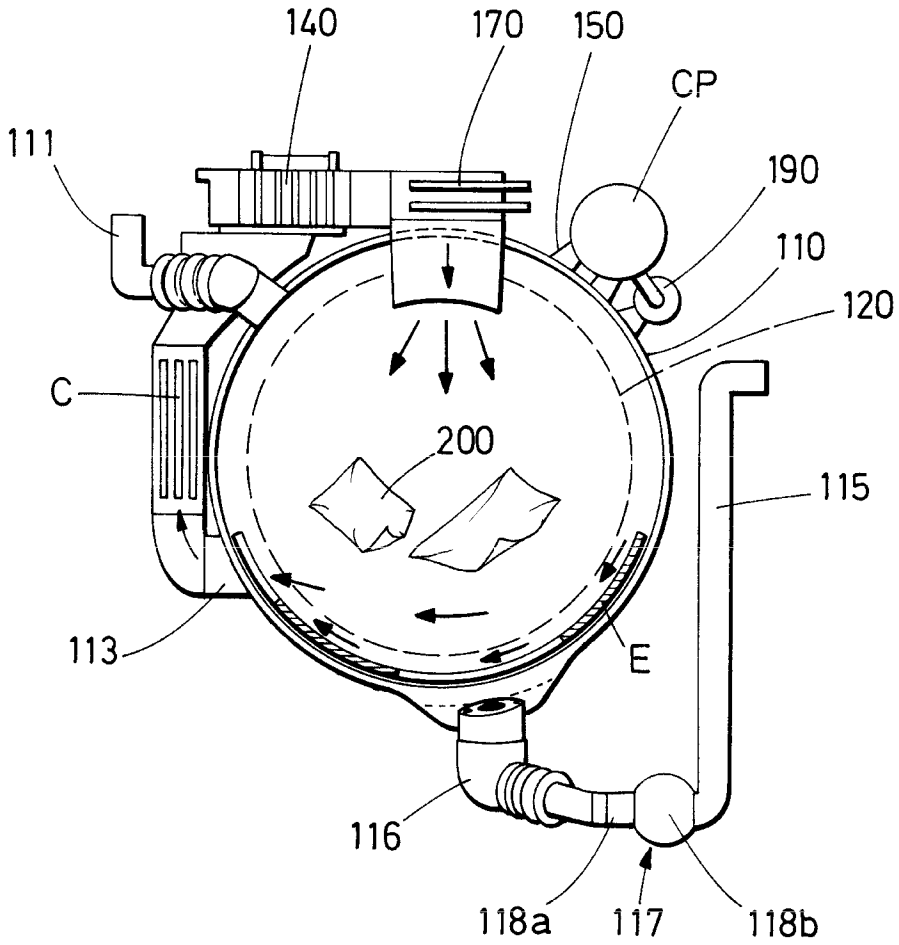

FIG.1

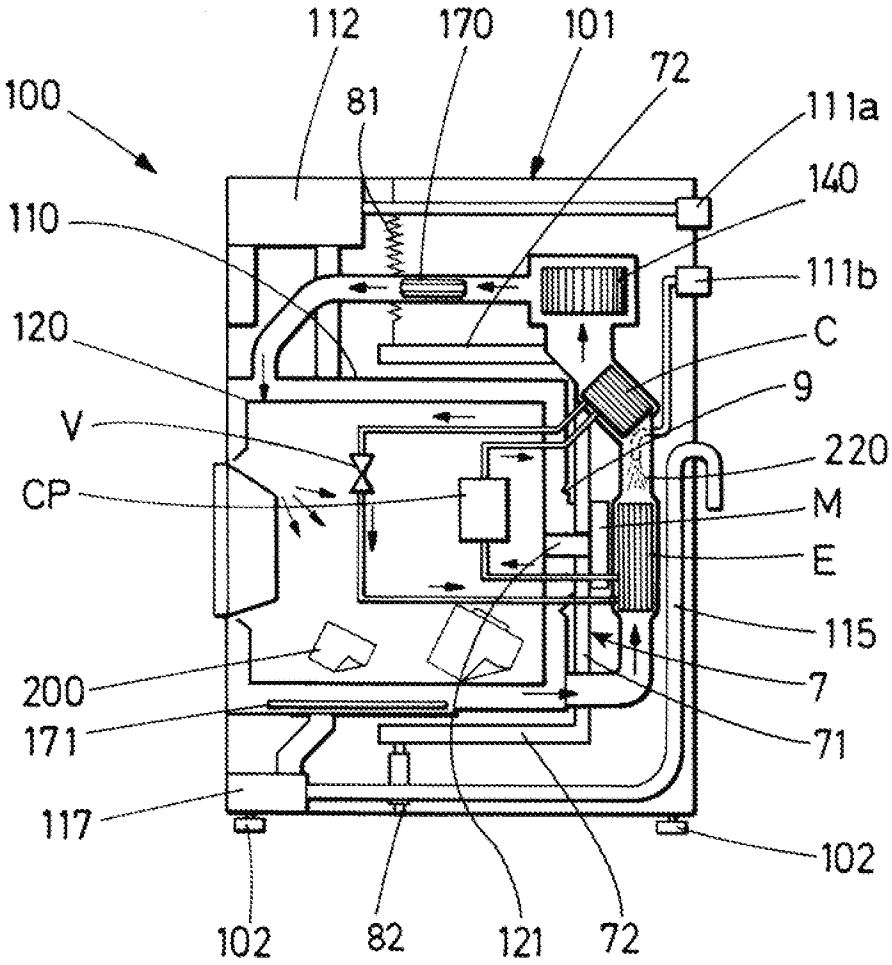
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FIG. 2

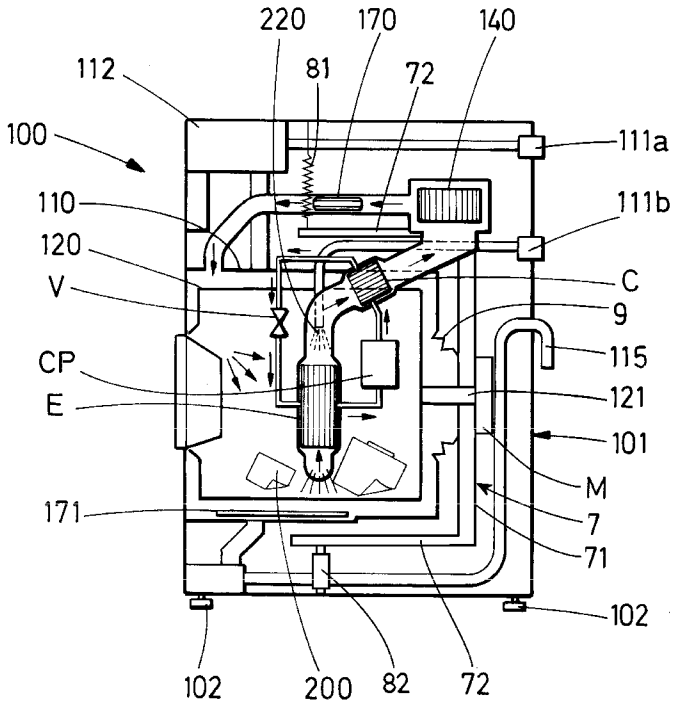
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FIG.3

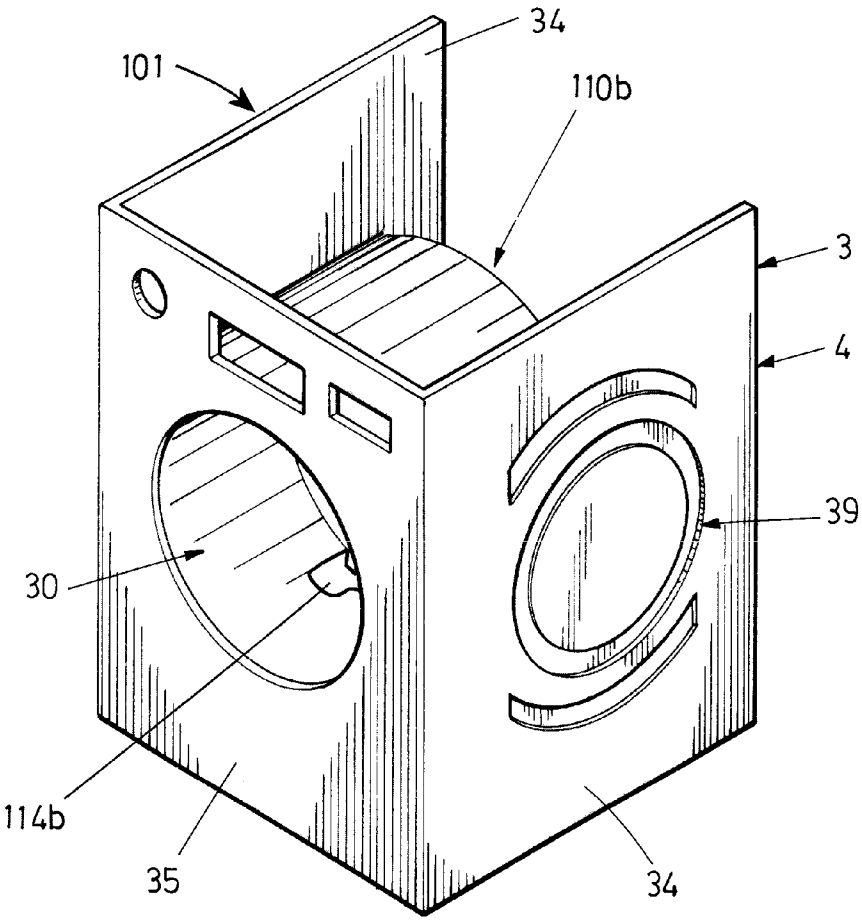

FIG.4

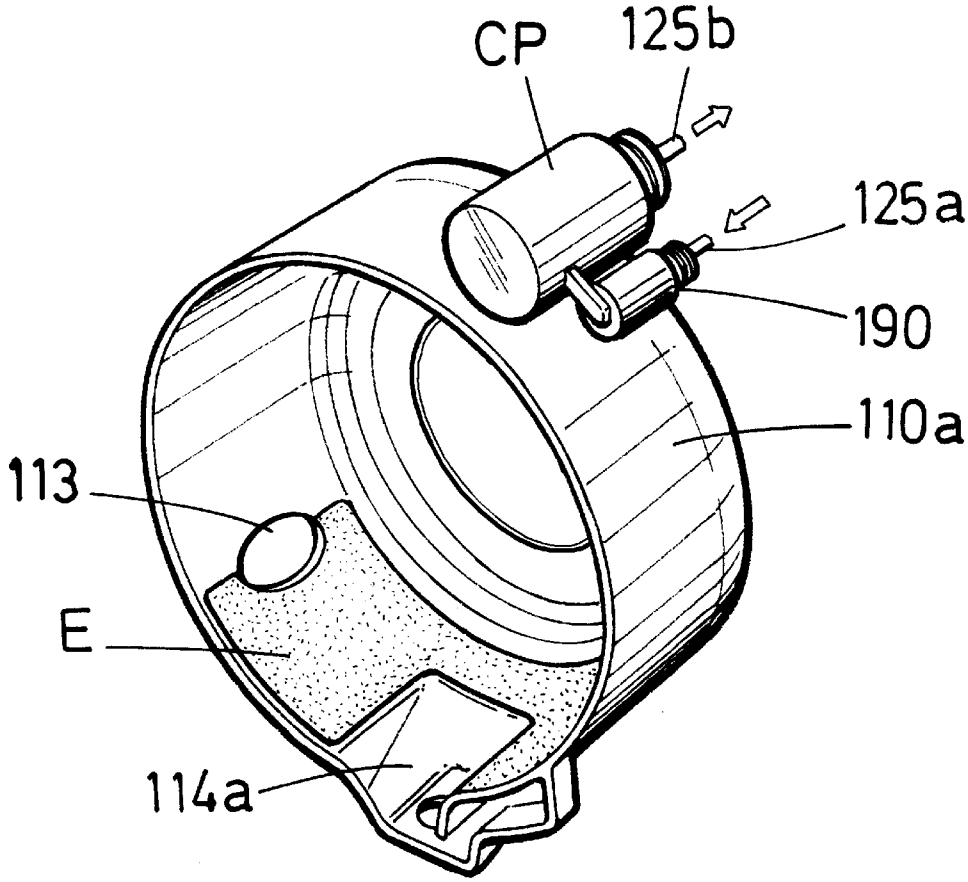

FIG.5

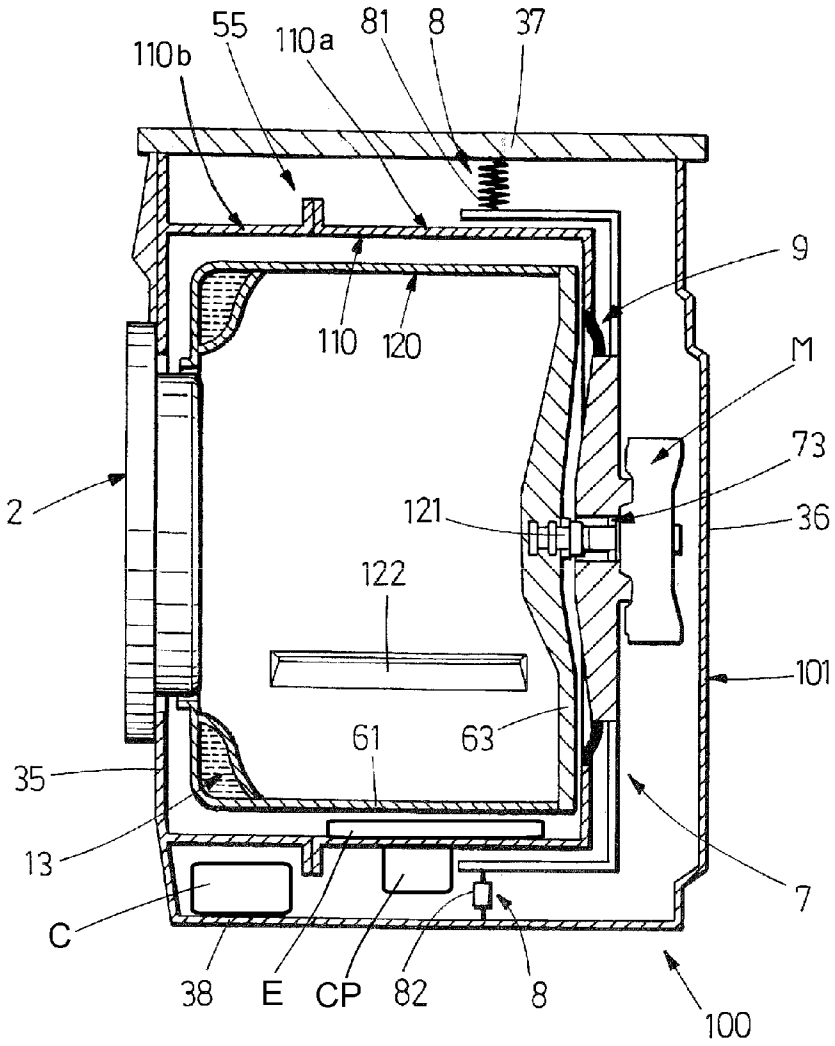
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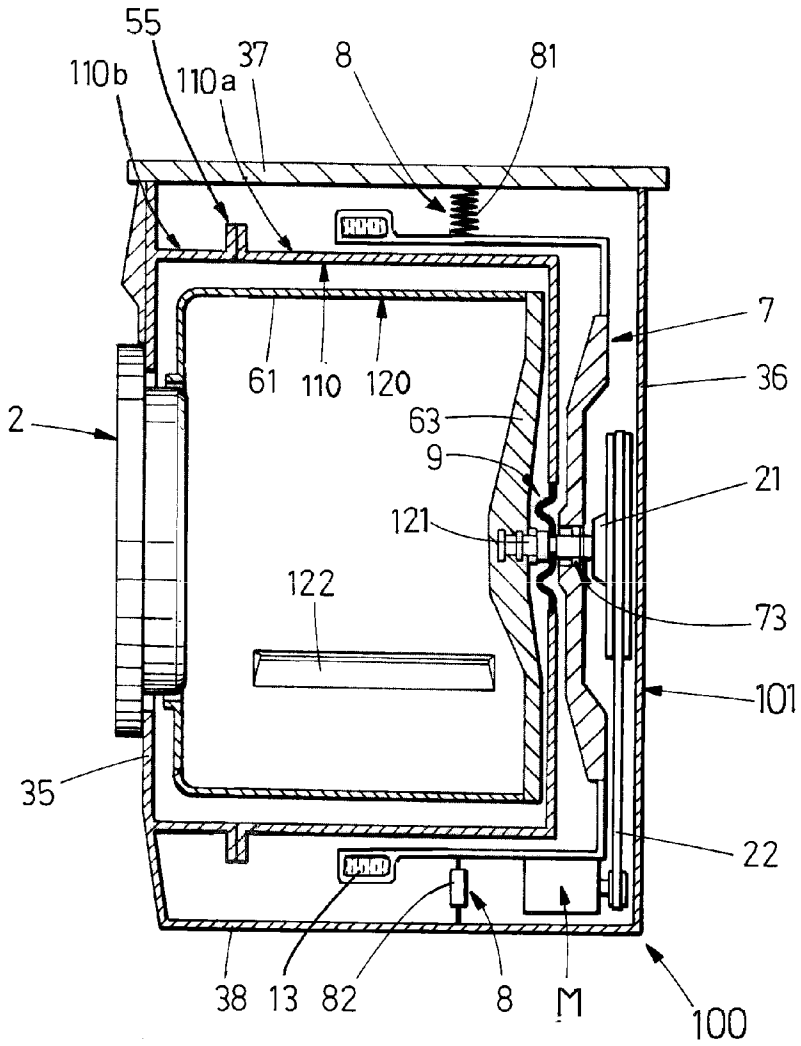
FIG.6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38
13
82
8
M
100

FIG.7

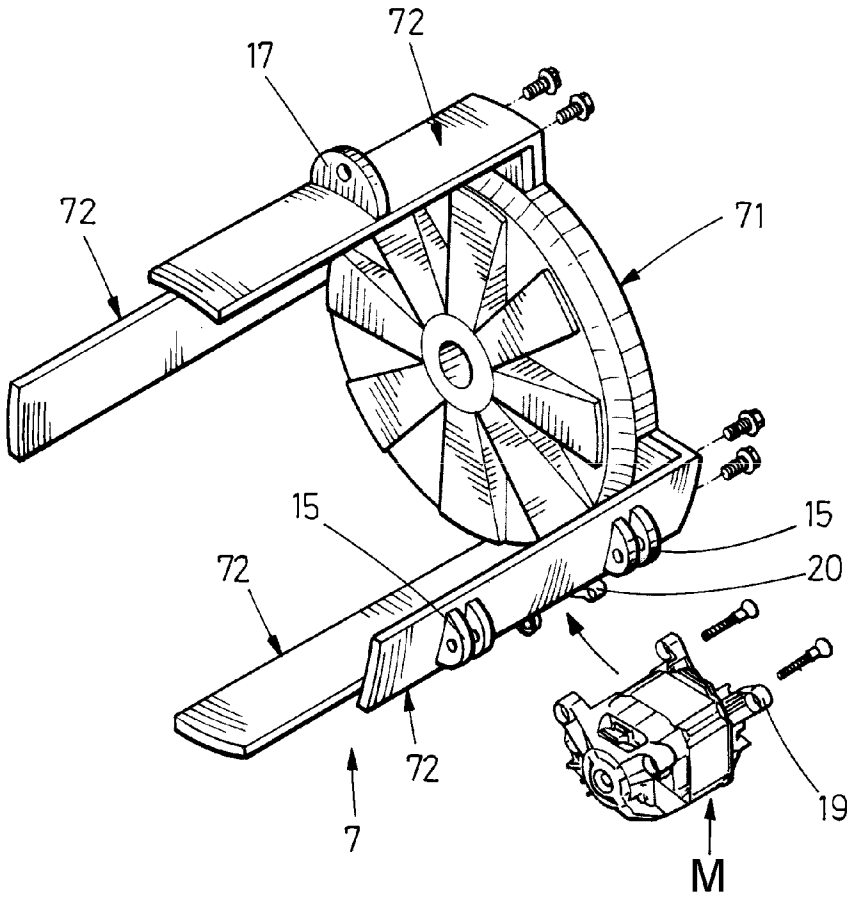

FIG.8

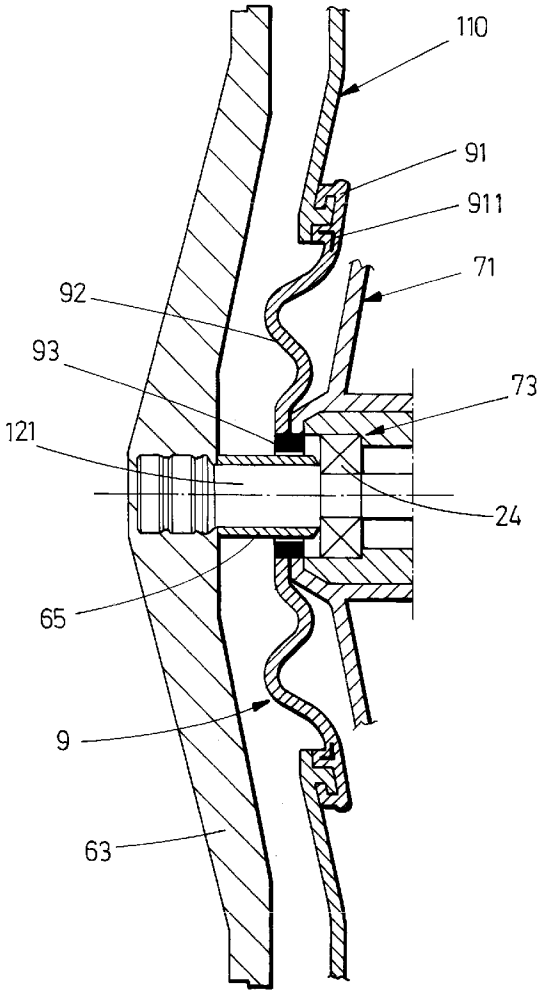

FIG.9

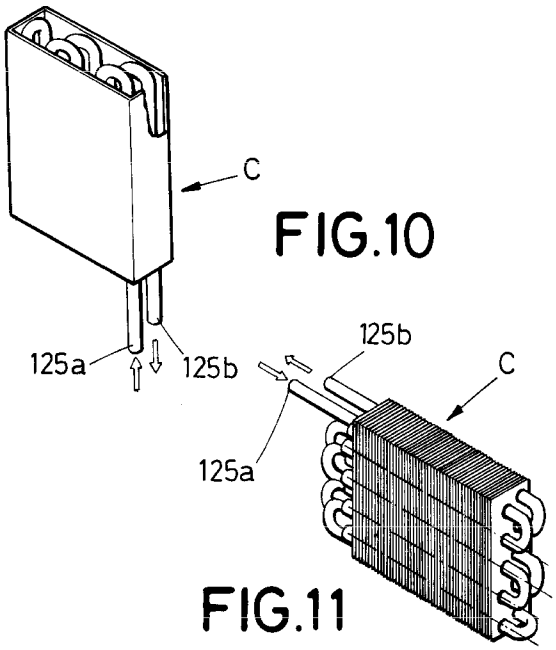

FIG.10

FIG.11

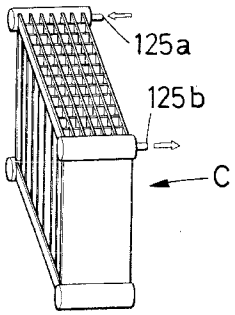

FIG.12

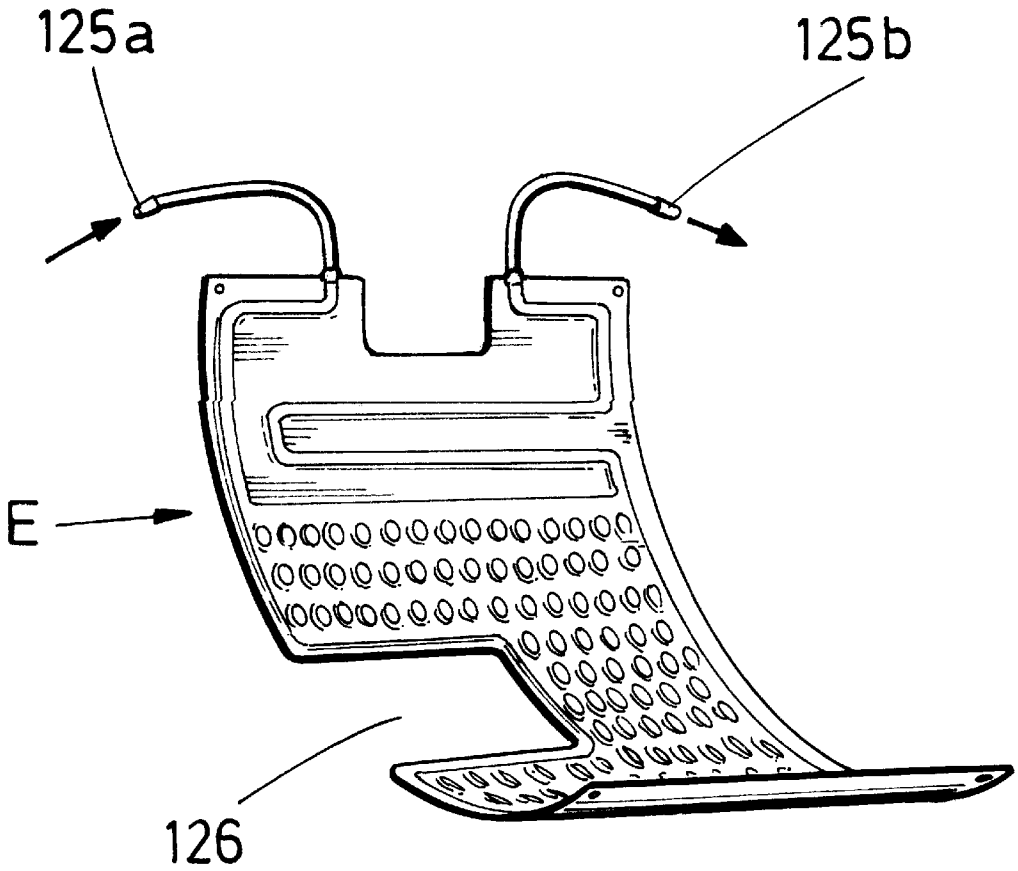

FIG.13

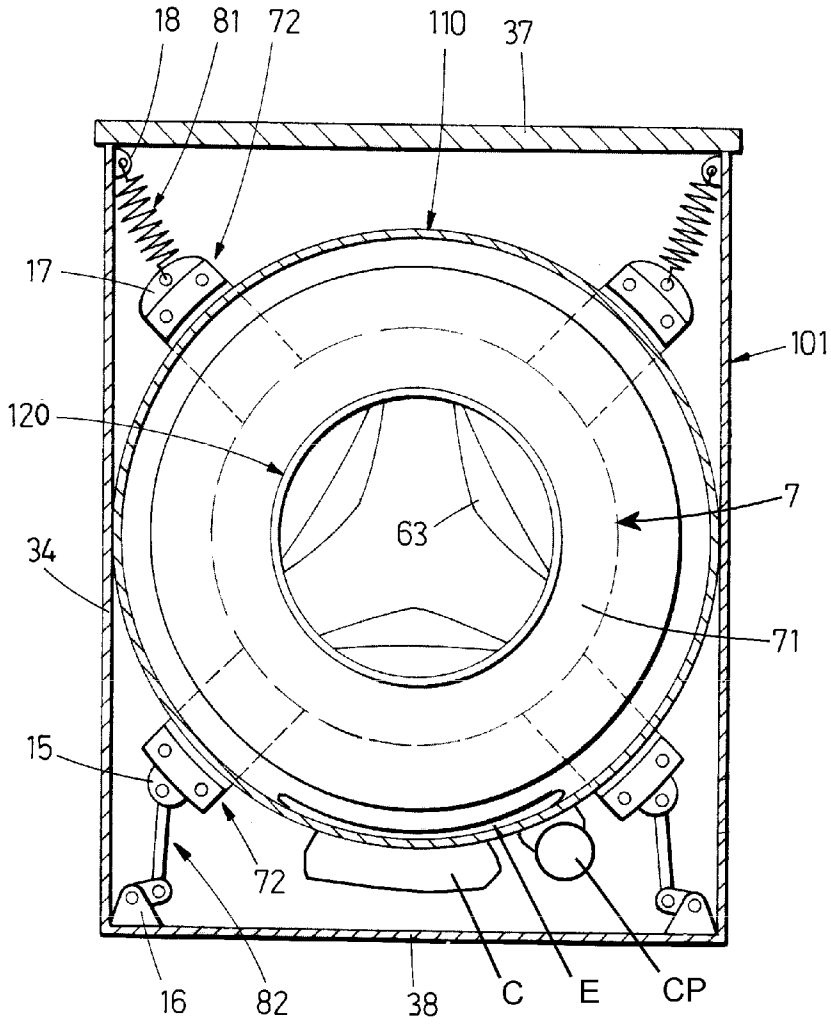

FIG.14

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/059279

A. CLASSIFICATION OF SUBJECT MATTER
INV. D06F25/00 D06F58/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 2 607 546 A2 (LG ELECTRONICS INC [KR]) 26 June 2013 (2013-06-26) paragraphs [0002], [0044], [0049] - [0054], [0065], [0095]; figures 1,2,11,13	1-13
Y	EP 2 759 634 A1 (PANASONIC CORP [JP]) 30 July 2014 (2014-07-30) figures 1,2,5,7	1-13
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 February 2016	12/02/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kising, Axel

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/059279

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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