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

(11) **EP 4 219 823 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.08.2023 Bulletin 2023/31

(21) Application number: **22153373.0**

(22) Date of filing: **26.01.2022**

(51) International Patent Classification (IPC):
D06F 58/24 *(2006.01)* ***D06F 58/38*** *(2020.01)*
D06F 58/48 *(2020.01)* *D06F 58/02* *(2006.01)*
D06F 58/20 *(2006.01)* *D06F 103/58* *(2020.01)*
D06F 105/36 *(2020.01)*

(52) Cooperative Patent Classification (CPC):
D06F 58/24; D06F 58/38; D06F 58/48; D06F 58/02; D06F 58/206; D06F 2103/58; D06F 2105/36

(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

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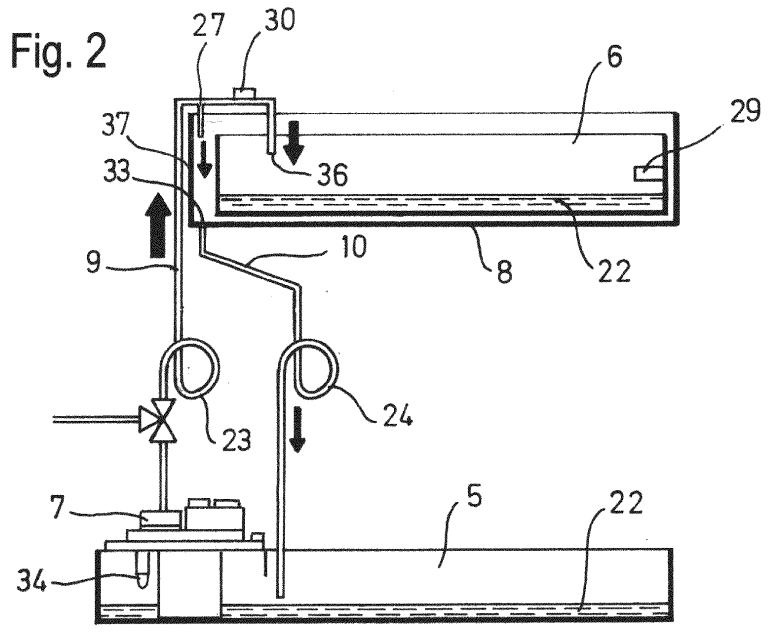
(54) DRYER WITH IMPROVED AIR TIGTHNESS OF A PROCESS AIR CIRCUIT AND PROCESS FOR OPERATING THE DRYER

(57) A dryer 1 comprising a drum 2 and a process air circuit 3, which includes a blower 12 ; a condensing device 18; a condensate collecting vessel 5; a condensate tank 6; an overflow container 8 in which the condensate tank 6 is placed; an electric pump unit 7 associated to the condensate collecting vessel 5; a pump conduit 9 fluidly connecting a pump outlet 35 to a condensate tank inlet 36; an overflow conduit 10 fluidly connecting the overflow container 8 to the condensate collecting vessel 5; wherein the pump conduit 9 and the overflow conduit 10 are adapted to conduct at least part of the water 22 that is transported from the condensate collecting vessel 5 towards the condensate tank 6 back to the condensate collecting vessel 5 without entering the condensate tank 6; and wherein an overflow siphon 24 is located in the overflow conduit 10.

Fig. 2



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Description

[0001] The invention relates to a dryer with improved air tightness of a process air circuit and a process for operating the dryer. The invention relates more particularly to a dryer comprising a drum for receiving laundry items to be dried and a process air circuit for passing process air through the drum, the process air circuit including a blower for driving the process air; a condensing device for condensing moisture from the process air coming from the drum; a condensate collecting vessel; a condensate tank for receiving water transferred from the condensate collecting vessel; an overflow container in which the condensate tank is placed; an electric pump unit associated to the condensate collecting vessel for pumping water contained in the condensate collecting vessel to the condensate tank; a pump conduit fluidly connecting a pump outlet to a condensate tank inlet; an overflow conduit fluidly connecting the overflow container to the condensate collecting vessel; and a siphon-like element located in the pump conduit and/or in the overflow conduit to limit air transfer through these conduits; and a process for operating this dryer.

[0002] Condensation laundry dryers having a drum rotatably mounted in a housing, a fan for generating a process air stream intended to flow through the drum as well as over a condensation device comprising a collecting vessel for collecting condensed water accumulating during the drying process, and in addition a condensate tank connected to the collecting vessel by means of a line, the condensate tank being arranged in a trough connected to the collecting vessel by means of a drain, are known. In this case, the condensate collected in the collecting vessel is usually conveyed to the condensate tank by means of a pump. The condensate tank is located in a trough which contains a drain to the collecting vessel. This allows condensate leaking from the condensate tank to be discharged into the collecting vessel. However, the process air flow is connected to the environment via the drain, so that room air is drawn into the already dry process air. If there is overpressure in the condenser area, some of the process air from the dryer will enter the room. This can lead to losses and reduce the effectiveness of the dryer and/or increase the humidity of the room air in the installation room of the dryer.

[0003] The publication EP 2 141 279 A1 discloses a condensing tumble dryer comprising a drum rotatably mounted in a housing, a fan for generating a process air flow which is provided to flow through the drum and via a condensing device which comprises a receiving vessel for receiving the condensation liquid produced in the drying process and a collection container connected to the receiving vessel by a line, the collection container being arranged in a tank which is connected to the receiving vessel by a discharge, the discharge having a valve which closes the discharge from the receiving vessel in an at least almost completely airtight manner and which can open the connection to the receiving vessel by means of the liquid flowing through the discharge, and the valve comprising a separate valve chamber which is separated from the receiving vessel and comprises an inlet opening and an outlet opening and in which a movable closure member is arranged for opening or closing the inlet opening and/or the outlet opening, wherein the inlet opening is arranged on the base of the valve chamber in such a way that the closure member can be moved from the rest position into the open position by liquid flowing into said valve chamber. In an embodiment of the condensing tumble dryer, the valve is fitted in close spatial proximity to or directly on or in the receiving vessel. In a further embodiment, the discharge is closed by the valve when the valve is in the rest position.

[0004] The publication EP 2 450 615 A1 discloses a dryer comprising a casing including a basement; a laundry chamber suitable to receive laundry to be dried; a process air circuit for circulating process air into said laundry chamber; a condensing device for removing moisture from the process air coming from said laundry chamber located within the process air circuit; a water collecting housing for the collection of moisture condensed by said condensing device; a condensate tank unit to collect water transferred from the water collecting housing; a pump unit associated to said water collecting housing for the removal of water contained therein and to pump it to the condensate tank unit; a first conduit fluidly connecting a pump unit outlet to a condensate tank unit inlet; a second conduit fluidly connecting the condensate tank unit to an inlet opening arranged in the basement; and wherein the dryer also includes a siphon-like element located in the first and/or in the second conduit to limit air transfer through the first and/or second conduit. In an embodiment, the siphon-like element is located at one end of the first and/or second conduit. Preferably, the siphon-like element is located at the end of the first conduit including the pump unit outlet and/or at the end of the second conduit including the inlet opening. Furthermore, a dryer is disclosed, wherein said first and/or second conduit includes a hose connecting the pump unit outlet to the condensate tank inlet and/or the outlet of the condensate tank to the inlet opening arranged in the basement. The siphon-like element comprises preferably an S-bent hose portion.

[0005] There are known solutions of siphons at pump outlet and overflow siphons. Known overflow siphons are filled only during activation of overflow system and could be always leaky if customer empties a condensate container after each cycle.

[0006] In view of this situation it was an object of the present invention to provide a dryer with an improved process air circuit in which its air tightness is improved. A dryer should be provided wherein a barrier is created between an underpressure inside the dryer and atmospheric pressure in the surrounding environment. Preferably, the overall efficiency of the operation of the dryer should be improved. A further object was the provision of a process for operating this dryer.

[0007] This object is achieved according to the present invention by the dryer and the process for its operation pursuant to the independent claims. Preferred embodiments of the dryer according to the invention are shown especially in the dependent claims. Preferred embodiments of the process correspond to preferred embodiments of the dryer and vice versa, even if not expressly stated herein.

[0008] The invention is thus directed to a dryer comprising a drum for receiving laundry items to be dried and a process air circuit for passing process air through the drum, the process air circuit including a blower for driving the process air; a condensing device for condensing moisture from the process air coming from the drum; a condensate collecting vessel; a condensate tank for receiving water transferred from the condensate collecting vessel; an overflow container in which the condensate tank is placed; an electric pump unit associated to the condensate collecting vessel for pumping water contained in the condensate collecting vessel to the condensate tank; a pump conduit fluidly connecting a pump outlet to a condensate tank inlet; an overflow conduit fluidly connecting the overflow container to the condensate collecting vessel; and a siphon-like element located in the pump conduit and/or in the overflow conduit to limit air transfer through these conduits, wherein the pump conduit and the overflow conduit are adapted to conduct at least part of the water that is transported from the condensate collecting vessel towards the condensate tank back to the condensate collecting vessel without entering the condensate tank; and wherein an overflow siphon is located in the overflow conduit.

[0009] In a preferred embodiment of this dryer, an overflow container pump conduit branches off from the pump conduit at a branch-off point to enter the overflow container directly, i.e. without entering the condensate tank. It is then preferable that a pump conduit closure device is placed in the pump conduit between the branch-off point and the condensate tank.

[0010] In a preferred alternative embodiment of the dryer, the dryer comprises a direct bypass conduit which directly connects the pump conduit and the overflow conduit. It is then preferred that a bypass conduit entry point is located between a pump siphon and the condensate tank. In any way it is also preferred that a direct bypass closure device is located between a bypass conduit entry point and a bypass conduit exit point. This allows to regulate the water flow through the direct bypass conduit.

[0011] In general a dryer is preferred, wherein a condensate collecting vessel level sensor is provided in the condensate collecting vessel. It is also preferred that a condensate tank water level sensor is provided in the condensate tank.

[0012] It is particularly advantageous to use the present invention in a condensation laundry dryer with a heat pump for generating the process air flow, since in this case the process air circuit must be particularly well sealed off from the room air in order to achieve good efficiency or to release a low level of humidity into the room air.

[0013] In a further preferred embodiment, the dryer thus contains a heat pump circuit comprising a refrigerant channel for circulating a refrigerant, a condenser as a heat source, an evaporator as a heat sink, an expansion device for expanding the refrigerant, and a compressor for driving and compressing the refrigerant, the refrigerant circulating sequentially through the compressor, the condenser, the expansion device and the evaporator. The condenser serves to heat the process air flow prior to entering the drum as drying chamber, and the evaporator serves to cool the air flow after leaving the drying chamber.

[0014] The overflow conduit has an overflow siphon which closes the overflow conduit to the condensate collecting vessel in an at least almost airtight manner. The overflow siphon thus seals off the condensate collecting vessel, which is in communication with the process air and in which a negative pressure or positive pressure prevails, from the external pressure in the installation space.

[0015] In the present invention, a dryer is moreover preferred that comprises both a pump siphon and an overflow siphon.

[0016] The dryer can be a dryer as such or a washer-dryer which combines the function of washing laundry with the function of drying. The dryer of the present invention is preferably embodied as a washer-dryer.

[0017] In the present invention, the condensate collecting vessel is for the condensation water produced during the drying process, which is pumped to the condensate tank by means of an electric pump unit via the pump conduit which is usually a hose. The condensate tank is placed in the overflow container, which is usually connected to the condensate collecting vessel via the overflow conduit comprising a pipe or hose. An overflow siphon is contained in the overflow conduit.

[0018] The condensate collecting vessel is for example a tray open at the top and arranged below the condensing device so that it can collect condensate produced in the condensing device. To prevent secondary air from entering the process air stream, the overflow siphon is present between the overflow conduit and the condensate collecting vessel, preventing secondary air from entering the process air from the drain when the overflow siphon is filled with water.

[0019] If for example a dryer of the invention is equipped with a heat pump including a compressor, heat exchanger and the piping for the refrigerant, no secondary air can enter the area of the condenser via the condensate collecting vessel or the overflow conduit, if the blower generates a negative pressure during drying operation.

[0020] The process air circuit comprises a condensing device for removing moisture from the process air coming from the laundry chamber, i.e. the drum. Condensation water formed in the condensing device is collected in the

condensate collecting vessel, preferably located in a basement of the dryer. The water in the condensate collecting vessel is then conveyed to the condensate tank which is preferably arranged on an upper portion of the dryer so that it can be easily and periodically emptied by a user. The condensate tank is preferably in the form of a drawer slidably arranged on said upper portion of the dryer. In order to convey the water from the condensate collecting vessel to the condensate tank, an electric pump unit is provided at said condensate collecting vessel. The electric pump unit is advantageously activated on the base of the water level inside the condensate collecting vessel. For this purpose, as an embodiment, a level (height) sensor may also be provided at the condensate collecting vessel.

[0021] The overflow container permits the water from the condensate tank to be transferred into the condensate collecting vessel when the condensate tank is full. The electric pump unit is advantageously positioned in a substantially airtight environment. However, airtight environment may cause a pressure difference between different volumes in the dryer, which in turn may cause an air flow from the condensate tank to the pump unit via the conveying pipe, i.e. the pump pipe, or from the condensate tank to the condensate collecting vessel via the overflow pipe (or vice-versa).

[0022] The overflow siphon and, if present in the dryer, the pump siphon limit air transfer through the overflow conduit and the pump conduit, respectively.

[0023] Advantageously, the conduits are realized in a simple manner by means of hoses. Preferably, the siphons comprise an S-bent hose portion. Advantageously, the siphon does not require additional elements to be produced and mounted on the dryer, an S-shaped torsion of the hose produces a siphon which is suitable for the intended purposes.

[0024] The dryer may be a front-loading dryer, which means that a drum in which the laundry is located has an axis which is positioned in a horizontal manner or slightly tilted with respect to the horizontal plane, or a top dryer, where the axis of the drum is substantially vertical. In a preferred embodiment, the dryer is a front loading laundry dryer.

[0025] The process air circuit, in particular a closed-loop circuit, includes a process air conduit for channeling a stream of air to dry the laundry load in the drum. The process air circuit is connected with its two opposite ends to the drum. More specifically, hot dry air is fed into the drying chamber, flowing over the laundry, and the resulting humid (and to a lower temperature cooled down) air exits the same. In case of a closed-loop drying air circuit, the humid process air is then fed into a condensing device, i.e. a heat exchanger. In a preferred embodiment of the invention, the humid air is fed to an evaporator of a heat pump system, where the moist process air is further cooled down and the humidity present therein condenses. The resulting cool dry air is then heated up before re-entering again in the drum by means of or example a condenser of the heat pump system, and the whole loop is repeated until the end of the drying process. However, the dehumidified process air can also to exhausted outside the dryer. Alternatively or in addition, to remove humidity from humid air stream exiting the drum, an air-air type heat exchanger may be used. Such a heat exchanger generally receives ambient air as cooling fluid to cool down and remove humidity from the humid air stream passing therethrough. Process air might be heated before entering the drum by means of an electric heating device or by means of a gas powered heating device. Heated air flowing through and on humid laundry contained in the drum removes humidity from laundry. The condensing device is thus positioned in the process air circuit.

[0026] If the dryer comprises a heat pump circuit, the refrigerant is circulated and thereby cyclically compressed and expanded as well as cooled and heated, on purpose of absorbing heat in the evaporator by evaporating the refrigerant at low pressure, and releasing heat in the condenser by condensing the refrigerant at high pressure. In accordance with a preferred embodiment of such a dryer, the dryer comprises a control device for controlling operation of the dryer, wherein the expansion device is a variable valve operably connected to the control device. Such operation may be of a switching type, whereby the valve is switched between an open position for recirculating a part of the refrigerant and a closed position which cuts off any recirculation. Alternatively such operation may allow varying the amount of refrigerant which is recirculated, either stepwise or continuously.

[0027] The overflow container can accept water from the condensate tank when the latter becomes full or water contained therein reaches a given level. Preferably, the condensate tank includes a first aperture positioned on one of the sides of the condensate tank at a given level, so that if a level of the water in the condensate tank raises above such given level, the water drops into the overflow container. In this way, the condensate tank is always filled up to a predetermined maximum level or below. Any additional water pumped by the pump unit to the condensed tank spills from the aperture and falls into the overflow container.

[0028] In order to avoid an air exchange, at least a siphon is positioned in the overflow but preferably also the pump conduit. The position of the siphon may be any, as long as it is along these conduits. The presence of the siphon, which blocks a quantity of water in the respective conduit also when the pump unit is not active or when water is not dripping from the condensate tank to the condensate collecting vessel, avoids or minimizes the possibility of air passage through the conduits. Pressure differences may be kept.

[0029] The dryer in general comprises a control unit for the operation of the dryer.

[0030] The invention is moreover directed to a process for the operation of a dryer comprising a drum for receiv-

ing laundry items to be dried and a process air circuit for passing process air through the drum, the process air circuit including a blower for driving the process air; a condensing device for condensing moisture from the process air coming from the drum; a condensate collecting vessel; a condensate tank for receiving water transferred from the condensate collecting vessel; an overflow container in which the condensate tank is placed; an electric pump unit associated to the condensate collecting vessel for pumping water contained in the condensate collecting vessel to the condensate tank; a pump conduit fluidly connecting a pump outlet to a condensate tank inlet; an overflow conduit fluidly connecting the overflow container to the condensate collecting vessel; a siphon-like element located in the pump conduit and/or in the overflow conduit to limit air transfer through these conduits, wherein the pump conduit and the overflow conduit are adapted to conduct at least part of the water that is transported from the condensate collecting vessel towards the condensate tank back to the condensate collecting vessel without entering the condensate tank; and wherein an overflow siphon is located in the overflow conduit; the process comprising the steps

(a) starting a drying process by starting the blower, a heating device and the rotation of the drum;
(b) starting the electric pump unit when the water level H^{ccv} in the condensate collecting vessel reaches a set height $H_{set1}{}^{ccv}$;
(c) pumping the water in the condensate collecting vessel via the pump conduit in the direction of the condensate tank;
(d) checking whether a height level H^{ct} of water in the condensate tank exceeds a preset value $H_{set2}{}^{ct}$; and
(e) if $H^{ct} > H_{set2}{}^{ct}$, moving at least part of the water that is transported from the condensate collecting vessel towards the condensate tank back to the condensate collecting vessel without entering the condensate tank.

[0031] In a preferred embodiment of the process of the present invention where in the dryer an overflow container pump conduit branches off from the pump conduit at a branch-off point to enter the overflow container directly, the process comprises furthermore the step (f), (f) if $H^{ct} > H_{set2}{}^{ct}$, pumping at least a part of the water pumped off from the condensed
water vessel from the pump conduit directly into the overflow container.

[0032] A process is furthermore preferred, wherein a pump conduit closure device is placed in the pump conduit between the branch-off point and the condensate tank, comprising the additional step (g),
(g) if $H^{ct} > H_{set2}{}^{ct}$, closing the pump conduit closure device.

[0033] Finally, a process is preferred, wherein the dryer comprises a direct bypass conduit which directly connects the pump conduit and the overflow conduit, comprising the additional step (f),
(f') if $H^{ct} > H_{set2}{}^{ct}$, pumping at least a part of the water pumped off from the condensed water vessel from the pump conduit into the direct bypass conduit directly into the overflow container.

[0034] The invention provides several advantages. Advantages of the invention include an improvement of the performance of the dryer by providing a dryer with an improved airtightness of the process air circuit. The invention applies in this regard simple, cheap and quickly assembled means. The energy consumption is reduced during drying.

[0035] Because the process air stream is now very well sealed, the effect of the process air stream is improved or optimized.

[0036] The present invention allows to create an effective barrier between underpressure inside a dryer and atmospheric pressure in the surrounding environment. This allows not only a prefilling with water upon a first activation of the condensate pump but ensures air tightness even when the condensate pump is stopped. In any way, the process circuit can be kept air tight. The overflow siphon is filled upon first condensate pump activation and keeps air tight by refilling upon each condensate pump cycle. The sealing of the dryer's process air pressure from atmospheric pressure enables to reach better dryer's performance.

[0037] Non-limiting examples for dryers according to the present invention or for parts which make a technical contribution to the invention and in which the process of the present invention can be implemented, are shown in Figs. 1 to 3 wherein corresponding components are identified by the same reference numerals.

Fig. 1 shows a vertically cut condensation dryer according to a first embodiment wherein a water container, here termed condensate collecting vessel, is provided for condensate originating from the evaporator which is here used as the condensing device and wherein the container is equipped with an electric pump and electrodes for detecting a water level.

Fig. 2 shows important parts related to the core of the invention, namely the components used for handling condensate produced in a dryer, according to a second embodiment of the present invention in a manner that airtightness is insured.

Fig. 3 shows important parts related to the core of the invention, namely the components used for handling condensate produced in a dryer, according to the first embodiment of the present invention shown in Fig. 1 in a manner that airtightness is insured.

[0038] Fig. 1 shows a vertically cut condensation dryer 1 (in the following abbreviated as "dryer") according to a first embodiment wherein a condensate collecting vessel

5 is provided for condensate 22 originating from the evaporator 18 of a heat pump and wherein the condensate collecting vessel 5 is equipped with an electric pump unit 7.

[0039] The dryer shown in Fig. 1 depicts a drum 2 as drying chamber which is rotatable around a horizontal axis. Within the drum, tappets 14 are fixed in order to move the laundry items (which are not shown here) during a rotation of the drum 2. An electric heating device 13 which supports here the heat pump, a heat pump 18, 19, 20, 11, as well as a blower 12 are provided in a process air circuit 3. Warm process air is thus moved to the drum 2, cooled after having passed through the drum 2 and warmed again after the condensation of the humidity contained in the process air. The heated process air is led from the rear, i.e. from the side of the drum 2 opposite to the access door 17, through its perforated floor into the drum 2, comes into contact with the laundry items to be dried and flows through the opening for filling the drum 2 to a fluff filter 21 within the access door 17 that closes the opening for filling the dryer 1. Thereafter, the air stream in the access door 17 is directed downwards and is moved within the process air circuit 3 to the evaporator 18. There, the humidity taken up from the laundry items condenses due to the cooling and the condensed water is collected by the condensate collecting vessel 5. The condensed water is pumped off by means of the electric water pump unit 7 to a condensate tank 6 that is placed within an overflow container 8. The overflow water container 8 is connected by means of an overflow conduit 10 to the condensate collecting vessel 5. A pump siphon 23 is placed in the pump conduit 9 and an overflow siphon 24 is placed in the overflow conduit 10 to limit air transfer through the pump and overflow conduit.

[0040] In this nonlimiting embodiment, the pump conduit 9 and the overflow conduit 10 are adapted to conduct at least part of the water 22 that is transported from the condensate collecting vessel 5 towards the condensate tank 6 back to the condensate collecting vessel 5 without entering the condensate tank 6.

[0041] In the specific embodiment shown in Fig. 1 there is a direct bypass conduit 26 which directly connects the pump conduit 9 and the overflow conduit 10. Although it cannot be seen in Fig. 1, a direct bypass conduit entry point of the bypass conduit 26 is located between an overflow siphon 24 and the condensate container 6. 23 refers to a pump siphon located in the pump conduit 9. Although not shown here, a conduit closure device is located between the direct bypass conduit entrance point and the direct bypass conduit exit.

[0042] In the embodiment of an inventive dryer shown in Fig. 1, a first water level sensor is provided in the condensate collecting vessel and a second water level sensor is provided in the condensate tank 6. Both water level sensors cannot be seen however in Fig. 1.

[0043] Behind the evaporator 18, the process air is moved by means of blower 12 again to the electric heating device 13. The process air is however also heated by the condenser 19 of the heat pump 38,18,19, 20,11.

[0044] The control of the dryer 1 is achieved by means of a control unit 4 which may be adjusted by a user by means of an operator panel 15.

[0045] In the heat pump 38,18,19,20,11 of this embodiment, the refrigerant is evaporated in evaporator 18, compressed in compressor 11 which is here a variable power compressor and subsequently condensed in condenser 19. 20 is a throttle.

[0046] Process air is fed through the drum 2 in a process air circuit 3 by means of a blower 12. After passing through the drum 2, the moist, warm process air is directed into the evaporator 18 of a heat pump 38,18,19,20,11, which also has a variable-speed compressor 11, a throttle 20 and a condenser 19. The arrows shown in Fig. 1 indicate the flow direction of the coolant in the heat pump and of the air in the process air circuit.

[0047] The refrigerant of the heat pump 38,18,19,20,11 evaporated in the evaporator 18 is led to the condenser 19 via the speed-dependent compressor 11. In the condenser 19, the refrigerant liquefies, releasing heat to the process air flowing in the process air circuit 3. The refrigerant, which is now in liquid form, is again fed to the evaporator 18 via the throttle 20, thus closing the refrigerant circuit. In this embodiment, a temperature sensor S^{T}_{WPK} 28 between evaporator 18 and compressor 11 measures the temperature T of the refrigerant.

[0048] In the embodiment shown in Fig. 1, the electric heating device 13 serves to heat the process air more rapidly. In other embodiments of the invention, the electric heater 13 may be omitted.

[0049] An optical/acoustical indication device 16 allows the user of the dryer to display, for example, operating parameters and/or an expected duration of the drying process.

[0050] In the process according to the invention, process air is repeatedly circulated through the process air circuit 3 until preferably a desired degree of drying of the laundry items is achieved.

[0051] The dryer 1 of Fig. 1 further enables precise control of the operation of the heat pump, so that a drying phase can be efficiently controlled by regulating the blower 12 and the compressor 11 by means of the control unit 4 so that a predetermined maximum temperature T_{max} for the temperature of the process air is not exceeded.

[0052] Fig. 2 shows important parts related to the core of the invention, namely the components used for handling condensate produced in a dryer, according to a second embodiment of the present invention in a manner that airtightness is insured.

[0053] Condensate which has been produced when humid air of the process air circuit (not shown here) had been cooled down by a condensing device, i.e. a heat exchanger (also not shown here) is collected in the condensate collecting vessel 5. An electric pump unit 7 is placed in the condensate collecting vessel 5 to allow condensate, i.e. water 22, to be pumped off. A water level sensor, namely the so-called condensate collecting ves-

sel level sensor 34, senses when the water level has reached a prescribed height such that condensate 22 should be pumped off. The condensate 22 is pumped via pump conduit 9 in which a pump siphon 23 is placed into the direction of the condensate tank 6 that is placed within an overflow container 8. The pump conduit 9 and an overflow conduit 10 in which also a siphon is placed are adapted to conduct at least part of the water 22 that is transported from the condensate collecting vessel 5 towards the condensate tank 6 back to the condensate collecting vessel 5 without entering the condensate tank 6. An overflow siphon 24 is located in the overflow conduit 10. The overflow conduit 10 is connected to the overflow container 8 at the exit 33 of the overflow container 8.

[0054] In the second embodiment shown in Fig. 2 an overflow container pump conduit 37 branches off from the pump conduit 9 at a branch-off point 27 to enter the overflow container 8 directly. In this manner the condensate 22 can avoid to enter the condensate tank 6 when for example the water level exceeds a predetermined height. In order to sense the water level, a so-called condensate tank water level sensor 29 is placed in the condensate tank.

[0055] In the dryer of Fig. 2 the process of the invention comprising the following steps can be carried out:

(a) starting a drying process by starting a blower, a heating device and the rotation of the drum (all not shown here);
(b) starting the electric pump unit 7 when the water level H^{ccv} in the condensate collecting vessel 5 reaches a set height $H_{set1}{}^{ccv}$;
(c) pumping the water 22 in the condensate collecting vessel 5 via the pump conduit 9 in the direction of the condensate tank 6;
(d) checking whether a height level H^{ct} of water in the condensate tank 6 exceeds a preset value $H_{set2}{}^{ct}$; and
(e) if $H^{ct} > H_{set2}{}^{ct}$, moving at least part of the water 22 that is transported from the condensate collecting vessel 5 towards the condensate tank 6 back to the condensate collecting vessel 5 without entering the condensate tank 6.

[0056] In the dryer of Fig. 2, i.e. its second embodiment, furthermore the step (f) can be carried out:

if $H^{ct} > H_{set2}{}^{ct}$, pumping at least a part of the water 22 pumped off from the condensed water vessel 5 from the pump conduit 9 directly into the overflow container (8).

(f) if $H^{ct} > H_{set2}{}^{ct}$, closing the pump conduit closure device 30.

[0057] In Fig. 2, the pump siphon 23 is located between the pump outlet 35 and the condensate tank inlet 36, in particular in this second embodiment between the pump outlet 35 and the branch-off point 27.

[0058] Fig. 3 shows important parts related to the core of the invention, namely the components used for handling condensate produced in a dryer, according to the first embodiment of the present invention shown in Fig. 1 in a manner that airtightness is insured.

[0059] The first embodiment differs from the second embodiment in that here no branching off of the pump conduit 9 directly into the overflow container 8 occurs. Instead, the dryer comprises here a direct bypass conduit 26 which directly connects the pump conduit 9 and the overflow conduit 10. In this manner, condensate 22 from the condensate collecting vessel 5 can flow through direct bypass conduit 26 directly back into the condensate collecting vessel 5, i.e. without entering the condensate tank 6. In order to control the flow through the direct bypass conduit 26 a so-called direct bypass closure device 25 is provided therein. In particular, the direct bypass closure device 25 is located between a bypass conduit entry point 31 and a bypass conduit exit point 32.

[0060] In the first embodiment shown in Fig. 3, the bypass conduit entry point 31 is located between a pump siphon 23 and the condensate tank 6.

[0061] The reference signs in Fig. 3 not mentioned explicitly have the same meaning as in Fig. 2.

LIST OF REFERENCE NUMERALS

[0062]

1	Dryer
2	Drum
3	Process air circuit
4	Control unit
5	Condensate collecting vessel
6	Condensate tank
7	Electric pump unit
8	Overflow container
9	Pump conduit
10	Overflow conduit
11	(variable power) Compressor
12	Blower
13	Electric heating device
14	Drum ribs for taking along laundry items, tappets
15	Operator panel
16	Optical/acoustical indication device
17	Access door
18	Evaporator; condensing device
19	Condenser
20	Throttle, expansion device
21	Fluff filter
22	Water
23	Pump siphon
24	Overflow siphon
25	Direct bypass closure device
26	Direct bypass conduit
27	Branch-off point
28	Temperature sensor $S^{T}WPK$ in the coolant circuit

for measuring a temperature T_K of the coolant
29 Condensate tank water level sensor
30 Pump conduit closure device
31 Bypass conduit entry point
32 Bypass conduit exit point
33 Exit from overflow container
34 Condensate collecting vessel level sensor
35 Pump outlet
36 Condensate tank inlet
37 Overflow container pump conduit
38 Refrigerant channel

Claims

1. A dryer (1) comprising a drum (2) for receiving laundry items to be dried and a process air circuit (3) for passing process air through the drum (2), the process air circuit (3) including a blower (12) for driving the process air; a condensing device (18) for condensing moisture from the process air coming from the drum (2); a condensate collecting vessel (5); a condensate tank (6) for receiving water (22) transferred from the condensate collecting vessel (5); an overflow container (8) in which the condensate tank (6) is placed; an electric pump unit (7) associated to the condensate collecting vessel (5) for pumping water (22) contained in the condensate collecting vessel (5) to the condensate tank (6); a pump conduit (9) fluidly connecting a pump outlet (35) to a condensate tank inlet (36); an overflow conduit (10) fluidly connecting the overflow container (8) to the condensate collecting vessel (5); and a siphon (23,24) located in the pump conduit (9) and/or in the overflow conduit (10) to limit air transfer through these conduits (9,10), **characterized in that** the pump conduit (9) and the overflow conduit (10) are adapted to conduct at least part of the water (22) that is transported from the condensate collecting vessel (5) towards the condensate tank (6) back to the condensate collecting vessel (5) without entering the condensate tank (6); and wherein an overflow siphon (24) is located in the overflow conduit (10).

2. Dryer (1) according to claim 1, wherein an overflow container pump conduit (37) branches off from the pump conduit (9) at a branch-off point (27) to enter the overflow container (8) directly.

3. Dryer (1) according to claim 2, wherein a pump conduit closure device (30) is placed in the pump conduit (9) between the branch-off point (27) and the condensate tank (6).

4. Dryer (1) according to claim 1, comprising a direct bypass conduit (26) which directly connects the pump conduit (9) and the overflow conduit (10).

5. Dryer (1) according to claim 4, wherein a bypass conduit entry point (31) is located between a pump siphon (23) and the condensate tank (6).

6. Dryer (1) according to claim 4 or 5, wherein a direct bypass closure device (25) is located between a bypass conduit entry point (31) and a bypass conduit exit point (32).

7. Dryer (1) according to any of claims 1 to 6, wherein a condensate collecting vessel level sensor (34) is provided in the condensate collecting vessel (5).

8. Dryer (1) according to any of claims 1 to 7, wherein a condensate tank water level sensor (29) is provided in the condensate tank (6).

9. Dryer (1) according to any of claims 1 to 8 containing a heat pump circuit comprising a refrigerant channel (38) for circulating a refrigerant, a condenser (19) as a heat source, an evaporator (18) as a heat sink, an expansion device (20) for expanding the refrigerant, and a compressor (11) for driving and compressing the refrigerant, the refrigerant circulating sequentially through the compressor (11), the condenser (19), the expansion device (20) and the evaporator (18).

10. Dryer (1) according to any of the preceding claims comprising a pump siphon (23) and an overflow siphon (24).
10. Dryer (1) according to any of the preceding claims, wherein the dryer (1) is embodied as a washer dryer.

11. Process for the operation of a dryer (1) comprising a drum (2) for receiving laundry items to be dried and a process air circuit (3) for passing process air through the drum (2), the process air circuit (3) including a blower (12) for driving the process air; a condensing device (18) for condensing moisture from the process air coming from the drum (2); a condensate collecting vessel (5); a condensate tank (6) for receiving water (22) transferred from the condensate collecting vessel (5); an overflow container (8) in which the condensate tank (6) is placed; an electric pump unit (7) associated to the condensate collecting vessel (5) for pumping water (22) contained in the condensate collecting vessel (5) to the condensate tank (6); a pump conduit (9) fluidly connecting a pump outlet (35) to a condensate tank inlet (36); an overflow conduit (10) fluidly connecting the overflow container (8) to the condensate collecting vessel (5); a siphon-like element (23,24) located in the pump conduit (9) and/or in the overflow conduit (10) to limit air transfer through these conduits (9,10), wherein the pump conduit (9) and the overflow conduit (10) are adapted to conduct at least part of the water (22) that is transported from the condensate

collecting vessel (5) towards the condensate tank (6) back to the condensate collecting vessel (5) without entering the condensate tank (6); and wherein an overflow siphon (24) is located in the overflow conduit (10); the process comprising the steps

(a) starting a drying process by starting the blower (12), a heating device (13) and the rotation of the drum (2);
(b) starting the electric pump unit (7) when the water level H^{ccv} in the condensate collecting vessel (5) reaches a set height $H_{set1}{}^{ccv}$;
(c) pumping the water (22) in the condensate collecting vessel (5) via the pump conduit (9) in the direction of the condensate tank (6);
(d) checking whether a height level H^{ct} of water in the condensate tank (6) exceeds a preset value $H_{set2}{}^{ct}$; and
(e) if $H^{ct} > H_{set2}{}^{ct}$, moving at least part of the water (22) that is transported from the condensate collecting vessel (5) towards the condensate tank (6) back to the condensate collecting vessel (5) without entering the condensate tank (6).

12. Process according to claim 11, wherein in the dryer (1) an overflow container pump conduit (37) branches off from the pump conduit (9) at a branch-off point (27) to enter the overflow container (8) directly, and wherein the process comprises furthermore the step (f),
(f) if $H^{ct} > H_{set2}{}^{ct}$, pumping at least a part of the water (22) pumped off from the condensed water vessel (5) from the pump conduit (9) directly into the overflow container (8).

13. Process according to claim 12, wherein a pump conduit closure device (30) is placed in the pump conduit (9) between the branch-off point (27) and the condensate tank (6), comprising the additional step (g),
(g) if $H^{ct} > H_{set2}{}^{ct}$, closing the pump conduit closure device (30).

14. Process according to claim 11, wherein the dryer (1) comprises a direct bypass conduit (26) which directly connects the pump conduit (9) and the overflow conduit (10), comprising the additional step (f'),
(f') if $H^{ct} > H_{set2}{}^{ct}$, pumping at least a part of the water pumped off from the condensed water vessel (5) from the pump conduit (9) into the direct bypass conduit (26) directly into the overflow container (8).

Fig. 1

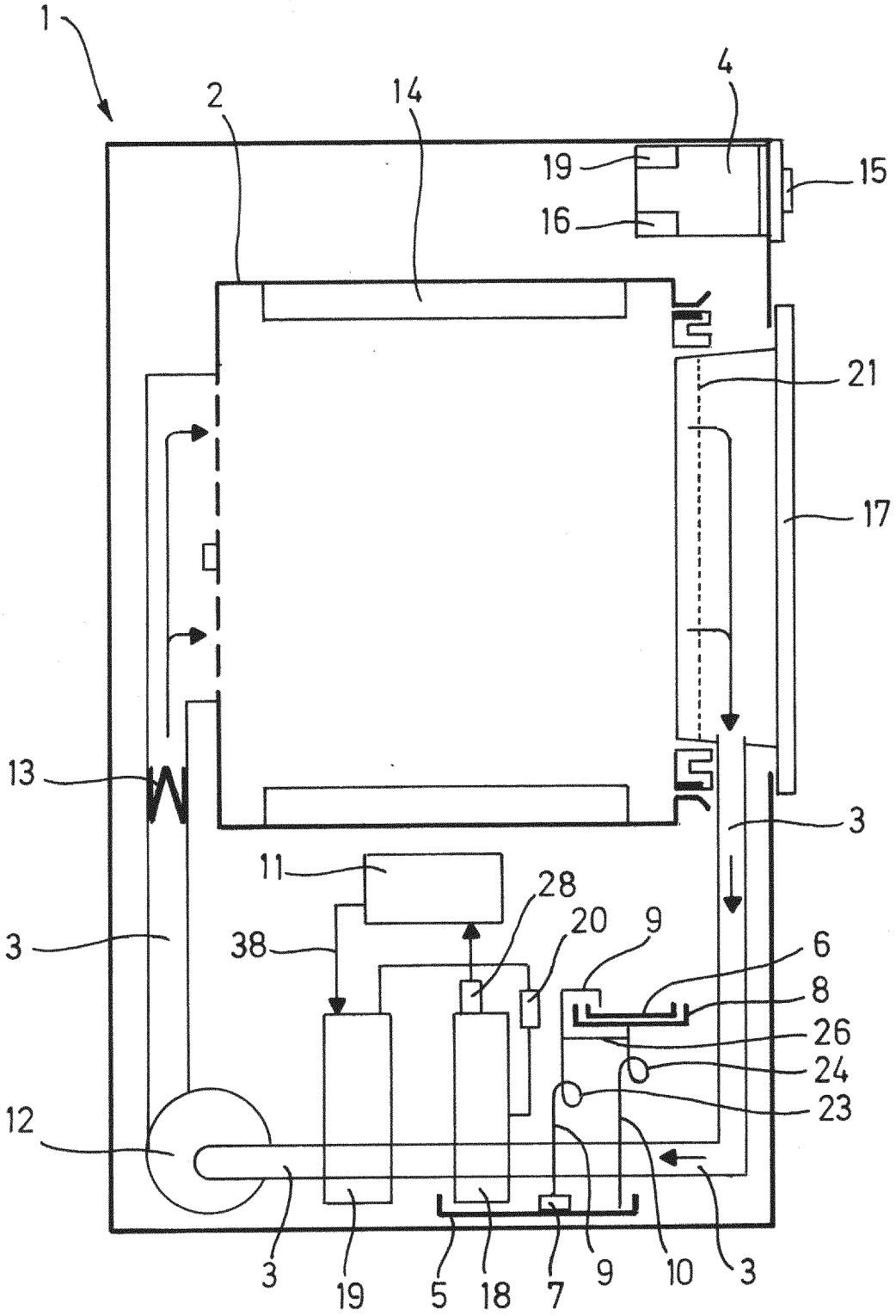

Fig. 2

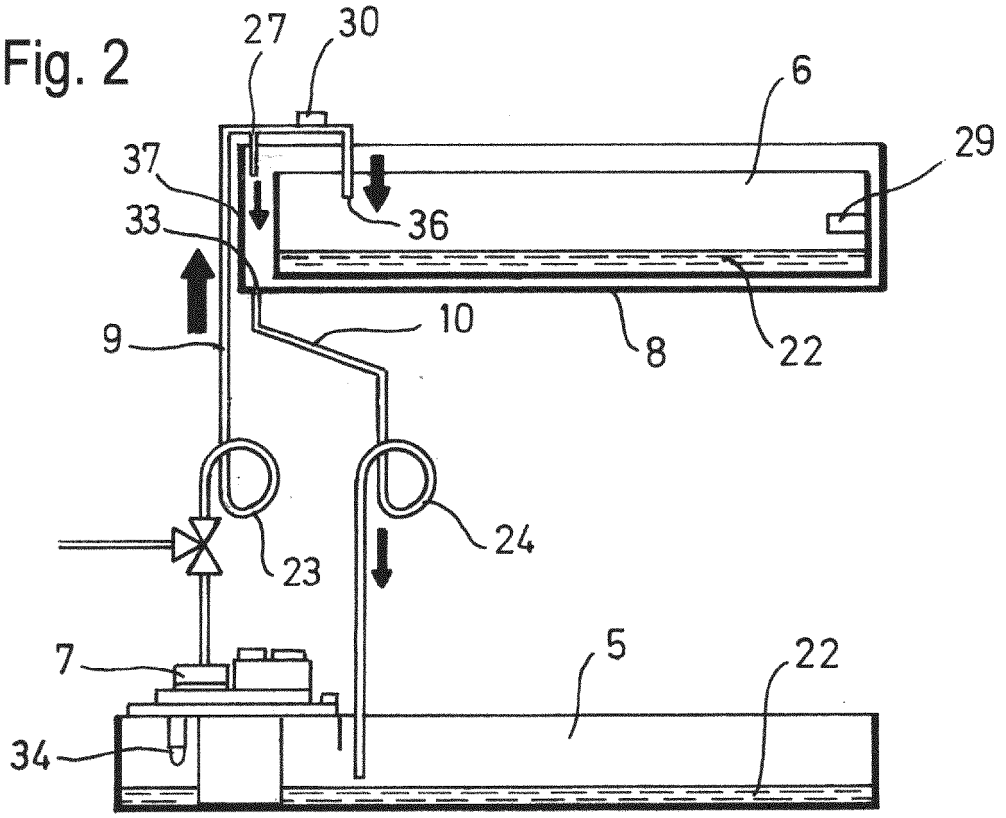
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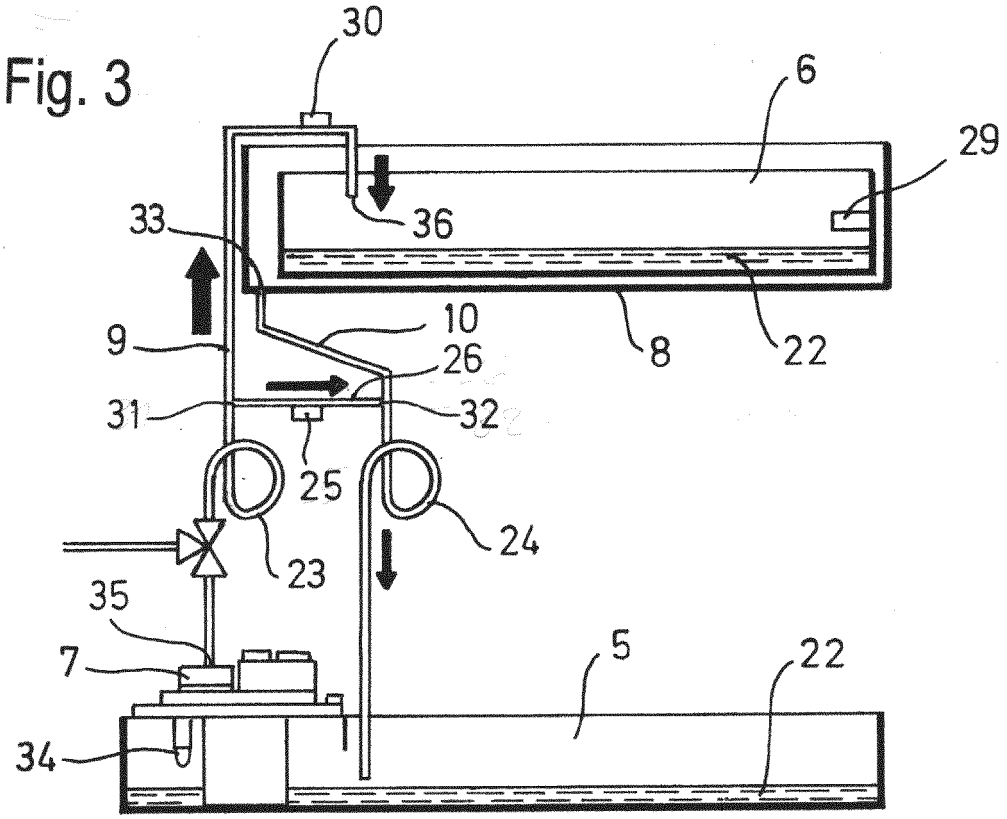
Fig. 3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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 3373

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D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 July 2022	Werner, Christopher

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