

(19)



Europäisches
Patentamt
European
Patent Office
Office européen
des brevets



(11)

EP 4 219 822 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

02.08.2023 Bulletin 2023/31

(51) International Patent Classification (IPC):

D06F 58/24 (2006.01) D06F 58/38 (2020.01)

D06F 58/30 (2020.01) D06F 25/00 (2006.01)

D06F 103/58 (2020.01) D06F 105/08 (2020.01)

D06F 58/20 (2006.01)

(21) Application number: 22153372.2

(22) Date of filing: 26.01.2022

(52) Cooperative Patent Classification (CPC):

D06F 58/24; D06F 58/38; D06F 25/00;

D06F 58/206; D06F 58/30; D06F 2103/58;

D06F 2105/08

(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: BSH Hausgeräte GmbH

81739 München (DE)

(72) Inventors:

• Koehler, Benjamin

10245 Berlin (DE)

• Baran, Marcin

95-080 Tuszyn (PL)

• Despang, Oliver

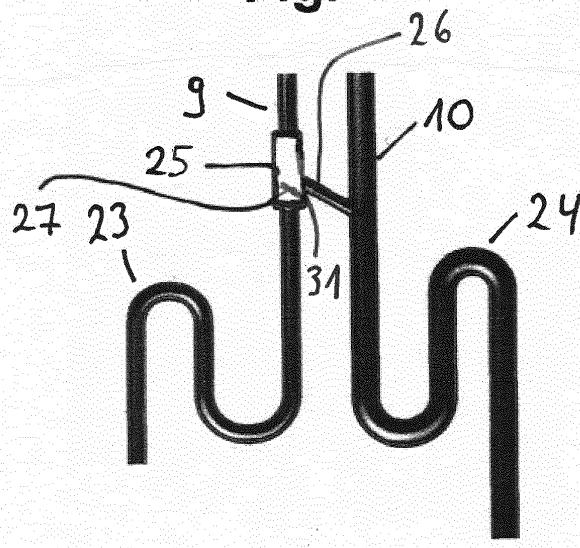
15712 Königs Wusterhausen (DE)

(54) DRYER WITH HIGH AIR TIGHTNESS 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 including a blower 12; a condensing device 18; a condensate collecting vessel 5; a condensate tank 6; an overflow container 8; an electric pump unit 7; 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. The pump conduit 9 comprises at a by-

pass conduit entry point 31 a flap system 25 including a flap 27 allowing a flow of condensate 22 from the pump outlet 35 to pass directly to the condensate tank 6 in that the bypass conduit 26 is closed by the flap 27, and to allow a flow of condensate 22 into the bypass conduit 26 and an overflow siphon 24 when the flow direction has changed.

Fig. 4



Description

[0001] The invention relates to a dryer with high 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 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 with high air tightness. A dryer should be provided wherein a barrier is created between an underpressure inside the dryer and atmospheric pressure in the surrounding environment. This should be achievable also after the operation of a condensate pump has stopped. 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 indicated 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 located in the pump conduit and/or in the overflow conduit to limit air transfer through these conduits; wherein the dryer comprises a bypass conduit which directly connects the pump conduit and the overflow conduit and wherein the pump conduit comprises at a bypass conduit entry point a flap system including a flap, wherein the flap system including the flap is adapted to cause by means of the operation of the pump unit a flow of condensate from the pump outlet directly to the condensate tank in that the bypass conduit is closed by the flap, and to cause a flow of condensate in the opposite direction and into the bypass conduit and an overflow siphon in the overflow conduit in that the bypass conduit is no longer closed by the flap when the flow direction has changed.

[0009] The dryer comprises a 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. It is also preferred that a 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 bypass conduit.

[0010] The flap system and the flap are not limited as long as the aforementioned effect can be achieved. It is thus for example possible to change the orientation of the flap and thus the direction of the water flow electrically. This could be realized for example in that the orientation of the flap is changed when the electric pump unit is stopped. Such an interaction can be controlled by a suitable control unit.

[0011] It is however preferred in the dryer of the present invention that the flap system and the flap have such a form and orientation that the orientation of the flap de-

pends on the flow direction of the water.

[0012] Namely, the flap should be in general close to a wall of the pump conduit in front of the bypass conduit entry point when the condensed water is flowing in the pump conduit from the pump unit to the condensate tank. Accordingly, if this were not the case, the flap should be positioned and formed such that it is pushed to said wall of the pump by the flow of the condensed water to the condensate tank.

[0013] In contrast, when the pump is stopped such that the condensed water flows in the opposite direction, the position and the form of the flap should be such that the orientation of the flap is changed to then prevent the condensed water to flow back to the pump but instead to the now open bypass conduit.

[0014] In a preferred embodiment of the dryer of the present invention, the bypass conduit runs obliquely downwards from the pump conduit to the overflow conduit.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] In the present invention, a dryer is moreover preferred that comprises both a pump siphon and an overflow siphon. Preferably, the flap system is located in the pump conduit between the pump siphon and the condensate tank.

[0021] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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.

[0025] 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).

[0026] The overflow siphon and, if present in the dryer,

the pump siphon limit air transfer through the overflow conduit and the pump conduit, respectively.

[0027] 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.

[0028] 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.

[0029] 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 for 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 be 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.

[0030] 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.

[0031] 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 condensate tank spills from the aperture and falls into the overflow container.

[0032] In order to avoid an air exchange, at least a siphon is positioned in the overflow conduit 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.

[0033] The dryer in general comprises a control unit for the operation of the dryer.

[0034] The invention is moreover directed to a process for the operation of 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; a siphon located in the pump conduit and/or in the overflow conduit to limit air transfer through these conduits; wherein the dryer comprises a bypass conduit which directly connects the pump conduit and the overflow conduit and wherein the pump conduit comprises at a bypass conduit entry point a flap system including a flap, wherein the flap system including the flap is adapted to cause by means of the operation of the pump unit a flow of condensate from the pump outlet directly to the condensate tank in that the bypass conduit is closed by the flap, and to cause a flow of condensate in the opposite direction and into the bypass conduit and an overflow siphon in the overflow conduit in that the bypass conduit is no longer closed by the flap when the flow direction has changed; the process comprising the steps

5

- (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, while the bypass conduit is closed by the flap at the bypass conduit entry point; and
- (d) stopping the electric pump unit such that the condensate flows in an opposite direction first in the direction of the electric pump unit, then through the bypass conduit into the overflow siphon.

10

15

20

25

30

35

40

45

50

55

[0035] 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. 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 the first embodiment of the present invention shown in Fig. 1 in a manner that airtightness is insured.

Fig. 3 shows an enlarged view of the pump conduit, in which a flap system including a flap is located, and the overflow conduit that both comprise a siphon and are directly connected by a bypass conduit, in a state where the flap blocks the bypass conduit entry such that the condensate can flow directly from a pump unit to a condensate tank which both are not shown here.

Fig. 4 shows an enlarged view of the pump conduit, in which a flap system including a flap is located, and the overflow conduit that both comprise a siphon and are directly connected by a bypass conduit, in a state where the flap blocks the pump conduit such that the condensate flows in an opposite direction and through the bypass conduit.

[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] Dryer 1 comprises a bypass conduit 26 which directly connects the pump conduit 9 and the overflow conduit 10. The pump conduit 9 comprises a flap system 25 including a flap (not to be seen here), wherein the flap

system 25 including the flap is adapted to cause by means of the operation of the pump unit 7 a flow of condensate 22 from the pump outlet 35 directly to the condensate tank 6 in that the bypass conduit 26 is closed by the flap, and to cause a flow of condensate 22 in the opposite direction and into the bypass conduit 26 and an overflow siphon 24 in the overflow conduit 10 in that the bypass conduit 26 is no longer closed by the flap when the flow direction has changed.

[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 bypass conduit exit 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 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 used in this particular 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_{WPK}^T 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] In the dryer of Fig. 1 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 while the bypass conduit 26 is closed by the flap 27 at the bypass conduit entry point; and
- (d) stopping the electric pump unit 7 such that the condensate 22 flows in an opposite direction first in the direction of the electric pump unit 7, then through the bypass conduit 26 into the overflow siphon 24.

[0053] Fig. 2 shows important parts related to the core of the invention, according to the first embodiment of the dryer of the present invention shown in Fig. 1.

[0054] Condensate which is produced when humid air of the process air circuit (not shown here) is 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 vessel 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. In Fig. 2, the pump siphon 23 is located between the pump outlet 35 and the condensate tank inlet 36. The overflow conduit 10 is connected to the overflow container 8 at the exit 33 of the overflow container 8.

[0055] In this first embodiment, the dryer comprises a 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 bypass conduit 26 directly back into the con-

densate collecting vessel 5, i.e. without entering the condensate tank 6, and also in the overflow siphon 24 to efficiently contribute to the airtightness of the process air circuit.

[0056] According to the present invention, the pump conduit 9 comprises a flap system 25 including a flap (not to be seen here), wherein the flap system 25 including the flap is adapted to cause by means of the operation of the pump unit 7 a flow of condensate 22 from the pump outlet 35 directly to the condensate tank 6 in that the bypass conduit 26 is closed by the flap, and to cause a flow of condensate 22 in the opposite direction and into the bypass conduit 26 and the overflow siphon 24 in the overflow conduit 10 in that the bypass conduit 26 is no longer closed by the flap when the flow direction has changed. The flap system 27 including a flap is placed at the bypass conduit entry point 31 which is here located between a pump siphon 23 and the condensate tank 6.

[0057] Fig. 3 shows an enlarged view of the pump conduit 9, in which a flap system 25 including a flap 27 is located, and the overflow conduit 10, wherein both conduits comprise a siphon 23,24 and are directly connected by a bypass conduit 26, in a state where the flap 27 blocks the bypass conduit entry 31 such that the condensate can flow directly from a pump unit to a condensate tank. The latter are not shown here. It can be recognized clearly that the bypass conduit 26 runs obliquely downwards from the pump conduit 9 to the overflow conduit 10.

[0058] Fig. 4 shows an enlarged view of the pump conduit 9, in which a flap system 25 including a flap 27 is located, and the overflow conduit 10. Both conduits 9,10 comprise a siphon 23,24 and are directly connected by a bypass conduit 26. The flap system 25 is shown in a state where the flap 27 blocks the pump conduit 9 such that the condensate flows in an opposite direction and down through the bypass conduit 27. It can be recognized clearly that the bypass conduit 26 runs obliquely downwards from the pump conduit 9 to the overflow conduit 10.

40 LIST OF REFERENCE NUMERALS

[0059]

| | |
|----|---|
| 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 | Flap system |
| 26 | Bypass conduit |
| 27 | Flap |
| 28 | Temperature sensor S_{WPK}^T 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 dryer (1) comprises a bypass conduit (26) which directly connects the pump conduit (9) and the overflow conduit (10) and **in that** the pump conduit (9) comprises at a bypass conduit entry point (31) a flap system (25) including a flap (27), wherein the flap system (25) including the flap (27) is adapted to cause by means of the operation of the pump unit (7) a flow of condensate (22) from the pump outlet (35) directly to the condensate tank (6) **in that** the bypass conduit (26)

is closed by the flap (27), and to cause a flow of condensate (22) in the opposite direction and into the bypass conduit (26) and an overflow siphon (24) in the overflow conduit (10) **in that** the bypass conduit (26) is no longer closed by the flap (27) when the flow direction has changed.

2. Dryer (1) according to claim 1, wherein the bypass conduit (26) runs obliquely downwards from the pump conduit (9) to the overflow conduit (10).
3. Dryer (1) according to claim 1 or 2, wherein the bypass conduit entry point (31) is located between a pump siphon (23) and the condensate tank (6).
4. Dryer (1) according to any of claims 1 to 3, wherein a pump conduit closure device (30) is placed in the pump conduit (9).
5. Dryer (1) according to any of claims 1 to 4, wherein a condensate collecting vessel level sensor (34) is provided in the condensate collecting vessel (5).
6. Dryer (1) according to any of claims 1 to 5, wherein a condensate tank water level sensor (29) is provided in the condensate tank (6).
7. Dryer (1) according to any of claims 1 to 6, 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).
8. Dryer (1) according to any of the preceding claims comprising a pump siphon (23).
9. Dryer according to claim 8, wherein the flap system (23) is located in the pump conduit (9) between the pump siphon (23) and the condensate tank (6).
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 (23,24) located in the pump conduit (9) and/or in the overflow conduit (10) to limit air transfer through these conduits (9,10); and wherein the dryer (1) comprises a bypass conduit (26) which directly connects the pump conduit (9) and the overflow conduit (10) and wherein the pump conduit (9) comprises at a bypass conduit entry point (31) a flap system (25) including a flap (27), wherein the flap system (25) including the flap (27) is adapted to cause by means of the operation of the pump unit (7) a flow of condensate (22) from the pump outlet (35) directly to the condensate tank (6) in that the bypass conduit (26) is closed by the flap (27), and to cause a flow of condensate (22) in the opposite direction and into the bypass conduit (26) and an overflow siphon (24) in the overflow conduit (10) in that the bypass conduit (26) is no longer closed by the flap (27) when the flow direction has changed; 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) while the bypass conduit (26) is closed by the flap (27) at the bypass conduit entry point (31); and
- (d) stopping the electric pump unit (7) such that the condensate (22) flows in an opposite direction first in the direction of the electric pump unit (7), then through the bypass conduit (26) into the overflow siphon (24).

45

50

55

Fig. 1

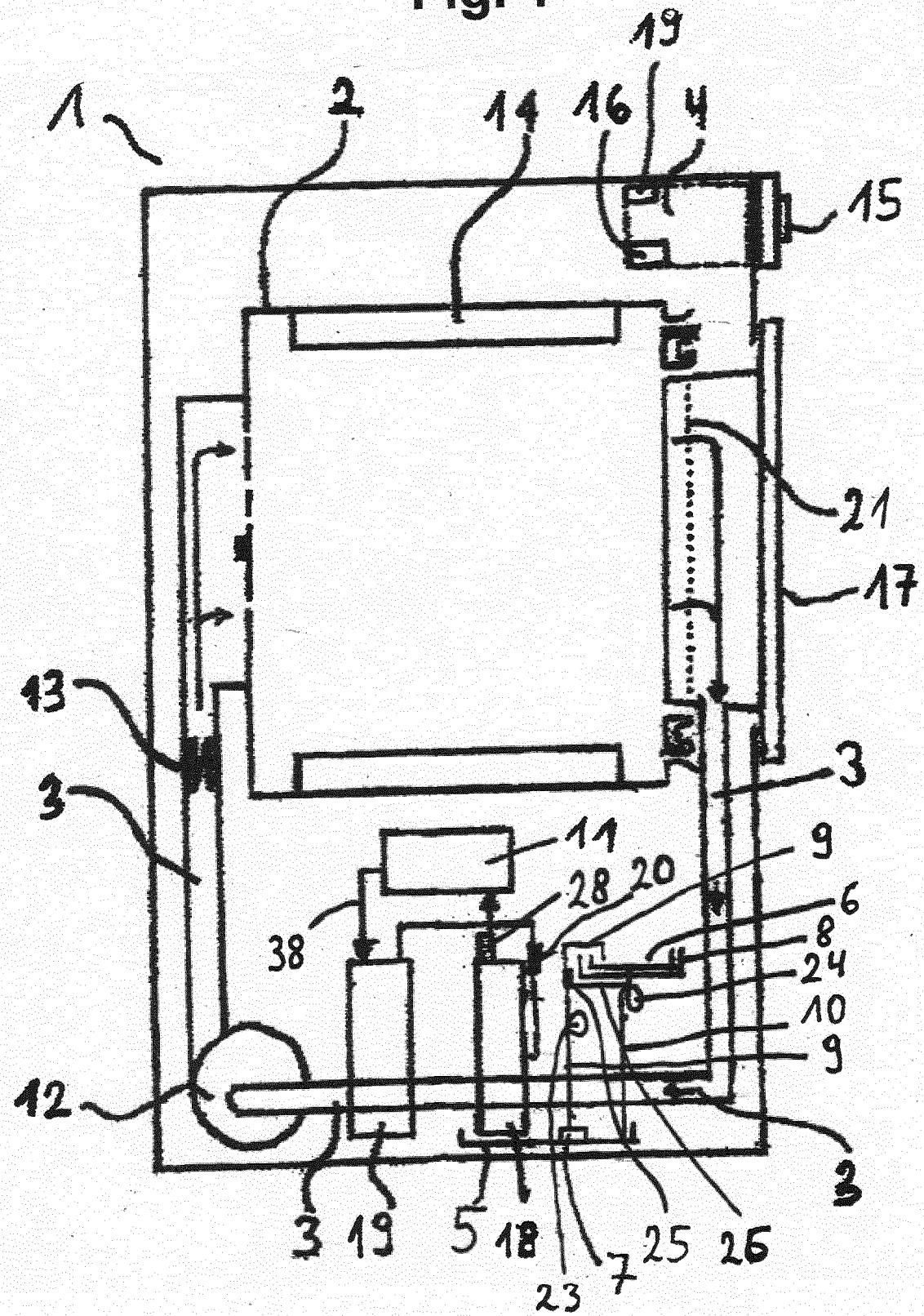


Fig. 2

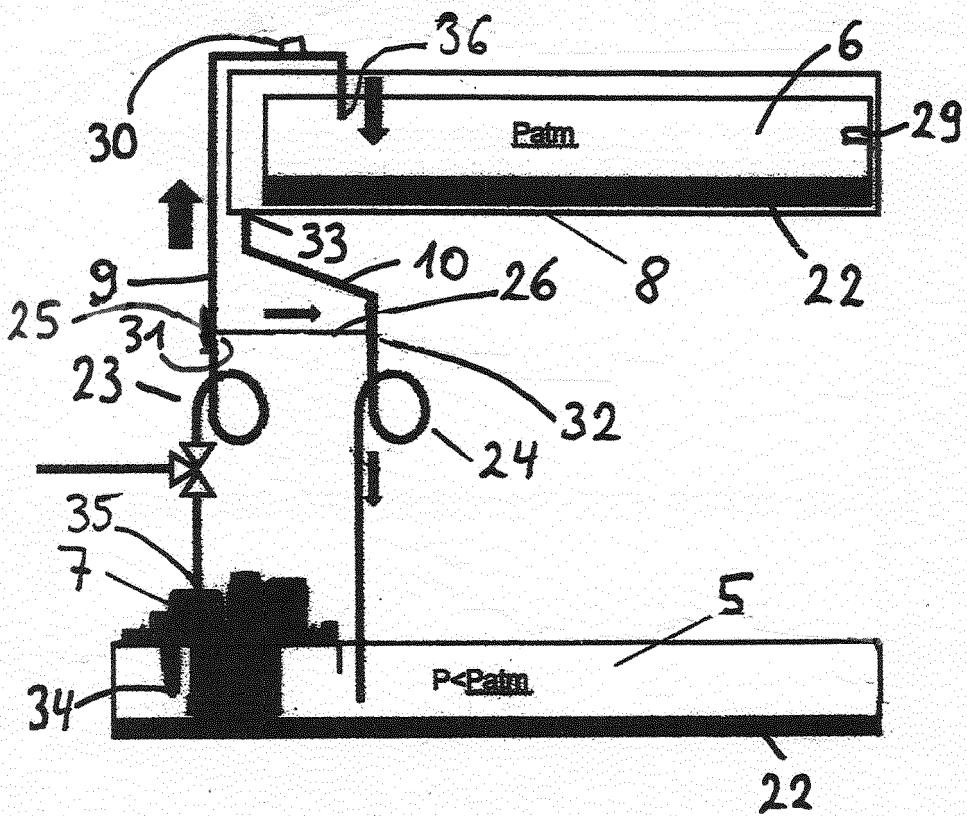


Fig. 3

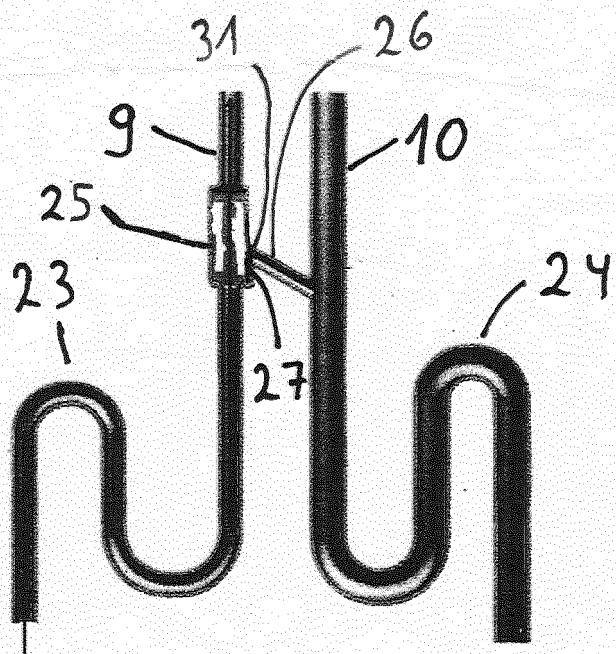
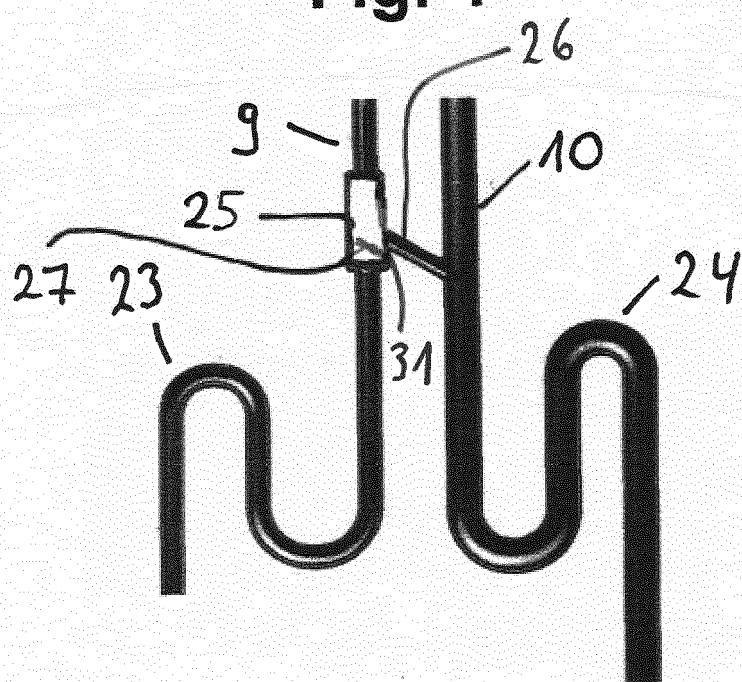


Fig. 4





EUROPEAN SEARCH REPORT

Application Number

EP 22 15 3372

5

| DOCUMENTS CONSIDERED TO BE RELEVANT | | | | | | | | | |
|---|--|---------------------|--|-----------------|----------------------------------|----------|--------|-------------|---------------------|
| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) | | | | | | |
| 10 | A WO 2015/101388 A1 (ELECTROLUX APPLIANCES AB [SE]) 9 July 2015 (2015-07-09) * figure 4a * ----- | 1-11 | INV. D06F58/24 D06F58/38 | | | | | | |
| 15 | A WO 2017/119589 A1 (LG ELECTRONICS INC [KR]) 13 July 2017 (2017-07-13) * figure 15 * ----- | 1-11 | ADD. D06F58/30 D06F25/00 D06F103/58 | | | | | | |
| 20 | A KR 2019 0128487 A (LG ELECTRONICS INC [KR]) 18 November 2019 (2019-11-18) * figure 4 * ----- | 1-11 | D06F105/08 D06F58/20 | | | | | | |
| 25 | A WO 2007/058009 A1 (TOSHIBA KK [JP]; TOSHIBA CONSUMER MARKETING [JP] ET AL.) 24 May 2007 (2007-05-24) * figures 3-4 * ----- | 1-11 | | | | | | | |
| 30 | | | TECHNICAL FIELDS SEARCHED (IPC) | | | | | | |
| 35 | | | D06F | | | | | | |
| 40 | | | | | | | | | |
| 45 | | | | | | | | | |
| 50 | The present search report has been drawn up for all claims | | | | | | | | |
| 55 | <table border="1"> <tr> <td>Place of search</td> <td>Date of completion of the search</td> <td>Examiner</td> </tr> <tr> <td>Munich</td> <td>4 July 2022</td> <td>Werner, Christopher</td> </tr> </table> | | | Place of search | Date of completion of the search | Examiner | Munich | 4 July 2022 | Werner, Christopher |
| Place of search | Date of completion of the search | Examiner | | | | | | | |
| Munich | 4 July 2022 | Werner, Christopher | | | | | | | |
| CATEGORY OF CITED DOCUMENTS <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p> | | | | | | | | | |
| EPO FORM 1509 03/82 (P04C01) | | | | | | | | | |

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 22 15 3372

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

04-07-2022

| 10 | Patent document cited in search report | Publication date | | Patent family member(s) | Publication date |
|----|--|------------------|--|---|--|
| 15 | WO 2015101388 A1 | 09-07-2015 | EP PL WO | 3090095 A1 3090095 T3 2015101388 A1 | 09-11-2016 29-06-2018 09-07-2015 |
| 20 | WO 2017119589 A1 | 13-07-2017 | AU CN EP JP JP KR US WO | 2016385263 A1 106939487 A 3190227 A1 6944940 B2 2019500172 A 20170082048 A 2017191215 A1 2017119589 A1 | 19-07-2018 11-07-2017 12-07-2017 06-10-2021 10-01-2019 13-07-2017 06-07-2017 13-07-2017 |
| 25 | KR 20190128487 A | 18-11-2019 | NONE | | |
| 30 | WO 2007058009 A1 | 24-05-2007 | CN EP JP JP KR TW US WO | 101310067 A 1961852 A1 4880982 B2 2007135897 A 20080056000 A 200801277 A 2009178442 A1 2007058009 A1 | 19-11-2008 27-08-2008 22-02-2012 07-06-2007 19-06-2008 01-01-2008 16-07-2009 24-05-2007 |
| 35 | | | | | |
| 40 | | | | | |
| 45 | | | | | |
| 50 | | | | | |
| 55 | | | | | |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2141279 A1 [0003]
- EP 2450615 A1 [0004]