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

(11) **EP 2 886 708 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
17.02.2021 Bulletin 2021/07

(21) Application number: **13382539.8**

(22) Date of filing: **20.12.2013**

(51) Int Cl.:
D06F 58/20 *(2006.01)* ***D06F 25/00*** *(2006.01)*
D06F 37/26 *(2006.01)* ***D06F 37/22*** *(2006.01)*

(54) Washer-dryer

Waschtrockner

Sèche-linge

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

(43) Date of publication of application:
24.06.2015 Bulletin 2015/26

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Description

[0001] The present invention relates to a washer-dryer comprising: a tub and a drum housed inside the tub in such a manner that the drum is rotatable with respect to the tub, the tub and the drum adapted for washing a laundry, an air circuit, adapted to circulate an air flow through the tub for drying the laundry, and a heat pump, adapted to exchange heat with the air flow, the heat pump including at least one compressor, at least one condenser and at least one evaporator.

[0002] The term "washer-dryer machine" includes the concept of a washing machine having a drying function.

State of the art

[0003] A washer-dryer of the generic type specified above is disclosed in EP 2 351 883 A2. Washer-dryers generally have the advantage of a saving in space since they incorporate both functions, washing and drying.

[0004] Washer-dryers are known in which the drying of the wet laundry contained in the washer-dryer takes place by applying an air current blown by a fan and which, when flowing through the laundry, provokes the extraction of humidity contained in said laundry. The air applied to the laundry can be heated, for example, by means of an electrical resistance, being loaded with the evaporated humidity. Then, the humid air can be discharged to the outside or condensed, turning into dry air, that can be recirculated in a closed circuit, humidity from humid air being thereby recovered in liquid state. In this manner, washer-dryers discharging air to the outside and air-condensing washer-dryers are defined. Washer-dryers discharging air to the outside have the drawback that they may require an installation to evacuate humid air outside the room in which they are placed.

[0005] Condensing washer-dryers are known, in which condensation of humid air is carried out by means of a heat exchanger by cooling with refrigeration air that is extracted from the ambient and expelled again to the ambient after flowing through the exchanger, being propelled by an additional fan as described for example in WO 2012/053751 A1. These washer-dryers have the drawback of the heating they can generate in the ambient of the room in which they are placed when the heated refrigeration air returns to the room.

[0006] Furthermore, condensing washer-dryers are known, in which condensation of humid air takes place by cooling with refrigeration water directly mixed with the humid air, as described for example in DE 10 2008 027 808 A1. These washer-dryers have the drawback related to their refrigeration water consumption.

[0007] WO 2007/144340 A1 and EP 2 096 203 A1 disclose a washing machine having a tub, a drum rotatably disposed in the tub, and a heat pump which includes a condenser disposed in the tub.

[0008] Washer-dryers of air condensation by a heat pump are known, which comprise a heat pump with a compressor, a condenser and an evaporator as described for example in EP 1 405 946 A2 and EP 2 351 883 A2. In these washer-dryers, the air current applied to the laundry to be dried is heated by means of the condenser and propelled by a fan. The condensation is effected by cooling the humid air by means of the evaporator. These condensing washer-dryers have the drawback of the heat pump configuration, particularly the size of the same, which has as a result that the device turns out to be undesirably voluminous or implies a reduction in load capacity of the washer-dryer to house the heat pump inside the housing or body of the washer-dryer.

[0009] It is the object of the present invention to provide an alternative to those types of washer-dryers known in the state of the art, or to improve the washer-dryers known in the state of the art.

Description of the invention

[0010] Having the objective of at least reducing the aforementioned drawbacks in comparison with the prior art, a washer-dryer is provided by which other additional advantages can be achieved as it shall be shown in the following.

[0011] The present washer-dryer comprises a tub that houses a drum inside in a rotatable manner with respect to the tub. The tub and the drum are adapted for washing laundry, in particular, the drum is adapted to receive inside the laundry to be washed. To make the drum rotate during the functioning of the washer-dryer, rotation driving means of the drum are arranged. Preferably, said actuating means comprise a motor fixed to the tub, for example, in a lower rear-side zone of the tub. The actuating means can comprise means to transmit rotation of the motor to the drum that preferably comprise a drive belt, said drive belt transmitting the movement between an output shaft of the motor and a pulley fixed to a rotation axis of the drum. The term "laundry" includes the concept of clothes.

[0012] The present washer-dryer also comprises an air circuit. The air circuit can be, for example, a closed circuit, i.e. a re-circulable air circuit. At least a part of the air circuit can be fixed to the tub, in particular at least partially integrated with the same. Said air circuit is adapted to circulate an air flow through the tub of the washer-dryer for drying the laundry, contained inside the drum. Circulation of air through the tub can be carried out by propelling air by action of at least a fan, and/or by means of the own rotation of the drum. The air flow can be guided by means of at least an air pipe. In some embodiments, said air circuit is adapted so that the air flow flows into the tub at a front part of the same. In addition to that, the air circuit can be adapted so that the air flow flows out of the tub at a side area and/or at a rear area of the same. The term "air flow" includes the concept of an air current.

[0013] The present washer-dryer also comprises a heat pump. The heat pump is adapted to exchange heat with the air flow circulating through the tub, i.e. the heat

pump is adapted to heat and/or cool said air flow. The heat pump includes at least one compressor, at least one condenser and at least one evaporator. The heating of the air flow brings about the evaporation of laundry's humidity. The drying takes place by evacuating the humid air to the outside of the machine and/or by condensing the same by cooling it. The heat pump comprises a refrigerant circuit to have a cooling fluid circulating among the said at least one compressor, at least one condenser and at least one evaporator in a per se conventional manner. The cooling fluid can be selected to obtain a thermodynamic efficiency and an appropriate rate of drying, for example, from CO2, R407C, R134a, R290 and 1234Y. The refrigerant circuit can comprise at least an expansion valve in a per se known manner. The expansion valve can be controllable, for example, electronically. The refrigerant circuit comprises at least a refrigerant pipe that can be rigid or flexible. The refrigerant pipe, in particular, at least a valve, can be fixed to the tub. The refrigerant pipe can be made of metallic material, for example of copper, or of plastic, for example a thermally stable plastic. Connection of the refrigerant pipes to the different components of the heat pump can be achieved, for example, by welding.

[0014] The incorporation of a heat pump into the present washer-dryer makes possible that thermodynamic efficiency of the drying is improved and, therefore, that energy consumption of the washer-dryer is reduced.

[0015] According to an important aspect of the present washer-dryer, at least two of the following components, compressor (CP), evaporator (E) and condenser (C) are fixedly connected to the tub through a direct connection between a part of said components and a part of said tub, and this independently from one another. The expression "fixedly coupled or connected" includes the concept of coupled or connected, respectively, rigidly, firmly, directly, or attachedly.

[0016] The expression "fixing means" is to be understood as means for fixing, in particular means having a fixing function, i.e. for fixing said component to the tub. The fixing means can include non-positive fixing means, as an example by adhesive, by welding, etc. Alternatively or in addition to that, the fixing means can include positive fixing means, as an example by press fit, 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 lug, a pin, a screw, a washer, a rivet, etc.

[0017] The expression "complementary fixing means" is to be understood as means suitable for complementing the fixation, in particular means having a function complementary to the fixing function, i.e. for completing the fixation of said component to the tub. The complementary fixing means can include vibration-isolating means, such as a rubber bushing or "silent block" (for example, for the fixation of the compressor), thermally insulating means, such as a blanket of thermally insulating material (for example, for the fixation of the condenser and/or the evaporator), or sealing means, such as a sealing gasket.

[0018] According to the present description, the term "fixed" also means that at least a part of any of the components of the heat pump, i.e. the compressor, the condenser and the evaporator, can be integrated into the tub, in any part of the same, particularly forming part of it. This embodiment is applicable, for example, in cases in which the tub is made of plastic and there are cavities or receptacles formed in it to receive one or more of the components of the heat pump. The own components of the heat pump, for example a housing of any of the components, can be shaped at least partially in one piece, for example obtained by injection moulding with the tub.

[0019] Due to this important constructional 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 of the components of the heat pump can be placed substantially closely or adjacently to the tub, what makes possible that the space available around the tub is utilized in a more profitable manner, being particularly possible to achieve an extremely compact set. Furthermore, compactness of the set allows advantageously the increase of the capacity of the drum to house more laundry, in particular to dry more wet laundry.

[0020] Besides, many other additional advantages are achieved by this feature, such as allowing a reduction in length of the pipes of the air circuit or of the refrigerant circuit, consequently having the advantage of the reduction of energy consumption since the load losses or losses by friction of the fluid, in particular air, in the pipes are reduced.

[0021] Even the use of flexible tubes, in particular of flexible air pipes, can be avoided or reduced. In addition to that, it is possible to fix a higher number of components, in particular compressors, condensers and/or evaporators, to the tub.

[0022] Preferably, the present washer-dryer is of a horizontal axis, i.e. having a substantially horizontal rotation axis of the drum. However, also embodiments are considered in which the rotation axis of the drum is arranged being substantially inclined upwards. In the embodiment having an inclined axis, the application of the invention is more advantageous since, in this manner, it is possible to achieve a bigger free space in an upper area rear in relation to the tub, provided by the inclination upwards of the tub. The expression "substantially horizontal rotation axis" includes the concept that the rotation axis of the drum has an inclination with respect to a horizontal plane lower than or equal to 5°, preferably lower than or equal to 3°, more preferably lower than or equal to 1°, in a resting position and the tub being empty.

[0023] Also embodiments in which the tub is swingable are provided. To this, the tub of the washer-dryer can be coupled to the frame of the washer-dryer by means of at least a spring and at least a damper in a per se conventional manner. In this case, the compactness provided by the feature of the described solution makes the em-

bodiment in which the tub is swingable be advantageous, taking into account the free space that needs to be available around the tub to prevent the tub when oscillating from hitting or approximating other components inside the washer-dryer, in particular the housing or the frame of the washer-dryer.

[0024] In the mentioned embodiment in which the tub is swingable, the washer-dryer comprises preferably a counterweight system. This counterweight system is suitably adapted to balance in a per se conventional manner an oscillating system including the tub. Together with the tub, the oscillating system comprises all the components of the washer-dryer that oscillate in conjunction with the tub, comprising in particular the counterweight system, the drum, and the motor. In this case, advantageously, the compressor that, as mentioned before, is fixed to the tub, can form part of the counterweight system, either partially or forming the entire counterweight system with the compressor. To this end, the compressor can be arranged in a position suitable for balancing the oscillating system, particularly taking into account the mass distribution of the oscillating system, including the motor, the drum support, etc. In this manner, the compressor can be arranged in a lateral zone of the tub, preferably in an upper lateral zone, taking into account that the motor can be arranged in a bottom lateral zone. Preferably, the compressor can be arranged in an upper lateral zone and at a distance from the rear part of the tub suitable for balancing the oscillating system. So, an interesting advantage is achieved, in the sense of being able to avoid or reduce the use of concrete counterweights, commonly utilized to this end, which have the drawback of their bad recyclability and entail an additional cost.

[0025] In the present washer-dryer, at least two of said components are fixed to the tub independently from one another. To this, fixing means for each of said components can be provided being independent from one another. The expression "the components are fixed to the tub independently from one another" includes the concept related to the fact that, to fix one of said components to the tub, no other component needs to be fixed to the tub. It also includes the concept related to the fact that fixing one of said components does not imply fixing another of said components. At least two of the components of the heat pump that are not fixed to the tub independently from one another, in particular at least two of the components that are not fixed to the tub, can be configured in a same module, for example fixed to a same structure or support.

[0026] The evaporator of the present washer-dryer, which, as indicated above, can be fixed to the tub, can be for example of the finned-tube type or of the tube-and-fins type. In an embodiment, it is provided that the evaporator has a substantially prismatic shape, configured in such a manner that the air flow flows through the condenser according to the direction of an edge of the prismatic shape. Alternatively, the evaporator can be of the roll-bond type, achievable for example by joining, in particular by welding, two superposed metal sheets, for example of aluminium, and with the refrigerant pipe being shaped between both sheets and achievable for example by blowing. The evaporator can be provided with adequate coatings, for example ceramic or paint coatings destined to avoid oxide formation, the adherence of lint, etc. The evaporator can be fixed in an air pipe of the air circuit, which can be fixed to the tub. The evaporator can comprise a housing fixable to the tub or the air pipe. Alternatively, the evaporator can comprise a metal tube overmoulded in plastic of the tub.

[0027] In an embodiment, the evaporator of the present washer-dryer can be arranged on an inner surface of the tub, in particular in a lateral position of the same, between the tub and the drum, to efficiently exchange heat with the interior of the tub. In this manner, the flow of humid air can pass properly the evaporator that is arranged on said surface of the tub. The evaporator can be fixed to the inner surface of the tub, for example, by overmoulding at least in part, by screwing, by riveting, welding, by press fit, gluing, etc.

[0028] In this particular embodiment, in which the evaporator is placed in thermal contact with the interior of the tub, the evaporator can be of the roll-bond type, made of metal sheet having a curvature suitable for adapting itself to the curved inner surface of the tub.

[0029] In embodiments in which the evaporator is adapted to cool the air flow, humidity of the heated air condenses on the side wall of the tub and falls towards a drainage outlet, being easily evacuated. In this manner, the utilization of an additional motor pump for evacuating the condensed water is avoided. Furthermore, the lint that, during the drying, may accumulate on the evaporator can be easily eliminated, for example by means of water from previous washing cycles, what avoids the need to use filters. The set is thereby simplified and costs are reduced.

[0030] As previously indicated, there are embodiments in which the air circuit is adapted so that the air flow flowing through the tub leaves the tub at a lateral zone of the same. In this manner, circulation of air through the tub is advantageously facilitated to promote condensation, particularly in an area outside the drum in which the evaporator is in thermal contact with the interior of the tub.

[0031] Furthermore, embodiments are considered in which the air flow flows out through a rear part of the tub, in particular a lower rear part. This configuration makes possible that condensation is promoted, since it allows the improvement of the flow-through of humid air through the area between the drum and the tub.

[0032] The condenser of the present washer-dryer, which, as indicated above, can be fixed to the tub, can be for example of the finned-tube type, of the tube-and-fins type, or of the microchannel type. In an embodiment, it is provided that the condenser has a substantially prismatic shape, adapted so that the air flow flows through the condenser according to the direction of an edge of the prismatic shape. The condenser can be fixed in an

air pipe of the air circuit, which is fixed in particular to the tub. The condenser can comprise a housing fixable to the tub or the air pipe.

[0033] 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 allows the evaporation of humidity of clothes, while the cooling of the humid air flow allows the condensation of vapour humidity in the form of condensed water. In this sense, embodiments are considered in which only the condenser (not the evaporator) is adapted to exchange heat (to heat) with the air flow and/or embodiments in which only the evaporator (not the condenser) is adapted to exchange heat (cool) with the air flow.

[0034] The compressor of the present washer-dryer can be fixed to the tub by means of fixing means comprising lugs and correspondingly pins associated by tongue and grove fixation. To this, the compressor can comprise a housing with integrated lugs. At least a part of the housing and the lugs can be obtained by injection moulding in a same piece, for example of plastic. The tub can comprise integrated pins, at least a part of the tub, and the pins can be obtained by injection moulding in a same piece. The compressor can be fixed by means of complementary fixing means, such as vibration-isolating means as for example "silent blocks".

[0035] The compressor can be of a rotary type, although other types of compressors are not excluded. In this sense, compressors of reciprocating type can be utilized, although they are less preferred. In particular, it is preferable to utilize a rotary compressor of the rolling-piston type or of the displaceable-piston type (Scroll type). More preferably, the present washer-dryer includes a rotary compressor of a horizontal rolling piston, having a fixed or controllable speed, fed either by alternating current or by continuous current. This type of compressor is preferred due to the saving in energy, cost and space.

[0036] The described washer-dryer can include means for heating the air flow. Said means for heating the air flow can be selected from a group consisting of at least an electrical resistance, at least a spotlight, such as a halogen or infrared spotlight, and/or a combination thereof. This means for heating the air flow can be complementary or alternative, or be activated in a complementary or alternative manner, to the heat pump. The present washer-dryer can also include means for cooling the air flow. This auxiliary means for cooling the air flow can be selected from the group consisting of refrigeration water, such as cool water coming from the water supply mains, refrigeration air, such as air extracted from the ambient and expelled to the ambient, and a combination thereof. This means for cooling the air flow can be complementary or alternative, or be activated in a complementary or alternative manner, to the heat pump. The incorporation of a heat pump in combination with other heating and/or cooling means allows the increase of the rate of drying, in particular since it makes possible to increase the amount of evaporated humidity and/or the amount of condensed water.

[0037] Preferably, the tub can be formed by a plurality of parts, in particular by two half-tubs. These parts or half-tubs can be fixable to one another, in particular hermetically. The mutual coupling of the half-tubs can be demountable. One or both half-tubs can be made of plastic, for example by injection moulding. These parts or half-tubs can be fixed to one another by any suitable conventional means known in the art, such as screwing, welding, preferably by ultrasonic welding. In a described embodiment of the washer-dryer in which the tub is formed by two half-tubs hermetically joinable to one another, at least one of the compressor, the evaporator and the condenser is fixed to one of or to both of said half-tubs. It is also provided that, if the tub is of plastic, at least a part of it can comprise at least a refrigerant pipe overmoulded with the tub or integrated with the same.

[0038] In any case, embodiments are provided in which at least one of the compressor, the evaporator and the condenser have a shape complementary to the shape of the external surface and/or the inner surface of the tub. This allows a good adaptation of the compressor and/or the evaporator and/or the condenser, an even more compact set being thereby achieved.

[0039] By means of the described washer-dryer, many advantages are achieved apart from those mentioned above in relation to the high compactness due to the fixation of the components of the heat pump in the tub, the improvement in the thermodynamic efficiency and the quick drying of laundry.

[0040] For example, the mentioned distribution of the components of the heat pump in the tub allows the achievement of interesting dynamic improvements given that the heat pump set moves in conjunction with the tub, making the set more compact, not only in relation to space but also in dynamic terms. This means advantageously that there are no relative movements among these elements, vibrations being reduced and, as a consequence thereof, the durability of the set being increased since less wear occurs among the pieces.

[0041] Another advantage consists in that the set can be simplified to a great extent, particularly regarding construction, manufacturing, assembly, repair or maintenance, in particular due to the fact that an improvement in accessibility to the different components of the heat pump and/or to the refrigerant circuit is achieved. Many operations such as connecting the different components of the heat pump and the refrigerant pipes, as well as detecting refrigerant leakages, can be simplified. These operations can be carried out separately for at least different parts of the refrigerant circuit, particularly refrigerant pipes and/or different components of the heat pump, which are fixed to the tub at least partially. Advantageously, the described washer-dryer can be constructed, manufactured, assembled, repaired or maintained in a simplified manner, only minimum modifications with respect to the construction, manufacturing or assembly process

of conventional washing machines being required, in particular minimum modifications in the assembly line being required, for example making possible that it can be assembled by adding a minimum amount of additional or auxiliary working positions or assembly operations such as assembly of the compressor or welding connections of the refrigerant pipes, etc. In this sense, fixing the components of the heat pump in a same part of the tub, in particular in one of the two half-tubs, simplifies the set to a great extent.

[0042] Furthermore, the integration or fixation of the components of the heat pump in the tub also allows a great design flexibility and adaptability, since diverse embodiments of washer-dryers with different features can be achieved starting from a common module comprising at least a part of the tub, in particular a half-tub, with the heat pump being at least partially fixed to the same. The design flexibility and adaptability can be also observed as different washer-dryer models can be achieved having a suitable thermodynamic efficiency and/or rate of drying.

Brief description of the drawings

[0043] Particular embodiments of the present washer-dryer are described in the following. The description of said embodiments is to be understood as a non-restrictive example, with reference to the attached drawings.

[0044] In said drawings:

Figure 1 is a general partial front elevation view that shows schematically an embodiment of the present washer-dryer with a heat pump integrated into the tub;

Figures 2 and 3 are side elevation views of the present washer-dryer with a heat pump integrated into the tub, an example in which the air flows out at a rear part of the washer-dryer and an example in which the air flows out at a lateral part of the washer-dryer being shown respectively;

Figure 4 is a perspective schematic view of the washer-dryer of the embodiment shown in figure 2, where the refrigeration air inlet at the front part of the washer-dryer is schematically shown;

Figures 5 and 6 are perspective schematic views that show respectively an embodiment with a first half-tub with an air outlet at a lateral part of the half-tub and an alternative embodiment of said first half-tub with an air outlet at a rear part of the half-tub;

Figure 7 is a perspective schematic view that shows an embodiment of a second half-tub adapted to be hermetically coupled to the first half-tub of any of the embodiments illustrated in figures 5 and 6;

Figures 8 and 9 are perspective schematic views that show respectively an embodiment of the coupling of the condenser in a tub with an air outlet at a lateral part of the same and the coupling of the condenser in a tub with an air outlet at a rear part of the same;

Figures 10 to 12 are perspective schematic views of several embodiments of the condenser that can be mounted in the present washer-dryer; and

Figure 13 is a perspective schematic view of an embodiment of an evaporator adapted to be integrated inside the tub of the present washer-dryer.

Detailed description of the embodiments

[0045] In the figures, some particular non-restrictive examples of the present washer-dryer are illustrated. The washer-dryer has been designated in its entirety in the drawings with the reference numeral 100. In the shown non-restrictive example, the rotation axis of the washer-dryer 100 is arranged in a substantially horizontal manner and the washer-dryer 100 is of the swingable type by means of springs and dampers (not shown).

[0046] In general, the washer-dryer 100 comprises a structure 101 resting on supporting legs 102. As shown in the general view in figure 1 of the drawings, the washer-dryer 100 includes a water inlet 111 in the upper part. The water coming from the water supply mains, and which has already flowed through the detergent tray 112, which is shown schematically in figures 2 and 3, flows into through the water inlet 111, through an electrovalve 111a, towards inside the drum 120, which shall be described below.

[0047] In the lower part of the washer-dryer 100, a discharge tube 115 of water coming from the water drainage outlet 116 of the tub 110 of the washing machine 100 is arranged. The water is expelled outwards by means of a motor pump 117 flowing through an appropriate filter 118a of the motor pump before flowing through the motor pump body 118b.

[0048] The illustrated washer-dryer 100 comprises a washing tub 110. The tub 110 houses inside the aforementioned drum 120, which can rotate with respect to the tub 110. The drum 120, which, as mentioned for the illustrated embodiment, has an axis 121 arranged in a substantially horizontal manner, is adapted to receive laundry 200 to be washed inside. In figures 8 and 9, the drum 120 can be observed being mounted inside the tub 110 in a rotatable manner. In its interior, the drum 120 has a perforated surface, where washing lifters 122 are arranged. The lifters 122 have the function of hitting the laundry 200 housed inside the drum 120 when this turns during the washing. As conventionally, the washing-dryer 100 washes the laundry 200 by combined action of the mechanical hitting of said lifters 122, the chemical action of the washing agent, such as detergent or softener, coming from the detergent tray 112, and the action of temperature by heating the washing water. In figures 8 and 9, it can be also observed that the tub 110 includes a sealing gasket 124 for coupling the tub 110 to the frame 101 of the washer-dryer 100 in a tight and flexible manner.

[0049] As shown in figures 5, 6 and 7 of the drawings, the washing tub 110 is formed by two parts of half-tubs

110a, 110b. Both half-tubs 110a, 110b are made of plastic and designed to be hermetically coupled to one another by ultrasonic welding. One of the half-tubs 110a includes an air outlet 113. In the embodiment shown in figure 5, the air outlet 113 is formed at a lateral part of the half-tub 110a, while, in the embodiment shown in figure 6, the air outlet 113 is formed at a rear part of the half-tub 110a. On the other hand, a cavity 114a, illustrated in figures 5 and 6 of the drawings, is formed in a lower part of the half-tub 110a. In the mounting position, with the half-tubs 110a, 110b being hermetically coupled to one another, the cavity 114a of the half-tub 110a remains closed by a complementary part 114b of the other half-tub 110b, shown in figure 7, defining a housing. This housing 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 an electrical resistance 171 as the one schematically illustrated in figures 2 and 3 of the drawings.

[0050] 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. Within this air circuit, air recirculates by the combined action of the rotation of the drum 120 and of the fan 140. The fan 140 is mounted in the upper part of the washer-dryer 100, as it can be seen in figures 1, 2, 3 and 4. Warm air flows through the tub 110 drying the laundry 200 contained inside the drum 120, passing the front area of the tub 110 and flowing out at the lateral zone of the same.

[0051] A heat pump is arranged to exchange heat with the air flow. In the shown embodiment, the heat pump includes a compressor CP, a condenser C and an evaporator E. In the example shown in figure 1, all components of the heat pump, i.e. 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 by means of their own fixing means, which are independent from one another. In the shown example, the evaporator E is fixedly connected to a lower lateral surface of the tub 110, the compressor CP is fixed to the tub 110 by means of lugs 150 integrated into a housing of the compressor CP, which lugs 150 can be tongue and groove joined to corresponding pins (not shown) of the tub 110, wherein the fixation of adequate "silent blocks" can be provided to reduce vibrations or noise during the function. To secure the tongue and groove fixation, this can incorporate for example screws screwed in the direction of the pins or expandable pins, in a per se known manner. As it can be observed in figure 1, the components C, CP, E of the heat pump are fixed adjacently to the surface of the tub 110, i.e. in an area very close to the same. In this manner, an extremely compact set is obtained.

[0052] Still referring to figure 1 of the drawings, the compressor CP, destined to compress the cooling fluid that circulates inside it to make its pressure and temperature raise, is fixed, as already indicated, in an upper lateral position of the tub 110, as shown for example in figures 1, 5 and 6. In this position, and given that this particular example relates to a washer-dryer 100 of an swingable tub, as already indicated, the compressor CP acts as a counterweight to properly balance the oscillating system formed by the tub 110 and the drum 120. This eliminates the need to utilize conventional concrete counterweights. If needed, counterweights can be arranged in a front, upper lateral or lower lateral position of the swingable tub 110 suitable for balancing the oscillating system. In figures 8 and 9 of the drawings, alternative positions of the counterweights 119 are shown, for example mounted on a front part of the tub 110.

[0053] The refrigerant circuit of the heat pump is configured by connecting the refrigerant pipes between the corresponding inlet connections 125a and outlet connections 125b.

[0054] The air pipes and/or refrigerant pipes represented particularly in figures 2, 3, 4, 8 and 9 can be at least partially rigid or flexible, in particular to allow the movement of the swingable tub, for example if the air circuit is fixed to the frame of the washer-dryer at least in part. In particular, the diverse parts represented in figures 8 and 9 in an exploded view can be connected fixedly or in a flexible manner, for example by means of gaskets or joints in a per se known manner.

[0055] Although the condenser C has been represented in the figures arranged before the fan 140 according to an air flow direction in the air circuit, it is also contemplated that it can be arranged after the fan 140. In the first case, the fan 140 works by aspirating air while, in the second case, the fan 140 works by propelling air from/towards the condenser.

[0056] In a preferred embodiment, a hermetic compressor CP of a rotary type is utilized, having its own motor incorporated, independent from the motor that drives the drum. Nevertheless, other options can include a hermetic compressor of the rotary type without having a motor incorporated, with magnetic coupling means for the coupling to a motor. It is also contemplated that the compressor can be actuated by the drum's actuating motor, for example by means of a drive mechanism having an appropriate rate of transmission that may include driving means and clutching means. A suction accumulator 190 is arranged next to the compressor CP, as shown in figures 1, 5 and 6.

[0057] The condenser C receives the compressed cooling fluid of the compressor CP where it transmits heat to the process air. In the embodiments in figures 8 and 9, the condenser C is fitted into the air pipe of a closed air circuit. In the embodiment in figure 8, the air flow leaves the tub through an air outlet 113 that is placed at a lateral part of the tub 110, while, in the embodiment in figure 9, the air outlet 113 is placed at a rear part of the tub 110 (in this case, the air outlet 113 is not shown in figure 9). The air circuit can be fixed to the tub at least in part, or to the frame of the washer-dryer at least in part. In the case that the air conduction is fixed to the tub, the

fixation of the condenser C to the tub 110 can include one or several thermally insulating elements 123 between the condenser C and the tub 110.

[0058] Different types of condenser C can be utilized in the present washer-dryer 100. In figures 10-12, several examples of condenser C are illustrated, which can be utilized in the present washer-dryer 100, although other types of condenser C are not excluded, provided that they are properly adapted so that air passes the condenser, in particular so that air flows through the condenser C or contacts the same. For example, an embodiment of a finned-tube condenser C is shown in figure 10, a tube-and-fins condenser C is shown in figure 11, and an embodiment of a microchannel condenser C is shown in figure 12. As it can be observed, the embodiments of the condenser C shown in figure 10 have a substantially prismatic shape, adapted in such a manner that the air flow flows through the condenser according to a direction of an edge of the prismatic shape (vertical direction in the drawings).

[0059] In figure 13, a particular embodiment of an exemplary evaporator E is illustrated. In this embodiment, the evaporator E is of the metal roll-bond type, for example of copper, aluminium or stainless steel. The evaporator E has a curved shape, complementary to the curved shape of the inner surface of the tub 110, as indicated above. A refrigerant pipe is formed inside the evaporator E. Externally, the metal supporting sheet 124 of the evaporator E can be die-cut to be adapted to elements of the tub, such as an air outlet 113 or a water drainage outlet 116 of the tub 110.

[0060] The evaporator E of the heat pump receives the cooling fluid coming from the condenser C. Since it has transmitted heat to the process air flow in the condenser C, the cooling fluid is at a lower temperature and turns into liquid state. After flowing through an expansion valve V, as shown in figure 3, the cooling liquid recovers the initial pressure, lower than the pressure that there was in the condenser C. As indicated above and as it can be seen in figures 5 and 6, the evaporator E, in particular a roll-bond evaporator, can be fixed to the inner surface of the tub 110, in particular in a lower area of the tub 110, between the tub 110 and the drum 120 in a position suitable for allowing the exchange of heat with the interior of the tub 110.

[0061] The evaporator E is utilized in the shown embodiment to condense water of the humid warm air by cooling it. However, embodiments, in which, alternatively or additionally, the evaporator E is utilized to heat the air or water in the tub 110 by actuating the heat pump in an inverse manner, are not excluded. In this last case, an open air circuit with valves and specific pipes for discharging cold air can be arranged. Condensed water 160, as indicated, can be evacuated through the water drainage outlet 116 of the tub 110. Embodiments, in which, alternatively or additionally, the condenser C of the heat pump is utilized to heat water in the tub 110, particularly for washing purposes, are not excluded either.

[0062] In the embodiment of the washer-dryer 100 shown in figure 2 and also in figure 3 of the drawings, auxiliary means are arranged being destined to, alternatively or additionally, cool the air flow 220. This means for cooling the air flow 220 can comprise a refrigeration air flow, or refrigeration water, or a combination thereof. In said figures 2 and 3, the means for cooling the air flow 220 by refrigeration water are shown as a refrigeration water pipe allowing a water inflow, flowing through an electrovalve 111b towards the tub 110. Figure 4 shows means for cooling the air flow 220 by means of refrigeration air that enters the washer-dryer at a lower front part and flows across the process air flow in a heat exchanger arranged in a rear zone of the tub, before being expelled through the rear part of the washer-dryer. In the embodiment shown in figure 4, said heat exchanger can be an evaporator E of the heat pump. It is also contemplated that the means for cooling can be arranged before or after the evaporator according to the air flow direction of the air circuit. The auxiliary means for cooling the air flow 220 can be activated in addition to or alternatively to the evaporator E, as required.

[0063] In the same manner as with the previously described means for cooling the air flow 220, means for heating the air flow can be arranged, as schematically illustrated 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 a halogen spotlight 180, for example fixed to the tub or to a door of the washer-dryer, or even by a combination of an electrical resistance and a halogen spotlight. It is also contemplated the means for heating can be arranged before or after the evaporator according to the air flow direction of the air circuit. The auxiliary means for heating the air flow 170, 180 can be activated in addition to or alternatively to the condenser C, as required.

[0064] The represented washer-dryer 100 also comprises rotation driving means of the drum 120. The actuating means of the drum 120 comprise a motor M. The motor M is fixed to the tub 110 in a lower rear side zone of the same, as shown in figures 1-3 of the drawings. The motor M is adapted to drive the shaft 121 of the drum 120. To this, a drive device is utilized, being formed by a rubber belt 210 suitable for drive a pulley 215a that is connected to the output shaft of the motor M and a corresponding pulley 215b that is fixed to the axis 121 of the drum 120.

[0065] The water 160 that has condensed in the process can be reutilized since it is clean water. In particular, the condensation water 160 could be stored in a tank or reservoir suitable for being utilized in other washing cycles of the present washer-dryer 100.

[0066] In the present document, several embodiments and particular examples of the present washer-dryer are described. However, the person skilled in the art shall

understand that other alternative embodiments of the same, as well as obvious modifications and equivalent elements, are possible.

[0067] Therefore, the objective of the present invention is to encompass all possible combinations of the particular embodiments herein described. The scope of the patent claims is not restricted to the described specific embodiments, but the scope shall be determined only by a proper interpretation of said patent claims.

[0068] The numerical references relative to the drawings and appearing in brackets in a patent claim aim exclusively at facilitating the understanding of said patent claim and in no case shall be interpreted as restricting the scope of protection of the patent claim.

Claims

1. Washer-dryer (100) comprising:

   a tub (110) and a drum (120) housed inside the tub (110) in such a manner that the drum (120) is rotatable with respect to the tub (110), the tub (110) and the drum (120) adapted for washing a laundry (200),
   an air circuit, adapted to circulate an air flow through the tub (110) for drying the laundry (200), and
   a heat pump, adapted to exchange heat with the air flow, the heat pump including at least one compressor (CP), at least one condenser (C) and at least one evaporator (E),
   characterized in that
   at least two of the following components, compressor (CP), evaporator (E) and condenser (C) are fixedly connected to the tub (110) through a direct connection between a part of said components and a part of said tub, and this independently from one another.

2. Washer-dryer (100) according to claim 1, **characterized in that** the washer-dryer (100) includes a frame, and the tub (110) is coupled to the frame by means of at least a spring and at least a damper.

3. Washer-dryer (100) according to claim 2, comprising a counterweight system adapted to balance an oscillating system comprising the tub (110), **characterized in that** the counterweight system includes said compressor (CP) that is fixed to the tub (110).

4. Washer-dryer (100) according to any of the above claims, **characterized in that** the drum (120) has a substantially horizontal rotational axis.

5. Washer-dryer (100) according to any of the above claims, **characterized in that** at least one of said evaporator (E) and said condenser (C) that is fixed to the tub (110) is adapted to exchange heat with the interior of the tub (110).

6. Washer-dryer (100) according to claim 5, **characterized in that** said evaporator (E) is arranged on an inner surface of the tub (110).

7. Washer-dryer (100) according to claim 6, **characterized in that** said evaporator (E) is of the roll-bond type.

8. Washer-dryer (100) according to any of the above 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).

9. Washer-dryer (100) according to any of the above 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).

10. Washer-dryer (100) according to any of the above claims, **characterized in that** the washer dryer (100) includes means for heating the air flow selected from the group consisting of at least a resistance (170), at least a spotlight (180) and a combination thereof.

11. Washer-dryer (100) according to any of the above claims, **characterized in that** the washer dryer (100) includes means for cooling (220) the air flow selected from the group consisting of refrigeration water, refrigeration air and a combination thereof.

12. Washer-dryer (100) according to any of the above claims, **characterized in that** the air circuit is a closed circuit.

13. Washer-dryer (100) according to claim 12, **characterized in that** the air circuit is adapted in such a manner that the air flow flows into the tub (110) at a front area of the tub (110) and flows out of the tub (110) at a side and/or rear area of the tub (110).

14. Washer-dryer (100) according to any of the above claims, **characterized in that** the tub (110) comprises two parts (110a, 110b) hermetically joinable to one another and at least one of the compressor (CP), the evaporator (E) and the condenser (C) is fixed to one of said parts (110a, 110b) of the tub (110).

Patentansprüche

1. Waschtrockner (100), der Folgendes umfasst:

   einen Laugenbehälter (110) und eine Trommel

(120), die so in dem Laugenbehälter (110) untergebracht ist, dass sie in Bezug auf den Laugenbehälter (110) drehbar ist, wobei der Laugenbehälter (110) und die Trommel (120) zu Waschen von Wäsche (200) ausgelegt sind,
einen Luftkreislauf, der so ausgelegt ist, dass er zum Trocknen der Wäsche (200) einen Luftstrom durch den Laugenbehälter (110) zirkulieren lässt, und
eine Wärmepumpe, die so ausgelegt ist, dass sie mit dem Luftstrom Wärme austauscht, wobei die Wärmepumpe mindestens einen Verdichter (CP), mindestens einen Verflüssiger (C) und mindestens einen Verdampfer (E) aufweist,
dadurch gekennzeichnet, dass
mindestens zwei der Komponenten Verdichter (CP), Verdampfer (E) und Verflüssiger (C) über eine direkte Verbindung zwischen einem Teil der Komponenten und einem Teil des Laugenbehälters unabhängig voneinander fest mit dem Laugenbehälter (110) verbunden sind.

2. Waschtrockner (100) nach Anspruch 1, **dadurch gekennzeichnet, dass** der Waschtrockner (100) einen Rahmen aufweist und der Laugenbehälter (110) mithilfe mindestens einer Feder und mindestens eines Dämpfers mit dem Rahmen gekoppelt ist.

3. Waschtrockner (100) nach Anspruch 2, der ein Gegengewichtsystem umfasst, das so ausgelegt ist, dass es ein den Laugenbehälter (110) umfassendes Schwingsystem ausgleicht, **dadurch gekennzeichnet, dass** das Gegengewichtsystem den Verdichter (CP) aufweist, der an dem Laugenbehälter (110) befestigt ist.

4. Waschtrockner (100) nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** die Trommel (120) eine im Wesentlichen horizontale Drehachse aufweist.

5. Waschtrockner (100) nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** der Verdampfer (E) und/oder der Verflüssiger (C), der an dem Laugenbehälter (110) befestigt ist, so ausgelegt ist, dass er mit dem Innenraum des Laugenbehälters (110) Wärme austauscht.

6. Waschtrockner (100) nach Anspruch 5, **dadurch gekennzeichnet, dass** der Verdampfer (E) an einer Innenfläche des Laugenbehälters (110) angeordnet ist.

7. Waschtrockner (100) nach Anspruch 6, **dadurch gekennzeichnet, dass** der Verdampfer (E) ein Rollbond-Verdampfer ist.

8. Waschtrockner (100) nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** der Luftkreislauf so ausgelegt ist, dass er den Luftstrom durch den Verflüssiger (C) zirkulieren lässt, und die Wärmepumpe so ausgelegt ist, dass sie den Luftstrom mithilfe des Verflüssigers (C) erwärmt.

9. Waschtrockner (100) nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** der Luftkreislauf so ausgelegt ist, dass er den Luftstrom durch den Verdampfer (E) zirkulieren lässt, und die Wärmepumpe so ausgelegt ist, dass sie den Luftstrom mithilfe des Verdampfers (E) kühlt.

10. Waschtrockner (100) nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** der Waschtrockner (100) Mittel zum Erwärmen des Luftstroms aufweist, die aus der Gruppe ausgewählt sind, welche aus zumindest einem Widerstand (170), zumindest einem Strahler (180) und einer Kombination davon besteht.

11. Waschtrockner (100) nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** der Waschtrockner (100) Mittel zum Kühlen (220) des Luftstroms aufweist, die aus der Gruppe ausgewählt sind, welche aus Kühlwasser, Kühlluft und einer Kombination davon besteht.

12. Waschtrockner (100) nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** es sich bei dem Luftkreislauf um einen geschlossenen Kreislauf handelt.

13. Waschtrockner (100) nach Anspruch 12, **dadurch gekennzeichnet, dass** der Luftkreislauf so ausgelegt ist, dass der Luftstrom in einem vorderen Bereich des Laugenbehälters (110) in den Laugenbehälter (110) hinein- und in einem seitlichen und/oder hinteren Bereich des Laugenbehälters (110) aus dem Laugenbehälter (110) herausströmt.

14. Waschtrockner (100) nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** der Laugenbehälter (110) zwei Teile (110a, 110b) umfasst, die hermetisch miteinander verbindbar sind, und der Verdichter (CP), der Verdampfer (E) und/oder der Verflüssiger (C) an einem der Teile (110a, 110b) des Laugenbehälters (110) befestigt ist.

Revendications

1. Lave-linge/sèche-linge intégré (100) comprenant :

une cuve (110) et un tambour (120) logé dans la cuve (110) de sorte que le tambour (120) peut tourner par rapport à la cuve (110), la cuve (110) et le tambour (120) étant propres à laver du linge

(200),
un circuit d'air, propre à faire circuler un flux d'air à travers la cuve (110) pour sécher le linge (200), et
une pompe à chaleur, propre à échanger de la chaleur avec le flux d'air, la pompe à chaleur comprenant au moins un compresseur (CP), au moins un condenseur (C) et au moins un évaporateur (E),
caractérisé en ce que
au moins deux des composants suivants, le compresseur (CP), l'évaporateur (E) et le condenseur (C) sont raccordés à immobilité à la cuve (110) par un raccord direct entre une partie desdits composants et une partie de ladite cuve, et ce, indépendamment l'un de l'autre.

2. Lave-linge/sèche-linge intégré (100) selon la revendication 1, **caractérisé en ce que** le lave-linge/sèche-linge intégré (100) comprend un bâti, et la cuve (110) est couplée au bâti au moyen d'au moins un ressort et d'au moins un amortisseur.

3. Lave-linge/sèche-linge intégré (100) selon la revendication 2, comprenant un système de contrepoids propre à équilibrer un système d'oscillation comprenant la cuve (110), **caractérisé en ce que** le système de contrepoids comprend ledit compresseur (CP) fixé à la cuve (110).

4. Lave-linge/sèche-linge intégré (100) selon l'une quelconque des revendications ci-dessus, **caractérisé en ce que** le tambour (120) a un axe de rotation essentiellement horizontal.

5. Lave-linge/sèche-linge intégré (100) selon l'une quelconque des revendications ci-dessus, **caractérisé en ce qu'**au moins l'un dudit évaporateur (E) et dudit condenseur (C), qui est fixé à la cuve (110), est propre à échanger de la chaleur avec l'intérieur de la cuve (110).

6. Lave-linge/sèche-linge intégré (100) selon la revendication 5, **caractérisé en ce que** ledit évaporateur (E) se trouve sur une surface intérieure de la cuve (110).

7. Lave-linge/sèche-linge intégré (100) selon la revendication 6, **caractérisé en ce que** ledit évaporateur (E) est du type soudé par laminage.

8. Lave-linge/sèche-linge intégré (100) selon l'une quelconque des revendications ci-dessus, **caractérisé en ce que** le circuit d'air est propre à faire circuler le flux d'air à travers le condenseur (C) et la pompe à chaleur est propre à chauffer le flux d'air au moyen dudit condenseur (C).

9. Lave-linge/sèche-linge intégré (100) selon l'une quelconque des revendications ci-dessus, **caractérisé en ce que** le circuit d'air est propre à faire circuler le flux d'air à travers l'évaporateur (E) et la pompe à chaleur est propre à refroidir le flux d'air au moyen dudit évaporateur (E).

10. Lave-linge/sèche-linge intégré (100) selon l'une quelconque des revendications ci-dessus, **caractérisé en ce que** le lave-linge/sèche-linge intégré (100) comprend des moyens pour chauffer le flux d'air sélectionnés parmi le groupe composé d'au moins une résistance (170), au moins un spot (180) et une combinaison de ceux-ci.

11. Lave-linge/sèche-linge intégré (100) selon l'une quelconque des revendications ci-dessus, **caractérisé en ce que** lave-linge/sèche-linge intégré (100) comprend des moyens pour refroidir (220) le flux d'air sélectionnés parmi le groupe composé d'une eau de réfrigération, d'un air de réfrigération et d'une combinaison de ceux-ci.

12. Lave-linge/sèche-linge intégré (100) selon l'une quelconque des revendications ci-dessus, **caractérisé en ce que** le circuit d'air est un circuit fermé.

13. Lave-linge/sèche-linge intégré (100) selon la revendication 12, **caractérisé en ce que** le circuit d'air est adapté de manière que le flux d'air s'écoule dans la cuve (110) sur une zone frontale de la cuve (110) et s'écoule hors de la cuve (110) par une zone latérale et/ou arrière de la cuve (110).

14. Lave-linge/sèche-linge intégré (100) selon l'une quelconque des revendications ci-dessus, **caractérisé en ce que** la cuve (110) comprend deux parties (110a, 110b) pouvant être assemblées hermétiquement l'une à l'autre et au moins l'un du compresseur (CP), de l'évaporateur (E) et du condenseur (C) est fixé à l'une desdites parties (110a, 110b) de la cuve (110).

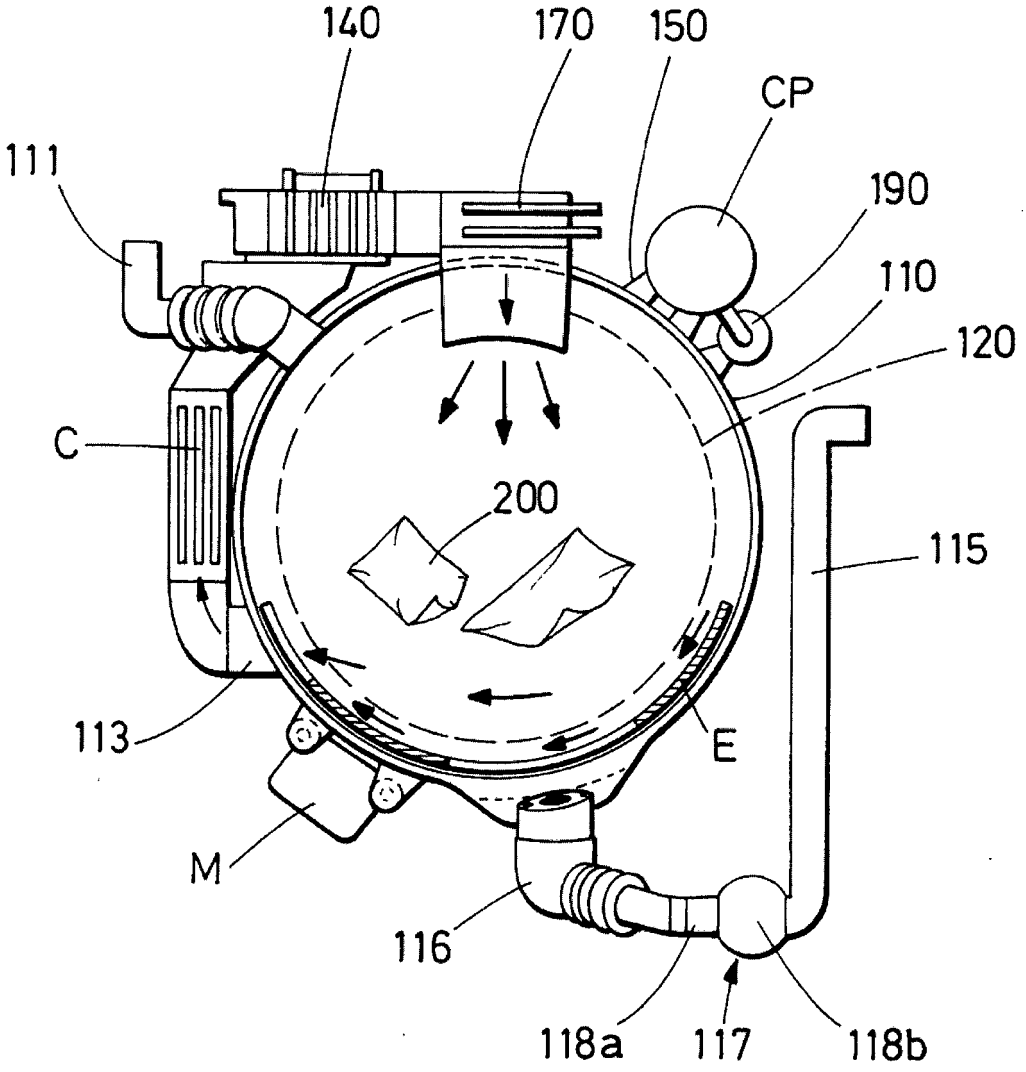

FIG.1

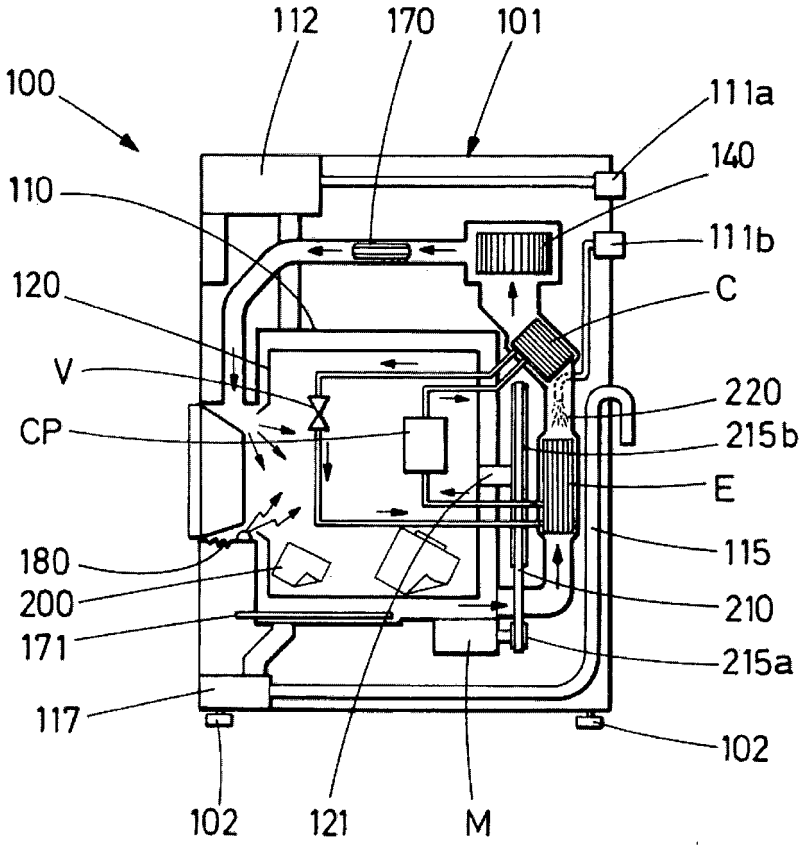
112
170
101
100
111a
140
110
111b
120
C
V
220
CP
215b
E
115
180
210
200
171
215a
117
102
102
121
M

FIG.2

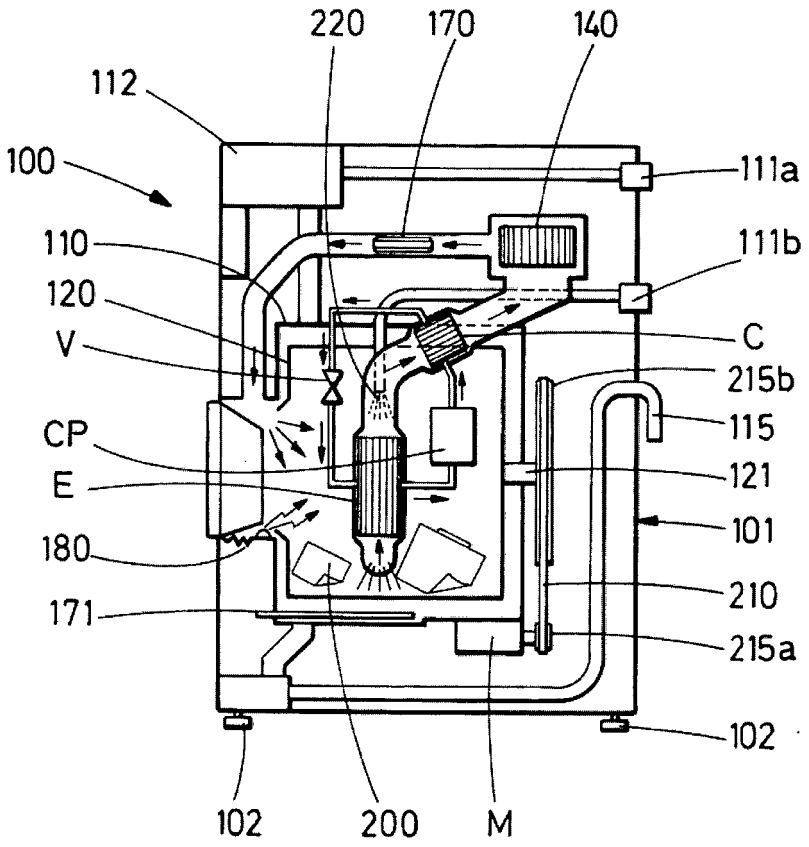
220
170
140
112
100
111a
110
111b
120
C
V
215b
115
CP
121
E
101
180
210
171
215a
102
102
200
M

FIG.3

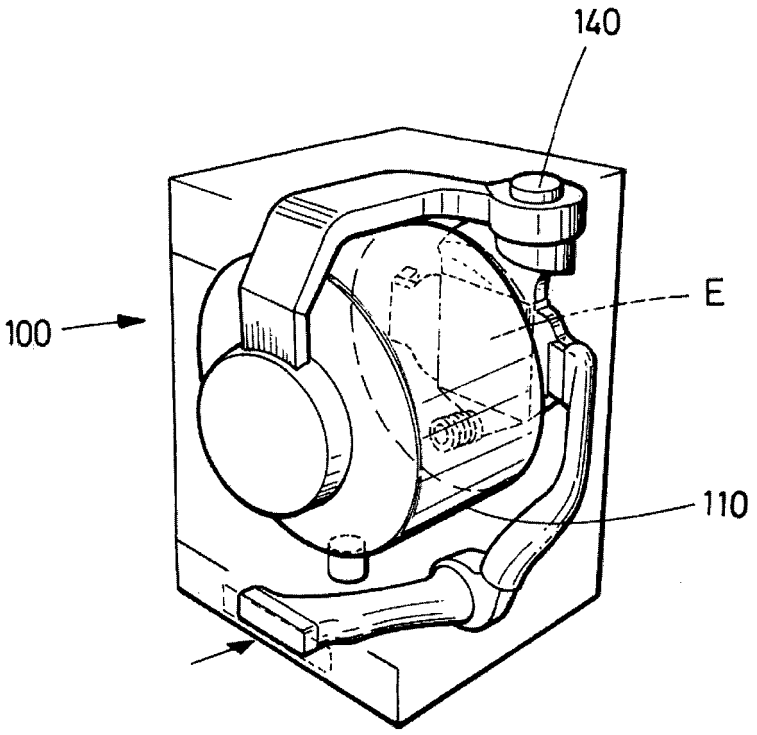

FIG.4

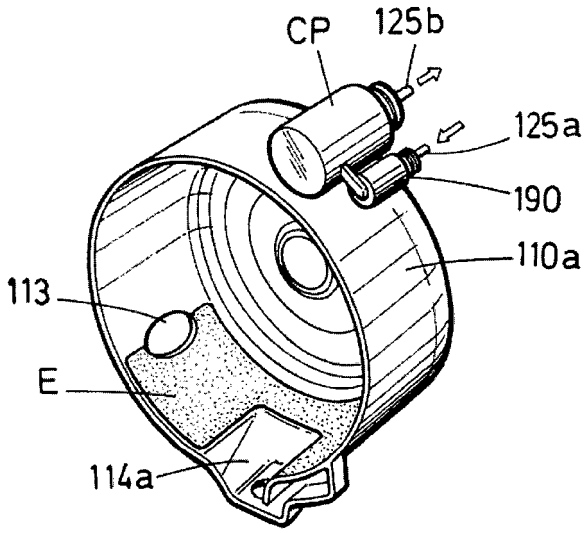

FIG.5

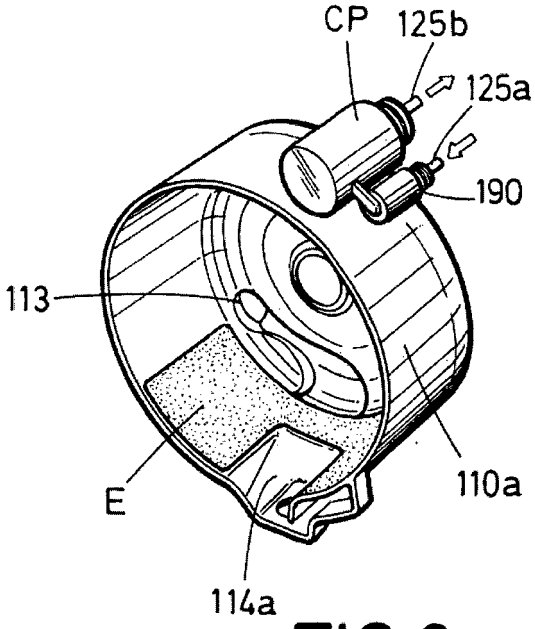

FIG.6

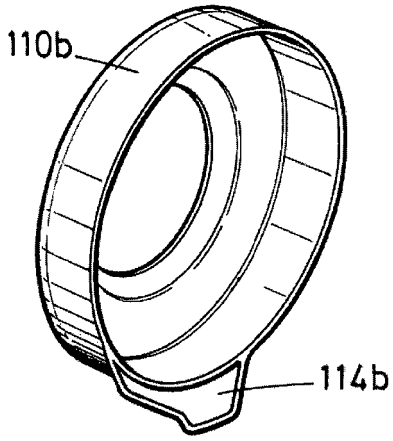

FIG.7

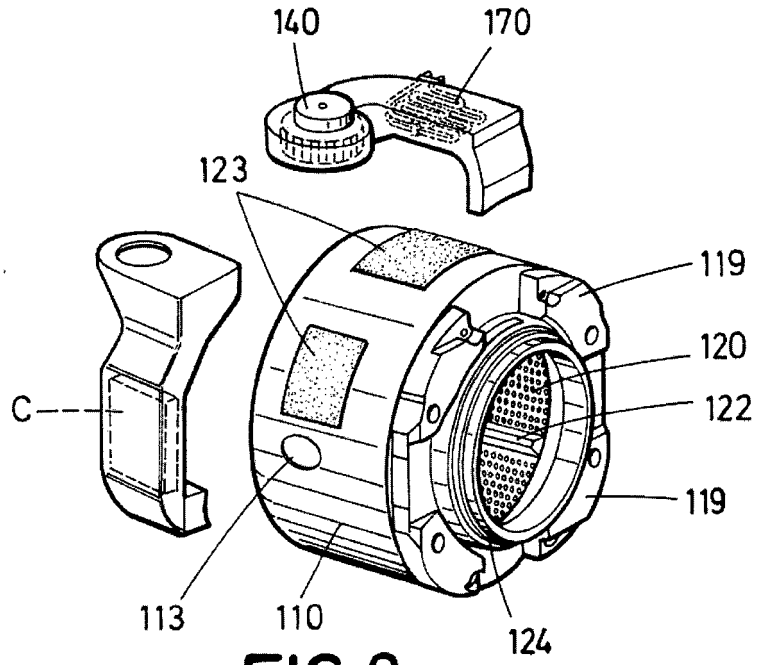
140
170
123
119
120
C
122
119
113
110
124

FIG.8

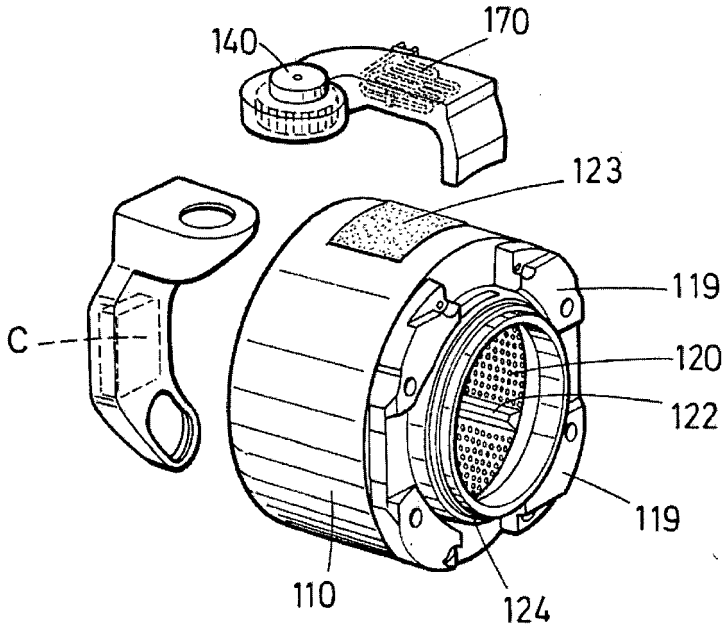
140
170
123
119
C
120
122
119
110
124

FIG.9

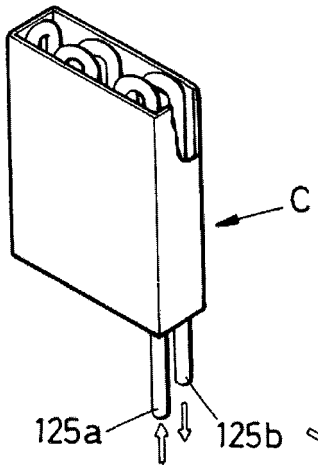

FIG.10

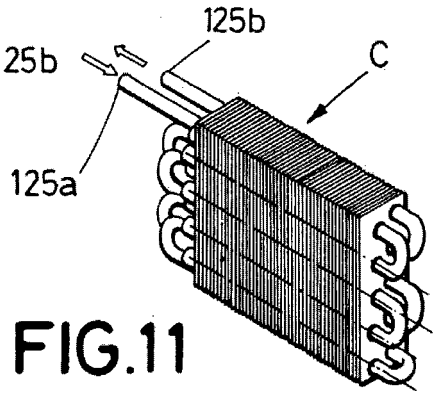

FIG.11

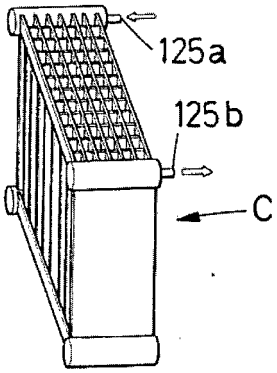

FIG.12

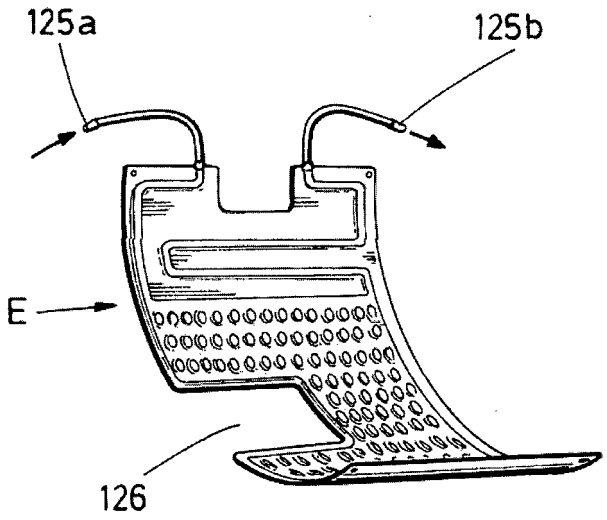

FIG.13

REFERENCES CITED IN THE DESCRIPTION

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