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

(11) **EP 3 919 671 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
08.12.2021 Bulletin 2021/49

(21) Application number: **20178479.0**

(22) Date of filing: **05.06.2020**

(51) Int Cl.:
D06F 58/50 *(2020.01)*
D06F 34/08 *(2020.01)*
D06F 103/48 *(2020.01)*
D06F 105/52 *(2020.01)*
D06F 58/20 *(2006.01)*
D06F 103/32 *(2020.01)*
D06F 105/26 *(2020.01)*

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

(71) Applicant: **ELECTROLUX APPLIANCES AKTIEBOLAG**
105 45 Stockholm (SE)

(72) Inventors:
- **SESSOLO, Mattia**
  33080 Porcia (IT)
- **ZAVAN, Christian**
  33080 Porcia (IT)
- **RAGOGNA, Roberto**
  33080 Porcia (IT)
- **RICCI, Alessandro**
  33080 Porcia (IT)
- **DALLA ROSA, Alessandro**
  33080 Porcia (IT)
- **ANTONELLO, Stefano**
  33080 Porcia (IT)

(74) Representative: **Electrolux Group Patents**
AB Electrolux
Group Patents
S:t Göransgatan 143
105 45 Stockholm (SE)

(54) A METHOD FOR OPERATING A LAUNDRY DRYING MACHINE EQUIPPED WITH A HEAT PUMP SYSTEM AND A LAUNDRY DRYING MACHINE IMPLEMENTING SAID METHOD

(57) The invention relates to a method for controlling a laundry drying machine (1) equipped with a heat pump system (50) including a compressor (52) and equipped with at least a passive switching device (70), not controllable by a control unit (UC1), adapted to cut the power supplied to the compressor (52) when predetermined operative parameters thresholds are exceeded. The machine (1) further comprises at least one compressor cooling fan (60) and at least one temperature sensor (80, 85). The method comprises the steps of:
activating the heat pump system (50) by switching on said compressor (52);
detecting a machine temperature (Tm) related to temperature conditions of the laundry drying machine (1);
detecting an electric parameter (Vd) related to the electric current absorbed by said compressor (52);
detecting a temperature (Tr) related to the compressor (52);
switching on said cooling fan (60) if said temperature (Tr) related to the compressor (52) is above one switch ON threshold temperature (Fan_Ton) selected among predetermined threshold temperatures (Fan_Ton);
switching off said cooling fan (60) if said temperature (Tr) related to the compressor (52) is below one switch OFF threshold temperature (Fan_Toff) selected among predetermined threshold temperatures (Fan_Toff);
maintaining said compressor (52) switched on or switching on said compressor (52) if said temperature (Tr) related to the compressor (52) is below one switch ON/OFF threshold temperature (Comp_Ton/off) among predetermined threshold temperatures (Comp_Ton/off);
switching off said compressor (52) if said temperature related (Tr) to the compressor (52) is above, or equal to, one switch ON/OFF threshold temperature (Comp_Ton/off) among predetermined threshold temperatures (Comp_Ton/off).
The predetermined threshold temperatures (Fan_Ton, Fan_Ton, Comp_Ton/off) are defined on the base of ranges of the machine temperature (Tm) and on the base of ranges of said electric parameter (Vd).

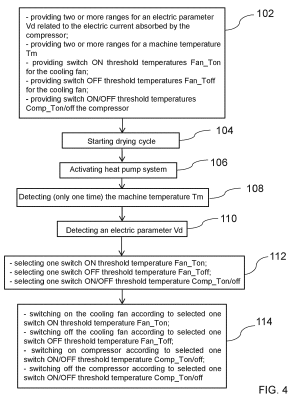

FIG. 4

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the field of laundry drying machines equipped with a heat pump system, more particularly to a method for operating such machines.

BACKGROUND ART

[0002] Laundry drying machines capable of carrying out a drying process on laundry, hereinafter simply indicated as laundry dryers, generally comprise a casing that houses a treating chamber, like a rotating drum, where laundry to be treated is received. A closed air stream circuit carries out drying operation by circulating hot air through the treating chamber containing the wet laundry.

[0003] The present invention can be usefully applied to all the machines performing a drying process on laundry, or wet clothes, such as a combined laundry washing-drying machine. In the present description, therefore, the term "laundry drying machine" will refer either to a simple laundry drying machine or a laundry washing-drying machine.

[0004] In laundry dryers, the heat pump technology is the most efficient way to save energy during the drying process/cycle. In conventional heat pump laundry dryers a drying air stream flows in a close loop. The drying air stream is moved by a fan, passes the laundry drum and removes water from wet clothes. Then the drying air stream is cooled down and dehumidified and then heated up in a heat pump system and finally reinserted again into the laundry drum.

[0005] The heat pump system comprises a refrigerant flowing in a closed-loop refrigerant circuit realized with pipes and comprising a compressor, a condenser, an expansion device and an evaporator. The condenser heats up the drying air while the evaporator cools and dehumidifies the drying air leaving the drum. The refrigerant flows in the refrigerant circuit where it is compressed by the compressor, condensed in the condenser, expanded in the expansion device and then vaporized in the evaporator.

[0006] Laundry dryers of the known type are typically equipped with overload protection devices to prevent the compressor from being damaged. An overload protection device typically used in laundry dryers preferably comprises a passive switch which interrupts the power supplied to the heat pump compressor from the mains when predetermined compressor temperature thresholds of heat or voltage load or absorbed current thresholds are exceeded.

[0007] The passive switch opens when a threshold temperature of the heat pump compressor is reached and/or when the current flowing through the passive switch is reached.

[0008] When normal functioning conditions are re-established the passive switch (e.g. a thermo protector device) is adapted to go back to the operative status closing the circuit for supplying again electrical power to the compressor.

[0009] However, there is a considerable delay before the overload protection device goes back to the operative status, due to the big inertia of the device for turning back to the closed position, typically about 40 minutes.

[0010] Therefore, a drawback of this known technique derives from the fact that intervention of the overload protection device causes increasing of the drying cycle duration and hence customer dissatisfaction.

[0011] To avoid the thermo protector device opening, it is known to carry out corrective actions generally only on the base of the temperature of the compressor, usually the temperature of the refrigerant flowing through the compressor. Corrective actions are generally carried out only on the base of the temperature of the compressor, due to the difficulty of detecting the current absorbed by the compressor.

[0012] Nevertheless, Applicant has recognized that corrective actions carried only on the base of the temperature, may be not completely effective, due to the fact that opening of the thermo protector device may be significantly affected by high values and/or peaks of the electrical current absorbed by the compressor.

[0013] It is an object of the present disclosure to overcome at least some of the problems associated with the prior art.

[0014] Therefore, it is an object of the present invention to provide a system apt to prevent the activation of the overload protection device also on the base of the electrical current absorbed by the compressor.

[0015] It is an object of the invention to implement a system for laundry drying machines equipped with a heat pump system apt to prevent the activation of the overload protection device.

[0016] It is another object of the invention to implement a system for laundry drying machines equipped with a heat pump system apt to prevent unwanted extension of the drying cycle duration.

DISCLOSURE OF INVENTION

[0017] According to one aspect of the present disclosure there is provided a method for controlling a laundry drying machine equipped with a heat pump system, as defined in claim 1.

[0018] In a first aspect the present invention relates, therefore, to a method for controlling a laundry drying machine equipped with a heat pump system, said laundry drying machine comprising:

- a treating chamber where laundry can be introduced to be dried with a drying air stream;
- a control unit;
- a heat pump system including a compressor, a first heat exchanger for cooling a refrigerant and heating the air stream, expansion means and a second heat exchanger for heating the refrigerant;
- at least a passive switching device not controllable by the control unit, adapted to cut the power supplied to the compressor when predetermined operative parameters thresholds are exceeded;
- at least an active switching device, controllable by the control unit, for selectively switching on and off the compressor;
- at least one compressor cooling fan, controllable by the control unit;
- at least one temperature sensor;

wherein said method comprises the steps of:

a1) providing at least two ranges of values of an electric parameter related to the electric current absorbed by said compressor;
a2) providing at least two ranges of values of a machine temperature related to temperature conditions of the laundry drying machine;
a3) on the base of ranges in steps a1) and a2), providing switch ON threshold temperatures for said cooling fan, providing switch OFF threshold temperatures for said cooling fan and providing switch ON/OFF threshold temperatures for said compressor;
b) activating said heat pump system by switching on said compressor;
c) detecting said machine temperature related to temperature conditions of the laundry drying machine;
d) detecting said electric parameter related to the electric current absorbed by said compressor;
e) on the base of the detected machine temperature in step c) and on the base of the electric parameter detected in step d), selecting one switch ON threshold temperature for said cooling fan among threshold temperatures defined in step a3), selecting one switch OFF threshold temperature for said cooling fan among threshold temperatures defined in step a3) and selecting one switch ON/OFF threshold temperature for said compressor among threshold temperatures defined in step a3);
f) detecting a temperature related to the compressor;
g) switching on said cooling fan if said temperature related to the compressor is above said one switch ON threshold temperature selected in step e);
h) switching off said cooling fan if said temperature related to the compressor is below said one switch OFF threshold temperature selected in step e);
i) maintaining said compressor switched on or switching on said compressor if said temperature related to the compressor is below said one switch ON/OFF threshold temperature selected in step e);
l) switching off said compressor if said temperature related to the compressor is above, or equal to, said one switch ON/OFF threshold temperature selected in step e).

[0019] Advantageously, the method according to the invention selectively operates the cooling fan and the compressor in order to cool down the compressor.

[0020] In a preferred embodiment of the invention, the step c) of detecting the machine temperature is performed after the step b) of activating the heat pump system by switching on the compressor.

[0021] In an alternative preferred embodiment of the invention, the step c) of detecting the machine temperature is performed before the step b) of activating the heat pump system by switching on the compressor.

[0022] According to a preferred embodiment of the invention, detecting the electric parameter related to the electric current absorbed by the compressor comprises detecting one of: the voltage level of the power main supplying electrical power to the laundry drying machine, the voltage level at the compressor, the current absorbed by the compressor.

[0023] Preferably, detecting the machine temperature related to temperature conditions of the laundry drying machine comprises detecting one of the temperatures, or a combination thereof, of the group comprising:
a temperature detected by any temperature sensor inside the casing of the laundry drying machine, a temperature detected by a temperature sensor mounted on an electronic board, a temperature detected by a drying air stream temperature sensor, a temperature detected by an ambient temperature sensor, any temperature sensor arranged at the heat pump system like the refrigerant temperature sensor.

[0024] In a preferred embodiment of the invention, detecting the temperature related to the compressor comprises detecting one of the temperatures, or a combination thereof, of the group comprising: a temperature detected by a refrigerant temperature sensor, a temperature detected by a compressor temperature sensor, a temperature detected by any sensor arranged at the heat pump system. According to a preferred embodiment of the invention, the step a1) comprises the step of providing three ranges, preferably a lower range, an intermediate range and an upper range and/or the step a2) comprises the step of providing three ranges, preferably a lower range, an intermediate range and an upper range. Preferably, the values of the switch ON/OFF threshold temperatures for the compressor provided in step a3)

decrease going from a lower range towards an upper range of the machine temperature and/or increase going from a lower range towards an upper range of the electric parameter.

[0025] In a preferred embodiment of the invention, the values of the switch ON threshold temperatures for the cooling fan provided in step a3) decrease going from a lower range towards an upper range of the machine temperature and/or increase going from a lower range towards an upper range of the electric parameter.

[0026] According to a preferred embodiment of the invention, the values of the switch OFF threshold temperatures for the cooling fan provided in step a3) decrease going from a lower range towards an upper range of the machine temperature and/or increase going from a lower range towards an upper range of the electric parameter.

[0027] Preferably, the step c) of detecting the machine temperature is carried out only one time at the beginning of the drying cycle. In this case, step c) can be carried out in different modes. In a first mode, step c) can be carried out before the control unit switches the compressor on, for example when the laundry machine is switched on but the user has not yet pressed the start button for starting the drying cycle and the compressor is still switched off, or, alternatively, within a predetermined time period after the user has pressed the start button for starting the drying cycle, for example 1 to 30 seconds, preferably 1 to 15 seconds, most preferably 1 to 5 seconds or, alternatively, after the compressor has remained switched off for a predetermined time, for example 10 to 30 minutes.

[0028] In a second mode, step c) can be carried out after a first predetermined time after the compressor is switched on, for example 1 to 10 seconds, but before the compressor gets warm.

[0029] Carrying out step c) according to the first or the second mode, allows detection of the machine temperature also by means of any sensor arranged at the heat pump system, like for example the refrigerant temperature sensor, in case no specific machine temperature sensors are available.

[0030] Indeed, at the beginning of the drying cycle, the machine temperature and the compressor temperature, in particular the refrigerant temperature have, generally, substantially the same value, so that the latter can be considered as being equivalent to the machine temperature.

[0031] In a further preferred embodiment of the invention, the step c) of detecting the machine temperature is periodically or continuously carried out during the drying cycle, wherein, in this case, the sensor used for detecting the machine temperature related to temperature conditions of the laundry drying machine is different from the sensor used for detecting the temperature related to the compressor.

[0032] According to a preferred embodiment of the invention, after the compressor is switched off, the compressor is available to be switched on again if a compressor temperature is below a threshold temperature.

[0033] Preferably, the steps from g) to 1) are carried out based upon one or more events comprising: lapse of a period of time from the starting of the drying cycle to reach a predetermined degree of humidity of the laundry.

[0034] In a preferred embodiment of the invention, the steps from g) to 1) are carried from the time of switching on the compressor.

[0035] Preferably, the steps a1), a2) and a3) are preferably performed by reading, through the control unit, data of a table comprising switch ON threshold temperatures for the cooling fan, switch OFF threshold temperatures for the cooling fan and switch ON/OFF threshold temperatures for the compressor which depend on ranges of values of an electric parameter related to the electric current absorbed by the compressor and on ranges of values of a machine temperature related to temperature conditions of the laundry drying machine.

[0036] In a further aspect the present invention relates to a laundry drying machine comprising a control unit configured for implementing a method according to the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] Further characteristics and advantages of the present invention will be highlighted in greater detail in the following detailed description of preferred embodiments of the invention, provided with reference to the enclosed drawings. In said drawings:

- Figure 1 shows an isometric view of a laundry drying machine which can implement the method of the present invention;
- Figure 2 is a schematic representation of the main components of the machine of figure 1 implementing the method of the present invention;
- Figure 3 illustrates a refrigerant temperature in the heat pump system of the machine of figure 2 as a function of the time;
- Figure 4 is a simplified flow chart of the basic operations of a method for operating a laundry drying machine according to a preferred embodiment of the invention;
- Figure 5 is a simplified flow chart of the basic operations of a method for operating a laundry drying machine according to a further preferred embodiment of the invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0038] The present invention has proved to be particularly successful when applied to a front-loading drying machine with a rotatable laundry container/drum; however it is clear that the present invention can be applied as well to a top-loading drying machine and also to laundry drying machines of cabinet type, i.e. laundry drying machines where the laundry container does not rotate.

[0039] Furthermore, the present invention can be usefully applied to all the machines performing the drying process on laundry, or wet clothes, such as a combined laundry washing-drying machine.

[0040] The term "laundry drying machine" refers, therefore, either to a simple laundry drying machine or a laundry washing-drying machine.

[0041] Generally, a laundry drying machine, o laundry dryer, according to the present invention includes a treating chamber where the laundry items can be introduced to be treated with a drying air stream; a circuit where the drying air stream circulates; a heat pump system including a first heat exchanger for cooling a refrigerant and heating the air stream, expansion means and a second heat exchanger for heating the refrigerant; at least an active switching device for selectively activating/deactivating the compressor; at least a passive switching device adapted to cut the power supplied to the compressor when predetermined temperature or load thresholds are exceeded.

[0042] Figures 1 and 2 illustrate a laundry dryer 1 with a heat pump system 50 according to a preferred embodiment of the present invention.

[0043] The laundry dryer 1 preferably comprises, though not necessarily, a substantially parallelepiped-shaped outer boxlike casing 2 which is preferably structured for resting on the floor. A treating chamber preferably consisting of a rotatably drum 9 is provided within the casing 2. A front door 8, pivotally coupled to the front upright side wall 2a, is provided for allowing access to the drum interior region to place laundry to be dried therein.

[0044] The drum 9 is advantageously rotated by a drum motor 10, preferably an electric motor, which preferably transmits the rotating motion to the shaft of the drum 9, advantageously by means of a belt/pulley system (not shown). In a different embodiment of the invention, the drum motor can be directly associated with the shaft of the drum 9.

[0045] A user control interface 15 is preferably arranged on the top of the casing 2. The user control interface 15 is preferably accessible to the user for the selection of the drying cycle/program and insertion of other parameters, for example the type of fabric of the load, the degree of dryness, etc. The user control interface 15 preferably displays machine working conditions, such as the remaining cycle time, alarm signals, etc. For this purpose, the user control interface 15 preferably comprises a display 13.

[0046] In different embodiments, for example in a combined laundry washing and drying machine, the user may select and insert other types of parameters, for example the washing temperature, the washing spinning speed, etc.

[0047] In further embodiments, the user control interface may be differently realized, for example remotely arranged in case of a remote-control system.

[0048] An air inlet path 20 is preferably connected to a side of the drum 9 and an air outlet path 22 is preferably connected to the other side of the drum 9. The air inlet path 20, the air outlet path 22 and the drum 9 define a drying air circuit 26 for the drying air stream. A circulating fan 28 is normally provided for moving drying air along the circuit 26. A dedicated motor 30 preferably operates the circulating fan 28, but in a possible simpler implementation the same motor can operate the circulating fan 28 and the drum 9 (in other words only one of the two motors 10 and 30 can be present).

[0049] The laundry dryer 1, as said above, then comprises a heat pump system 50 comprising a compressor 52, a first heat exchanger 54 (also called condenser), acting as a hot sink (i.e. condenser or gas cooler in case the refrigerant operates at least at critical pressure), a second heat exchanger 56 (also called evaporator), acting as a cold sink (i.e. evaporator or gas heater in case refrigerant operates at least at critical pressure). A throttle 58 is normally provided between the first heat exchanger 54 and the second heat exchanger 56.

[0050] Alternative solutions to the throttle include expansion means, capillary tube or controlled expansion valve. In the embodiment shown in figure 2 the drying air circuit 26 forms a substantially closed loop and the air stream from the drum 9 passes through the second heat exchanger 56 (evaporator) and then through the first heat exchanger 54 (condenser).

[0051] According to an aspect of the invention, preferably a cooling fan 60 is provided to cool down the compressor 52, as better described later, and a dedicated motor 62 operates the cooling fan 60.

[0052] A control unit UC1 is connected to the various parts of the laundry dryer 1 in order to ensure its operation. The user control interface 15 preferably communicates with the control unit UC1.

[0053] Electrical power is supplied to the laundry dryer 1 from a power main PM, preferably through wire connections L, N, e.g. line wire L and neutral wire N connected to the power main PM.

[0054] Electrical power is supplied to various parts of the laundry dryer 1. In figure 2, only some parts of the laundry dryer 1 are explicitly shown as supplied by the electrical power, namely the control unit UC1 and the compressor 52.

[0055] The compressor 52 is preferably connected in series with a passive switching device 70, and the assembly formed by the compressor 52 and the passive switching device 70 is connected to the line wire L and to the neutral wire

N of the power main PM.

[0056] The passive switching device 70 is not controllable by control unit UC1 and is preferably adapted to cut the power supplied from the main power PM when predetermined operative parameters thresholds are exceeded. In a preferred embodiment of the invention, the passive switching device 70 comprises a thermo protector device adapted to cut the power supplied to the compressor 52 from the power main PM when predetermined temperature or absorbed current thresholds are exceeded.

[0057] An active switching device 72, typically a relay or a solid state device, such as a triac, etc., is placed along the neutral wire N and controllable by the control unit UC1 to activate/deactivate the compressor 52. The active switching device 72 will be also referred to as "relay" in the following, but it is understood that it could be a different switching device.

[0058] The laundry dryer 1 is also preferably provided with a first temperature detecting device 80, or temperature sensor, for monitoring a temperature at the heat pump system 50.

[0059] Preferably, as illustrated in Figure 2, the first temperature sensor 80 is placed at a predetermined position along the pump system 50 to measure the refrigerant temperature Tr. The first temperature sensor 80 conveys the information to the control unit UC1. In particular, the first temperature sensor 80 is an NTC thermistor placed in such a way to measure the refrigerant temperature Tr at the outlet of the condenser 54 (or at the inlet of the throttle 58). Additionally, or alternatively, one or more than one temperature sensor can be arranged at different locations of the heat pump system 50, for example at the outlet of compressor 52 or more preferably directly on the compressor 52.

[0060] Generally, for the scope of the present invention, at least one sensor temperature is used to detect a first temperature related to the compressor 52, preferably the actual working temperature of the compressor 52. The detected temperature, or temperatures, will be preferably used to control the selective activations of the cooling fan 60 and deactivations of the compressor 52, as better illustrated below.

[0061] The laundry dryer 1 is also preferably provided with a second temperature detecting device 85, or temperature sensor, for monitoring a machine temperature Tm.

[0062] In a preferred embodiment, as illustrated in Figure 2, the second temperature sensor 85 is placed at the air outlet path 22 of the drying air circuit 26 for detecting the temperature of the drying air stream leaving the drum 9, preferably an NTC thermistor.

[0063] Additionally, or alternatively, one or more than one temperature sensor can be arranged inside the casing 2, for example a temperature sensor mounted on an electronic board or a refrigerant temperature sensor or a drying air stream temperature sensor or an ambient temperature sensor.

[0064] The second temperature sensor 85 conveys the information to the control unit UC1.

[0065] Generally, for the scope of the present invention, at least one temperature sensor is used to detect a machine temperature Tm, or temperatures, which gives information on the status of the laundry dryer 1.

[0066] It has to be noted that in further preferred embodiments, not shown, the first temperature related to the compressor 52 and the machine temperature Tm may both be detected through the same temperature sensor, instead of having two temperature sensors 80, 85 as described above. For example, the first temperature related to the compressor 52 and the machine temperature Tm may both be obtained through the first temperature sensor 80 that measures the refrigerant temperature Tr.

[0067] The laundry dryer 1 is also preferably provided with an electrical detecting device 90 for detecting an electric parameter related to the electric power supplied to the compressor 52.

[0068] Preferably, as illustrated in the figure, the electrical detecting device 90 comprises a voltage sensor adapted to measure the power main voltage Vd between line and neutral wires L, N (or supplying voltage Vd).

[0069] Alternatively, the electrical detecting device can be arranged at different locations of the laundry dryer 1 to detect other electric parameters related to the electric power supplied to the compressor 52, for example a voltage sensor directly applied to the compressor 52 or a current sensor detecting the current absorbed by the compressor 52. In the preferred embodiment illustrated in Figure 2, the electrical detecting device 90 is preferably integrated in the control unit UC1. In different embodiments, nevertheless, electrical detecting device may be a separated device.

[0070] The laundry dryer 1 implementing the method according to a preferred embodiment of the present disclosure is preferably controlled by the control unit UC1 which receives information and output control signals to components of the laundry dryer 1.

[0071] As mentioned above, thermo protector device opening, or cut-off event, is an event that should be avoided during functioning of the laundry dryer 1 in normal conditions.

[0072] According to the invention, corrective actions are taken in order to reduce the probability of the cut-off event while the laundry dryer 1 is working, i.e. after the drying cycle has started and in particular when the heat pump system 50 is activated by switching on the compressor 52. Corrective actions are preferably carried out under the control of the control unit UC1 on the base of a detected temperature, preferably on the base of the first temperature detected by the first temperature sensor 80, preferably the refrigerant temperature Tr.

[0073] A first preferred corrective action provides for selectively operating the cooling fan 60 in order to cool down the compressor 52.

[0074] Preferably, the cooling fan 60 is switched on by the control unit UC1 if the first temperature, preferably the refrigerant temperature Tr detected by the first temperature detecting device 80, is above a given threshold temperature Fan_Ton, hereinafter indicated as "switch ON threshold temperature". The cooling fan 60 is then switched off if the first temperature, preferably the refrigerant temperature Tr detected by the first temperature detecting device 80, is below a given threshold temperature Fan_Toff, hereinafter indicated as "switch OFF threshold temperature".

[0075] Activation of the cooling fan 60 helps the decreasing of the compressor temperature and, in turn, the decreasing of the refrigerant temperature Tr. Conversely, when the cooling fan 60 is deactivated the compressor temperature and the refrigerant temperature Tr increases.

[0076] Figure 3 exemplary shows a schematic diagram of the refrigerant temperature Tr as a function of the time where the switch ON threshold temperature Fan_Ton of the refrigerant at which the cooling fan 60 is switched on is set to 80°C and the switch OFF threshold temperature Fan_Toff of the refrigerant at which the cooling fan 60 is switched off is set to 78°C.

[0077] It can be appreciated that refrigerant temperature Tr falls and rises between the two threshold temperatures Fan_Ton and Fan_Toff according to respective activations and de-activations of the cooling fan 60.

[0078] A second preferred corrective action provides for switching off the compressor 52, preferably through the relay 72. The compressor 52 is switched off if the first temperature, preferably the refrigerant temperature Tr detected by the first temperature detecting device 80, is above, or equal to, a given threshold temperature Comp_Ton/off, hereinafter indicated as "switch ON/OFF threshold temperature". For example, the compressor 52 is switched off if the refrigerant temperature Tr detected by the first temperature detecting device 80, is above, or equal to, 90°C.

[0079] Deactivation of the compressor 52 causes the decreasing of the compressor temperature and, in turn, the decreasing of the refrigerant temperature Tr.

[0080] In a first aspect of the invention, therefore, the control unit UC1 opportunely selectively switches on-off the cooling fan 60 and switches off the compressor 52 on the base of the detected first temperature so that the compressor 52 cools down and does not reach critical working conditions which may cause the undesired opening of the thermo protector device 70.

[0081] In case the compressor 52 is switched off by the control unit UC1, preferably, a predetermined period of time is set before the compressor 52 is available to be switched on again. Said period of time allows reestablishment of correct pressure of the refrigerant in the pump system 50. Said predetermined period of time is preferably set to 2-3 minutes. In a further preferred embodiment, the compressor 52 may be switched on again only if the refrigerant temperature Tr has decreased below a predetermined temperature.

[0082] Advantageously, corrective actions may prevent the cut-off event, i.e. opening of the thermo protector device 70, that would imply the deactivation of the compressor 52 and the suspension of the drying cycle for a long time, typically about 40 minutes.

[0083] By means of corrective actions, at worst, the compressor 52 is deactivated for 2-3 minutes, thus significantly reducing suspension time of the drying cycle compared to a suspension caused by the deactivation of the compressor 52 through intervention of the thermo protector device 70.

[0084] In a preferred embodiment of the method, corrective actions may be carried out from the very beginning of the drying cycle.

[0085] In a more preferred embodiment of the method, corrective actions may be carried out based upon one or more events.

[0086] For example, in a first preferred embodiment of the invention, said corrective actions are carried out after a period of time has lapsed from the beginning of the drying cycle, for example 30 minutes after the drying cycle started. It is clear that such a period may depend on the type of cycle selected, for example may be proportional to the duration of the selected cycle.

[0087] It is known, in fact, that at the beginning of the drying cycle the laundry is generally wet and not warm. In this case, the compressor 52 is usually not warm and therefore far from its critical working condition. This may not occur if a new drying cycle immediately follows a previous drying cycle so that the compressor 52 can be still warm/hot.

[0088] In a further preferred embodiment of the invention, the corrective actions are carried out at the reaching of a predetermined degree of humidity of the laundry. It is known that a predetermined degree of humidity of the laundry is reached after a certain period of time from the beginning of the drying cycle when the wet clothes dries. The degree of humidity of the laundry may be evaluated, for example, through a humidity sensor arranged inside the drum 9.

[0089] Applicant has recognized that corrective actions carried out by the control unit UC1, according to the methodology above described, may be not completely effective to avoid the thermo protector device opening only on the base of the detected first temperature, preferably the detected refrigerant temperature Tr. Applicant has recognized, in fact, that opening of the thermo protector device 70 may be affected by high values and/or peaks of the electrical current absorbed by the compressor 52. Furthermore, opening of the thermo protector device 70 may be affected by environment temperature of the laundry dryer, or machine temperature Tm.

[0090] Therefore, according to an aspect of the present invention, said corrective actions are calibrated considering

the electrical current absorbed by the compressor 52 and the machine temperature Tm. The machine temperature Tm is preferably obtained through the second temperature detecting device 85, as explained above.

[0091] A first preferred way to evaluate the electrical current absorbed by the compressor 52 is monitoring the voltage level Vd of the power main PM, preferably by means of the electrical detecting device 90.

[0092] For the same amount of power requested by the compressor 52, in fact, lower values of supplying voltage Vd determine higher values of electrical current absorbed by the compressor 52 and, vice versa, higher values of supplying voltage Vd determine lower values of electrical current absorbed by the compressor 52.

[0093] Therefore, according to an aspect of the invention, said corrective actions are calibrated considering the actual supplying voltage Vd compared to predetermined ranges of the voltage level Vd, as better described below. Preferably, the voltage level Vd of the power main PM detected by the electrical detecting device 90 is measured on each peak of the sinusoidal signal of the power main PM. At this purpose, an electronic circuit is used to detect the zero crossing and synchronize the signal sampling on the peak. The measured voltage is then processed to filter any voltage spike or high frequency noise.

[0094] According to the method of the invention, corrective actions are calibrated on the base of voltage levels Vd of the power main PM detected by the electrical detecting device 90 and on the base of machine temperatures Tm detected by the second temperature detecting device 85.

[0095] According to the invention, the calibration of said corrective actions is performed by considering different switch ON threshold temperatures Fan_Ton for the cooling fan 60, different switch OFF threshold temperatures Fan_Toff for the cooling fan 60 and different switch ON/OFF threshold temperatures Comp_Ton/off for the compressor on the base of predetermined ranges of the supplying voltage Vd and on the base of predetermined ranges of the machine temperature Tm.

[0096] In an aspect thereof, therefore, the invention preferably comprises the definition of two or more ranges for the power main voltage levels Vd and of two or more ranges for the machine temperature Tm. Switch ON threshold temperatures Fan_Ton, switch OFF threshold temperatures Fan_Toff and switch ON/OFF threshold temperatures Comp_Ton/off are then defined according to the said ranges, as better described below.

[0097] In a preferred embodiment of the invention, three ranges are preferably defined for the power main voltage levels Vd, for example a low range, an intermediate range and a high range as indicated below:

- low range for $Vd \leq 210$ V;
- intermediate range for $210\ V < Vd < 240\ V$;
- high range for $Vd \geq 240$ V.

[0098] Three ranges are also preferably defined for the machine temperature Tm, for example a low range, an intermediate range and a high range as indicated below:

- low range for $Tm < 15°$ C;
- intermediate range for $15°\ C < Tm < 27°$ C;
- high range for $Tm \geq 27°$ C.

[0099] On the base of the ranges defined for the power main voltage Vd and for the machine temperature Tm, corresponding switch ON threshold temperatures Fan_Ton for the cooling fan 60, switch OFF threshold temperatures Fan_Toff for the cooling fan 60 and switch ON/OFF threshold temperatures Comp_Ton/off for the compressor 52 are provided, as indicated for example in the correction table below:

		Power main voltage Vd		
		low range Vd ≤ 210 V	intermediate range 210V<Vd< 240V	high range Vd ≥ 240 V
Machine temperature	low range Tm ≤ 15° C	Fan_Ton=75°C Fan_Toff=74°C Comp_Ton/off=85°C	Fan Ton=80°C Fan_Toff=79°C Comp_Ton/off=90°C	Fan_Ton=80°C Fan_Toff=79°C Comp_Ton/off=90°C
	intermediate range 15°C <Tm< 27°C	Fan_Ton=75°C Fan_Toff=74°C Comp_Ton/off=85°C	Fan_Ton=80°C Fan_Toff=78°C Comp_Ton/off=90°C	Fan_Ton=80°C Fan_Toff=79°C Comp_Ton/off=90°C
	high range Tm ≥ 27° C	Fan_Ton=70°C Fan_Toff=69°C Comp_Ton/off=80°C	Fan_Ton=80°C Fan_Toff=79°C Comp_Ton/off=85°C	Fan_Ton=80°C Fan_Toff=79°C Comp_Ton/off=90°C

[0100] As it can be appreciated from the table, threshold temperatures Fan_Ton, Fan_Toff and Comp_Ton/off are provided in accordance to possible working conditions of the laundry dryer 1: more restrictive threshold temperatures Fan_Ton, Fan_Toff and Comp_Ton/off are provided for more critical possible working conditions of the laundry dryer 1. For example, the most critical working condition corresponds to the lower range for power main voltage Vd (i.e. Vd ≤ 210 V) and the higher range for the machine temperature Tm (i.e. Tm ≥ 27° C). Accordingly, the switch ON threshold temperature Fan_Ton for the cooling fan 60 is set to a low value of 70°C (instead of 80°C of a normal/standard working condition), the switch OFF threshold temperature Fan_Toff for the cooling fan 60 is set to a low value of 69°C (instead of 78°C of a normal/standard working condition) and the switch ON/OFF threshold temperature Comp_Ton/off for the compressor 52 is set to a low value of 80°C (instead of 90°C of a normal/standard working condition).

[0101] Preferably, the values of the switch ON/OFF threshold temperatures Comp_Ton/off for the compressor 52 decrease going form a lower range towards an upper range of the machine temperature Tm.

[0102] Preferably, the values of the switch ON/OFF threshold temperatures Comp_Ton/off for the compressor 52 increase going form a lower range towards an upper range of the power main voltage Vd.

[0103] Preferably, the values of the switch ON threshold temperatures Fan_Ton for the cooling fan 60 decrease going form a lower range towards an upper range of the machine temperature Tm.

[0104] Preferably, the values of the switch ON threshold temperatures Fan_Ton for the cooling fan 60 increase going form a lower range towards an upper range of the power main voltage Vd.

[0105] Preferably, the values of the switch OFF threshold temperatures Fan_Toff for the cooling fan 60 decrease going from a lower range towards an upper range of the machine temperature Tm.

[0106] Preferably, the values of the switch OFF threshold temperatures Fan_Toff for the cooling fan 60 increase going from a lower range towards an upper range of the power main voltage Vd.

[0107] In a preferred embodiment of the invention, said values are organized in form of data, for example in form of a correction table which is preferably stored in the control unit UC1, for example stored in a ROM (Read Only Memory) of the control unit UC1.

[0108] In a more preferred embodiment of the invention, the correction table is prepared and stored in the control unit UC1 by the manufacturer during manufacturing of the laundry dryer 1.

[0109] The data of the correction table are therefore available once the laundry dryer 1 is installed and ready for the use.

[0110] In different embodiments, the correction table may be created in a different moment and opportunely stored, or updated, in the control unit UC1, even after installation of the laundry dryer 1.

[0111] A possible use of the correction table according to the invention is described with reference to Figure 4.

[0112] The first phase of the method for controlling the laundry dryer 1 (block 102 in Figure 4) comprises the steps of:

- providing at least two ranges of an electric parameter related to the electric current absorbed by the compressor, for example the supplying voltage Vd;
- providing at least two ranges of values of the machine temperature Tm;
- providing switch ON threshold temperatures for the cooling fan 60, providing switch OFF threshold temperatures for the cooling fan 60 and providing switch ON/OFF threshold temperatures for the compressor 52 on the base of the ranges of the supplying voltage Vd and of the machine temperature Tm.

[0113] The steps of the first phase (block 102) above listed substantially indicates that the data of said correction table are provided/available and may be accessed by the control unit UC1.

[0114] The drying cycle is then started (step 104).

[0115] Once the drying cycle is started, the heat pump system 50 may be activated by the control unit UC1 by switching on the compressor 52 (step 106). Also, preferably, the circulating fan 28 is operated for moving drying air along the circuit 26 and the drum 9 is opportunely rotated.

[0116] It has to be noted that the first phase (block 102) may also be performed after the drying cycle has started, i.e. after step 104, and preferably before activation of the heat pump system 50 (step 106).

[0117] In a following step, detection of the machine temperature Tm is performed (step 108).

[0118] In a first preferred embodiment of the invention, detection of the machine temperature Tm is performed one time.

[0119] Preferably, detection of the machine temperature Tm is performed after the drying cycle has started (step 104) and preferably after activation of the heat pump system 50 (step 106).

[0120] In further preferred embodiments, said machine temperature detection may be performed before activation of the heat pump system 50 (step 106) or even before the drying cycle has started (step 104), for example just after the laundry machine is switched on, before selecting a drying program.

[0121] From said detection, it is then determined which is the range to which the machine temperature Tm belongs to. For example, if the detected machine temperature Tm is 25°C, it belongs to the intermediate range (referring to correction table above described).

[0122] During the cycle, then, an electric parameter is detected, preferably the main power voltage Vd is detected (step 110). In a preferred embodiment, the main power voltage Vd is detected continuously during the drying cycle. In a further preferred embodiment, the main power voltage Vd is detected periodically during the drying cycle.

[0123] In a following step (step 112), on the base of the detected machine temperature Tm (step 108) and on the base of the main power voltage Vd actually detected (step 110), corresponding threshold temperatures Fan_Ton, Fan_Toff and Comp_Ton/off stored in the correction table are selected.

[0124] According to the threshold temperatures Fan_Ton, Fan_Toff and Comp_Ton/off selected (step 112), the cooling fan 60 and the compressor 52 are controlled to cool down the compressor 52, as described above, and therefore the control unit UC1 opportunely switches on and off the cooling fan 60, and switches on and off the compressor 52 by means of the active switching device 72 on the base of the detected refrigerant temperature Tr (step 114).

[0125] For example, if the detected machine temperature Tm was 25°C at the beginning of the cycle and therefore the corresponding intermediate range was selected, the cooling fan 60 and the compressor 52 will be controlled by the control unit UC1 using threshold temperatures Fan_Ton, Fan_Toff and Comp_Ton/off of the correction table according to the range to which the actual detected main power voltage Vd belongs to, i.e. using the threshold temperatures of one cell of the second row of the correction table.

[0126] Figure 5 illustrates a flow chart of a second implementation of the method. In the flow chart, steps corresponding to the steps of the first preferred embodiment as illustrated in figure 4 are identified by the same numbers.

[0127] This embodiment differs from the embodiment previously described in that the machine temperature Tm is not detected only once, preferably at the beginning of the drying cycle, but rather the machine temperature Tm is also detected during the drying cycle (step 108'), as it happens for the main power voltage Vd (step 110).

[0128] In a preferred embodiment of the invention, the machine temperature Tm is periodically carried out during the drying cycle. In such a case, the machine temperature Tm is preferably obtained through the second temperature detecting device 85, as explained above. In a further preferred embodiment, nevertheless, the machine temperature Tm may be obtained through the first temperature detecting device 80.

[0129] In a further preferred embodiment of the invention, the machine temperature Tm is continuously carried out during the drying cycle. In such a case, the machine temperature Tm is obtained through the second temperature detecting device 85. In the following step of the method (step 112'), threshold temperatures Fan_Ton, Fan_Toff and Comp_Ton/off stored in the correction table are selected on the base of the actually detected machine temperature Tm (step 108') and on the base of the main power voltage Vd actually detected (step 110).

[0130] According to the threshold temperatures Fan_Ton, Fan_Toff and Comp_Ton/off selected (step 112'), the cooling fan 60 and the compressor 52 are controlled to cool down the compressor 52, as described above, and therefore the control unit UC1 opportunely switches on and off the cooling fan 60 and switches on and off the compressor 52 on the base of the detected refrigerant temperature Tr (step 114).

[0131] For example, if the actual detected machine temperature Tm is 30°C then the cooling fan 60 and the compressor 52 will be controlled by the control unit UC1 using threshold temperatures Fan_Ton, Fan_Toff and Comp_Ton/off of the correction table according to the range to which the actual detected main power voltage Vd belongs to, referring in this case to the threshold temperatures of one cell of the third row of the correction table.

[0132] Advantageously, from the above description it has been shown that corrective actions that may prevent the cut-off event are opportunely calibrated to be more effective thanks to the monitoring of electrical parameters related to the absorbed current by the compressor an thanks to the monitoring of the machine temperature.

[0133] While the corrective actions above described for the preferred embodiments are preferably calibrated considering different ranges of the voltage level Vd of the power main PM detected by the electrical detecting device 90 and machine temperatures detected by the second temperature detecting device 85, it has to be noted that in different embodiments other electrical parameters related to the absorbed current by the compressor may be used, for example the voltage level at the compressor or the current directly absorbed by the compressor and other machine temperatures, or combination thereof, may be used, for example a temperature detected by any temperature sensor inside the casing of the laundry drying machine, a temperature detected by a temperature sensor mounted on an electronic board, a temperature detected by a refrigerant temperature sensor, a temperature detected by a drying air stream temperature sensor, a temperature detected by an ambient temperature sensor.

[0134] Furthermore, while the preferred embodiments above described considered three ranges for the voltage level Vd and three ranges for the machine temperature Tm, it has to be noted that in different embodiments a different number of ranges for the voltage level and/or for the machine temperature may be used, for example only two ranges or more than three ranges.

[0135] Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to that precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. For example, the laundry dryer may comprise further auxiliary heat exchangers associated to the heat pump system. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

Claims

1. A method for controlling a laundry drying machine (1) equipped with a heat pump system (50), said laundry drying machine (1) comprising:

- a treating chamber (9) where laundry can be introduced to be dried with a drying air stream;
- a control unit (UC1);
- a heat pump system (50) including a compressor (52), a first heat exchanger (54) for cooling a refrigerant and heating the air stream, expansion means (58) and a second heat exchanger (56) for heating the refrigerant;
- at least a passive switching device (70) not controllable by the control unit (UC1), adapted to cut the power supplied to the compressor (52) when predetermined operative parameters thresholds are exceeded;
- at least an active switching device (72), controllable by the control unit (UC1), for selectively switching on and off the compressor (52);
- at least one compressor cooling fan (60 controllable by the control unit (UC1
- at least one temperature sensor (80, 85);

wherein said method comprises the steps of:

a1) providing at least two ranges of values of an electric parameter (Vd) related to the electric current absorbed by said compressor (52);
a2) providing at least two ranges of values of a machine temperature (Tm) related to temperature conditions of the laundry drying machine (1);
a3) on the base of ranges in steps a1) and a2), providing switch ON threshold temperatures (Fan_Ton) for said cooling fan (60), providing switch OFF threshold temperatures (Fan_Toff) for said cooling fan (60) and providing switch ON/OFF threshold temperatures (Comp_Ton/off) for said compressor (52);
b) activating said heat pump system (50) by switching on said compressor (52);
c) detecting said machine temperature (Tm) related to temperature conditions of the laundry drying machine (1);
d) detecting said electric parameter (Vd) related to the electric current absorbed by said compressor (52);
e) on the base of the detected machine temperature (Tm) in step c) and on the base of the electric parameter (Vd) detected in step d), selecting one switch ON threshold temperature (Fan_Ton) for said cooling fan (60) among threshold temperatures (Fan_Ton) defined in step a3), selecting one switch OFF threshold temperature (Fan_Toff) for said cooling fan (60) among threshold temperatures (Fan_Toff) defined in step a3) and selecting one switch ON/OFF threshold temperature (Comp_Ton/off) for said compressor (52) among threshold temperatures (Comp_Ton/off) defined in step a3);
f) detecting a temperature (Tr) related to the compressor (52);
g) switching on said cooling fan (60) if said temperature (Tr) related to the compressor (52) is above said one switch ON threshold temperature (Fan_Ton) selected in step e);

h) switching off said cooling fan (60) if said temperature (Tr) related to the compressor (52) is below said one switch OFF threshold temperature (Fan_Toff) selected in step e);
i) maintaining said compressor (52) switched on or switching on said compressor (52) if said temperature (Tr) related to the compressor (52) is below said one switch ON/OFF threshold temperature (Comp_Ton/off) selected in step e);
l) switching off said compressor (52) if said temperature related (Tr) to the compressor (52) is above, or equal to, said one switch ON/OFF threshold temperature (Comp_Ton/off) selected in step e).

2. The method according to claim 1, **characterized in that** detecting said electric parameter (Vd) related to the electric current absorbed by the compressor (52) comprises detecting one of: the voltage level of the power main (PM) supplying electrical power to the laundry drying machine (1), the voltage level at the compressor (52), the current absorbed by the compressor (52).

3. The method according to any preceding claim, **characterized in that** detecting said temperature (Tr) related to the compressor (52) comprises detecting one of the temperatures, or a combination thereof, of the group comprising: a temperature (Tr) detected by a refrigerant temperature sensor (80), a temperature detected by a compressor temperature sensor, a temperature detected by any sensor arranged at said heat pump system (50).

4. The method according to any preceding claim, **characterized in that** said step a1) comprises the step of providing three ranges, preferably a lower range, an intermediate range and an upper range and/or said step a2) comprises the step of providing three ranges, preferably a lower range, an intermediate range and an upper range.

5. The method according to any preceding claim, **characterized in that** said values of said switch ON/OFF threshold temperatures (Comp_Ton/off) for said compressor (52) provided in step a3) decrease going from a lower range towards an upper range of said machine temperature (Tm) and/or increase going from a lower range towards an upper range of said electric parameter (Vd).

6. The method according to any preceding claim, **characterized in that** said values of said switch ON threshold temperatures (Fan_Ton) for said cooling fan (60) provided in step a3) decrease going from a lower range towards an upper range of said machine temperature (Tm) and/or increase going from a lower range towards an upper range of said electric parameter (Vd).

7. The method according to any preceding claim, **characterized in that** said values of said switch OFF threshold temperatures (Fan_Toff) for said cooling fan (60) provided in step a3) decrease going from a lower range towards an upper range of said machine temperature (Tm) and/or increase going from a lower range towards an upper range of said electric parameter (Vd).

8. The method according to any preceding claim, **characterized in that** said step c) of detecting said machine temperature (Tm) is carried out only one time at the beginning of the drying cycle, or before switching the compressor on, or at a first predetermined time after the compressor is switched on.

9. The method according to any preceding claim 1 to 7, **characterized in that** said step c) of detecting said machine temperature (Tm) is periodically or continuously carried out during the drying cycle, wherein the sensor (85) used for detecting said machine temperature (Tm) related to temperature conditions of the laundry drying machine (1) is different from the sensor (80) used for detecting said temperature (Tr) related to the compressor (52).

10. The method according to any preceding claim, **characterized in that** detecting said machine temperature (Tm) related to temperature conditions of the laundry drying machine (1) comprises detecting one of the temperatures, or a combination thereof, of the group comprising:
a temperature detected by any temperature sensor (80, 85) inside the casing of said laundry drying machine (1), a temperature detected by a temperature sensor mounted on an electronic board, temperature sensor arranged at the heat pump system, a temperature (Tr) detected by a refrigerant temperature sensor (80), a temperature detected by a drying air stream temperature sensor (85), a temperature detected by an ambient temperature sensor.

11. The method according to claim 10, **characterized in that** detecting said machine temperature (Tm) related to temperature conditions of the laundry drying machine (1) is carried out in a predetermined time.

12. The method according to any preceding claim, **characterized in that** after said compressor (52) is switched off,

said compressor (52) is available to be switched on again if a compressor temperature (Tr) is below a threshold temperature.

13. The method according to any preceding claim, **characterized in that** said steps from g) to 1) are carried out based upon one or more events comprising:
lapse of a period of time from the starting of the drying cycle to reach a predetermined degree of humidity of the laundry.

14. The method according to any preceding claim 1 to 13, **characterized in that** said steps from g) to 1) are carried out from the time of switching on said compressor (52).

15. A laundry drying machine (1) comprising a control unit (UC1) configured for implementing a method according to any of the preceding claims.

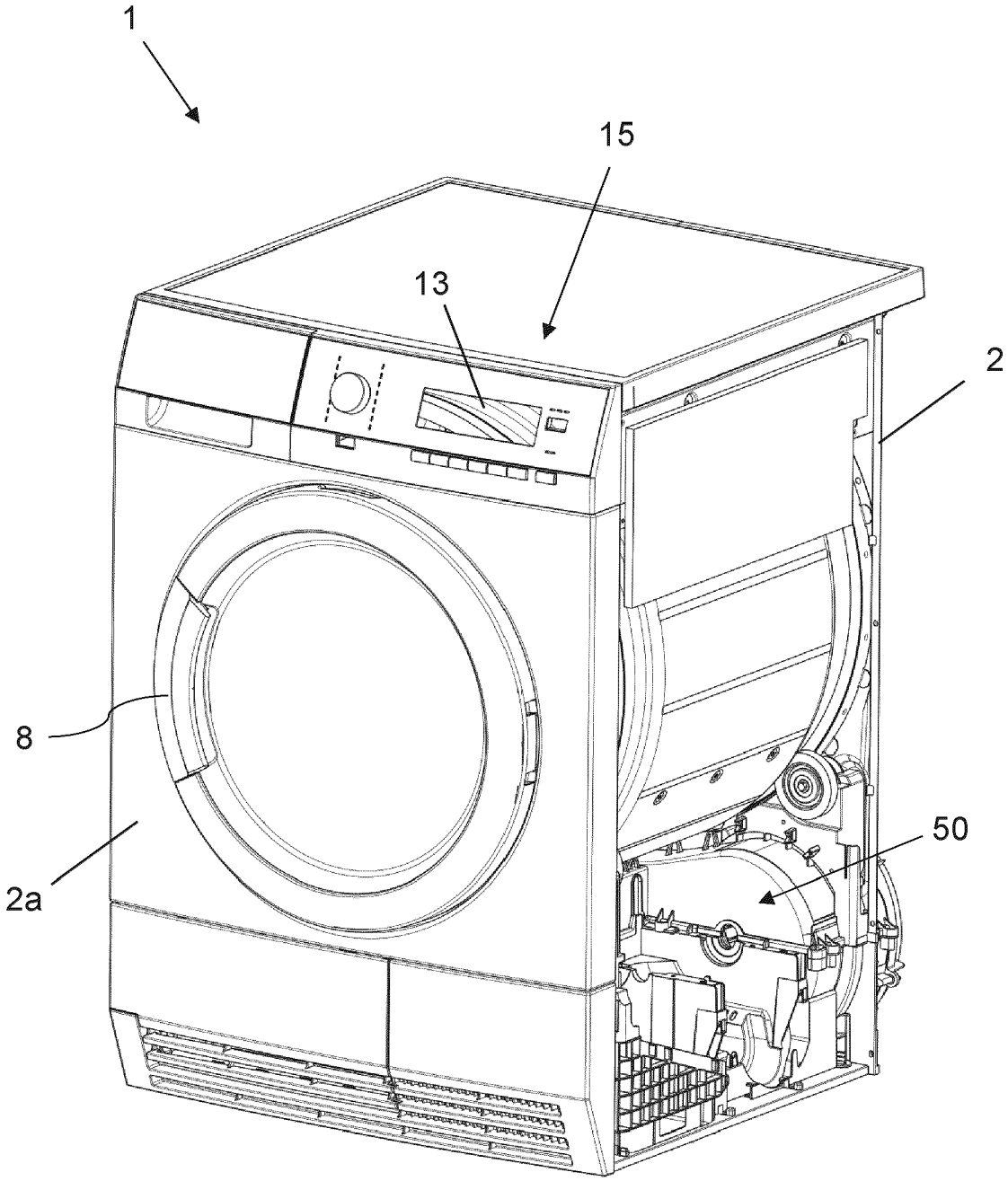

FIG. 1

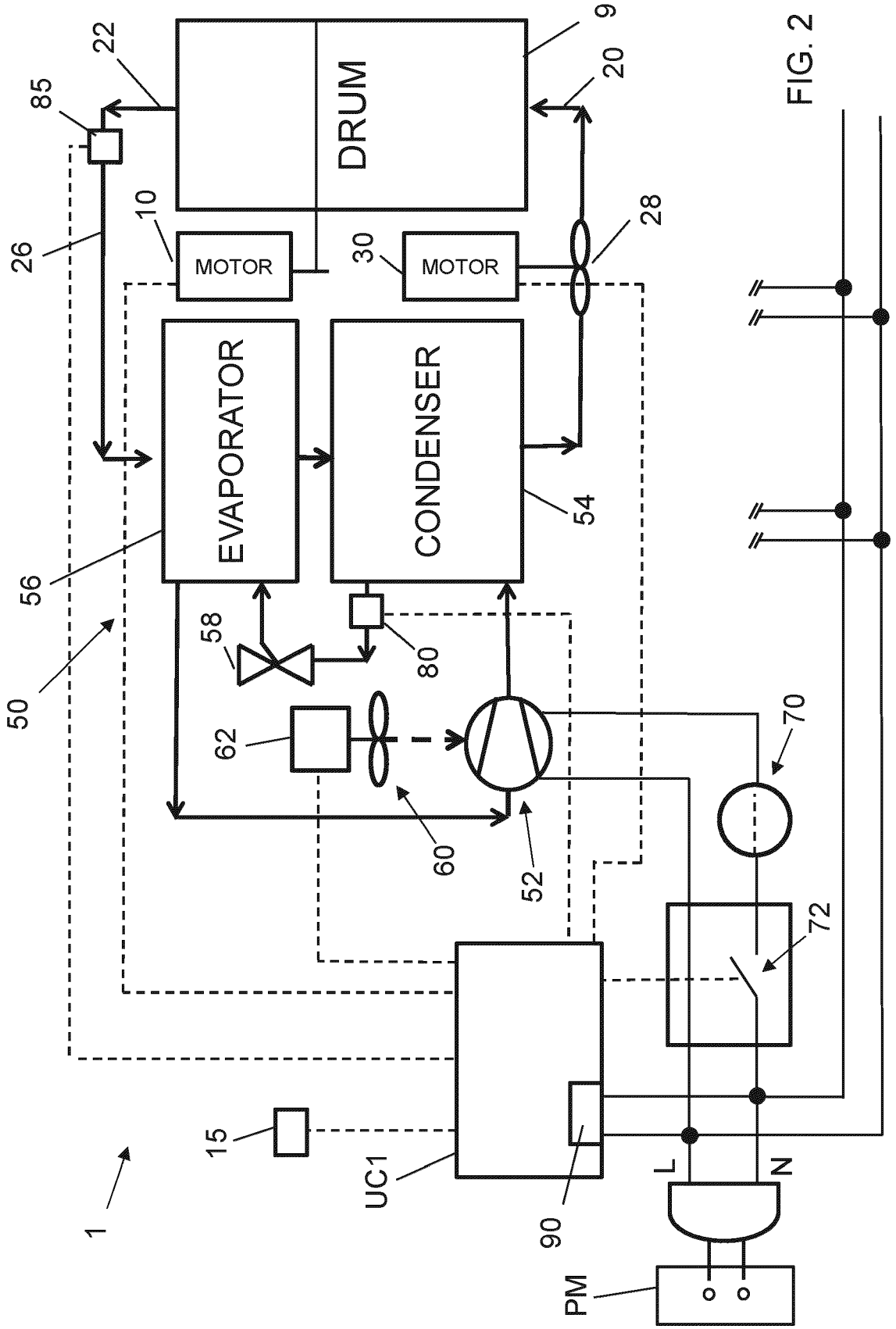
DRUM
9
20
22
85
10
MOTOR
26
30
MOTOR
28
EVAPORATOR
CONDENSER
54
56
50
58
80
62
70
60
52
72
15
UC1
1
90
L
N
PM

FIG. 2

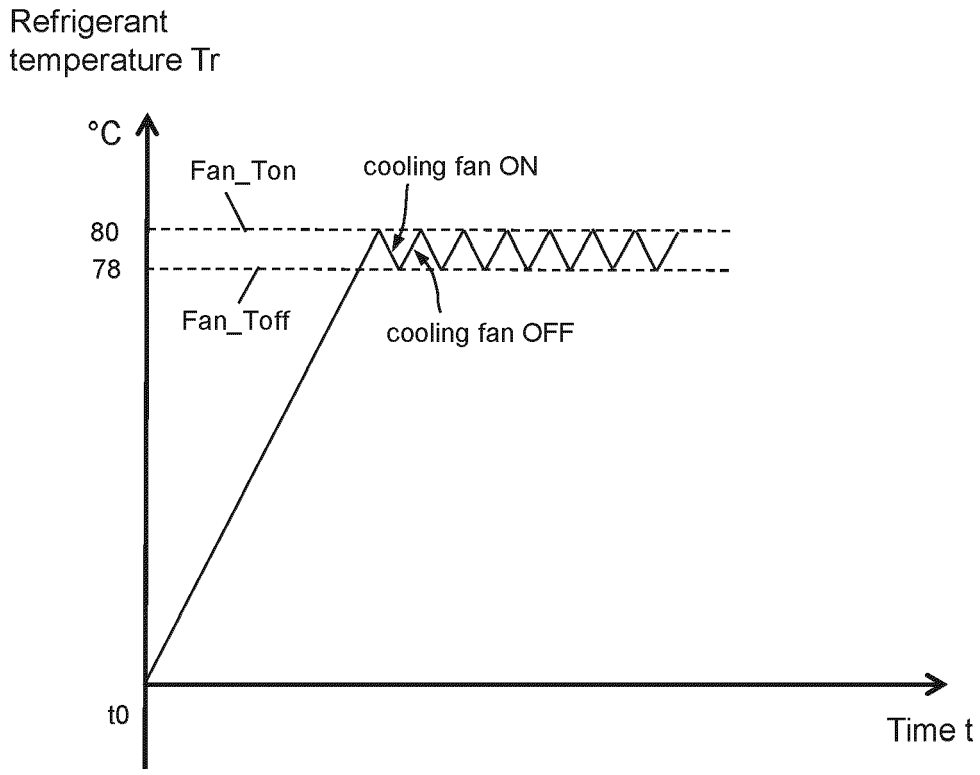
Refrigerant
temperature Tr
°C
Fan_Ton
cooling fan ON
80
78
Fan_Toff
cooling fan OFF
t0
Time t

FIG. 3

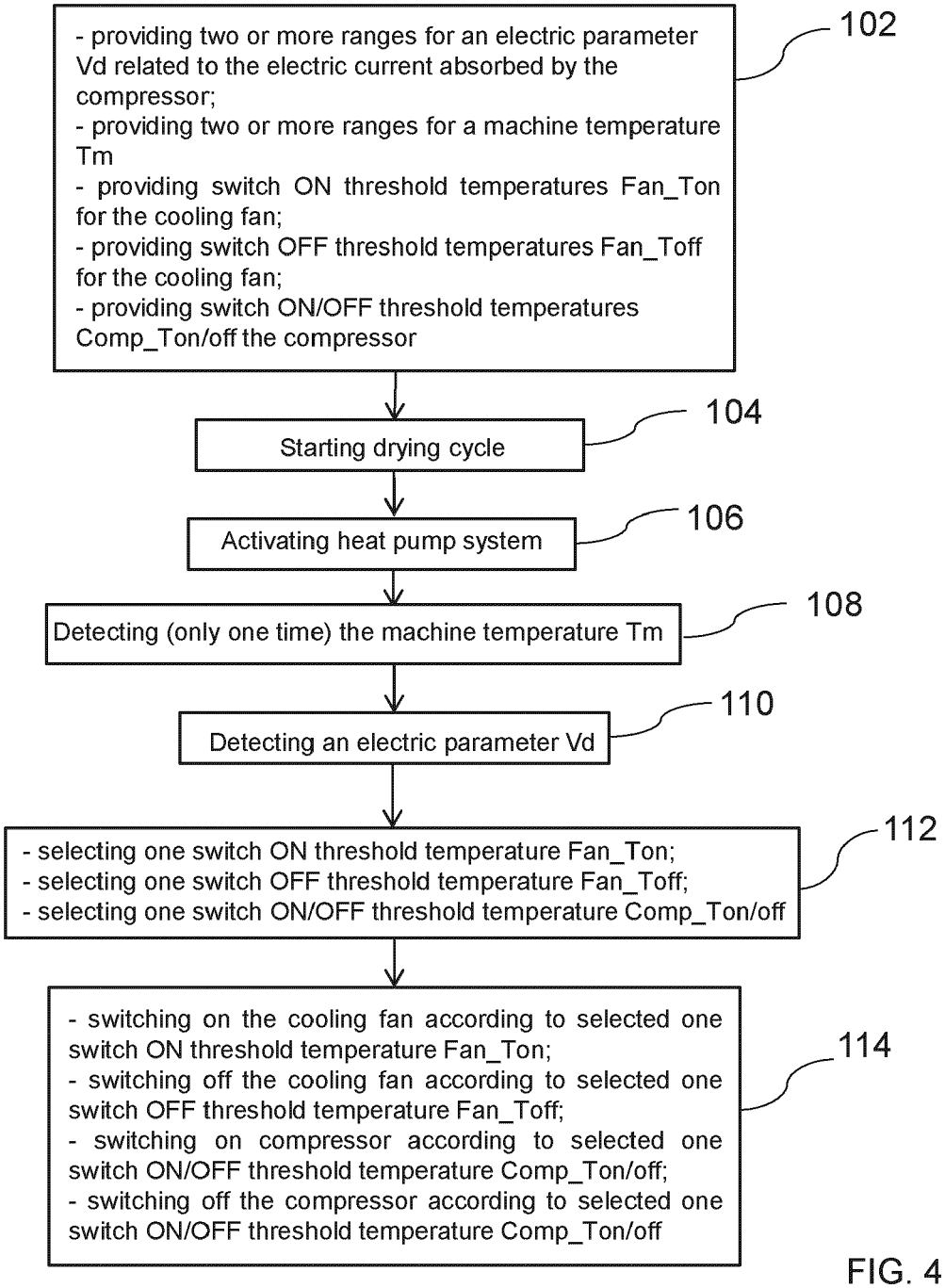
- providing two or more ranges for an electric parameter Vd related to the electric current absorbed by the compressor;
- providing two or more ranges for a machine temperature Tm
- providing switch ON threshold temperatures Fan_Ton for the cooling fan;
- providing switch OFF threshold temperatures Fan_Toff for the cooling fan;
- providing switch ON/OFF threshold temperatures Comp_Ton/off the compressor
102
Starting drying cycle
104
Activating heat pump system
106
Detecting (only one time) the machine temperature Tm
108
Detecting an electric parameter Vd
110
- selecting one switch ON threshold temperature Fan_Ton;
- selecting one switch OFF threshold temperature Fan_Toff;
- selecting one switch ON/OFF threshold temperature Comp_Ton/off
112
- switching on the cooling fan according to selected one switch ON threshold temperature Fan_Ton;
- switching off the cooling fan according to selected one switch OFF threshold temperature Fan_Toff;
- switching on compressor according to selected one switch ON/OFF threshold temperature Comp_Ton/off;
- switching off the compressor according to selected one switch ON/OFF threshold temperature Comp_Ton/off
114

FIG. 4

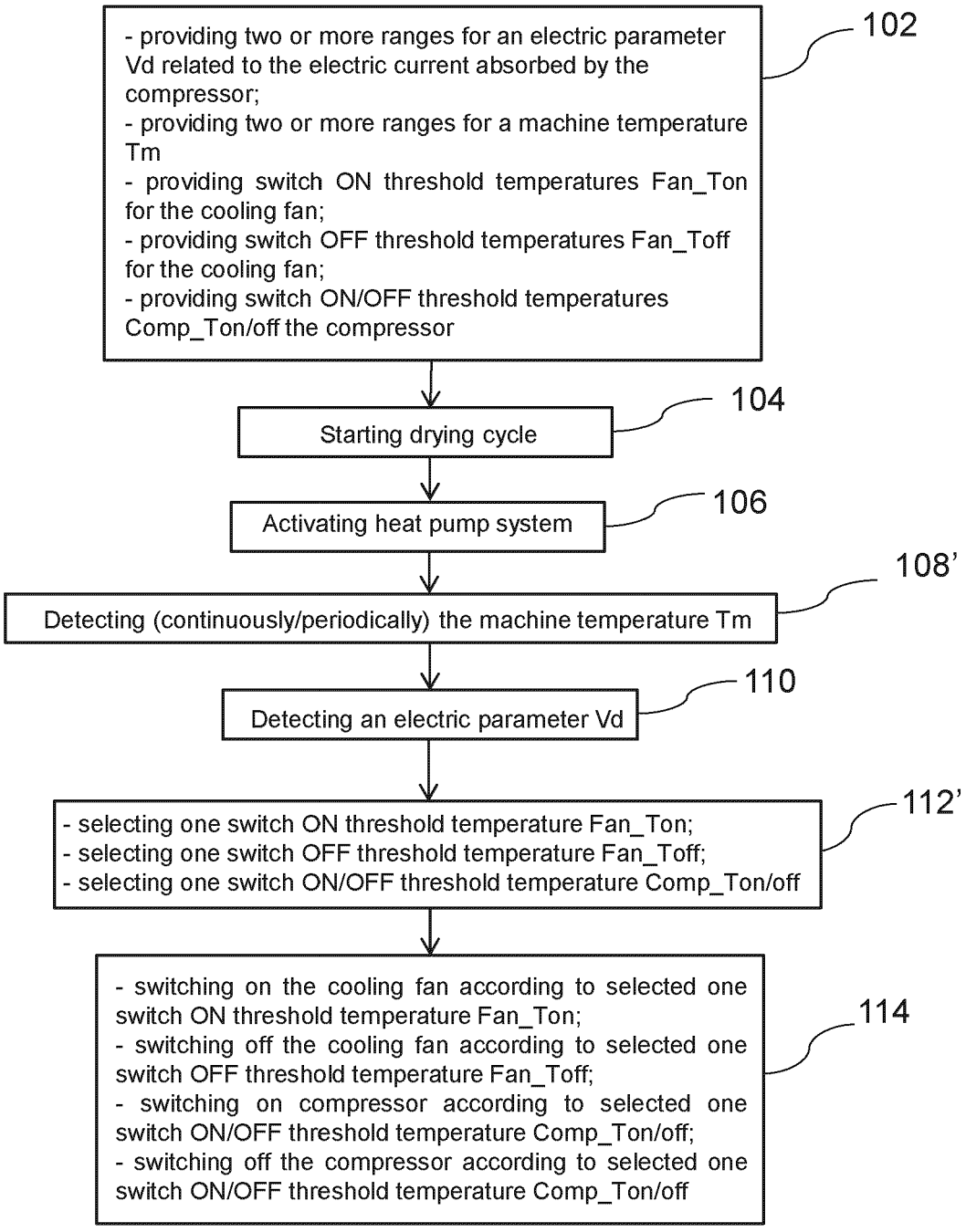
- providing two or more ranges for an electric parameter Vd related to the electric current absorbed by the compressor;
- providing two or more ranges for a machine temperature Tm
- providing switch ON threshold temperatures Fan_Ton for the cooling fan;
- providing switch OFF threshold temperatures Fan_Toff for the cooling fan;
- providing switch ON/OFF threshold temperatures Comp_Ton/off the compressor
102
Starting drying cycle
104
Activating heat pump system
106
Detecting (continuously/periodically) the machine temperature Tm
108'
Detecting an electric parameter Vd
110
- selecting one switch ON threshold temperature Fan_Ton;
- selecting one switch OFF threshold temperature Fan_Toff;
- selecting one switch ON/OFF threshold temperature Comp_Ton/off
112'
- switching on the cooling fan according to selected one switch ON threshold temperature Fan_Ton;
- switching off the cooling fan according to selected one switch OFF threshold temperature Fan_Toff;
- switching on compressor according to selected one switch ON/OFF threshold temperature Comp_Ton/off;
- switching off the compressor according to selected one switch ON/OFF threshold temperature Comp_Ton/off
114

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 20 17 8479

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	EP 3 124 678 A1 (ELECTROLUX APPLIANCES AB [SE]) 1 February 2017 (2017-02-01) * paragraphs [0013], [0014], [0018], [0033], [0034], [0037], [0039], [0040], [0050], [0051] * * paragraphs [0060], [0061], [0074], [0081], [0087], [0111] * * claims; figures * -----	1-4,10, 12,15 5-9,11, 13,14	INV. D06F58/50 ADD. D06F58/20 D06F34/08 D06F103/32 D06F103/48 D06F105/26 D06F105/52
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TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 August 2020	Popara, Velimir

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 17 8479

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18-08-2020

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