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(54) **LAUNDRY DRYER WITH AIR-COOLED CONDENSER**

WÄSCHETROCKNER MIT EINEM LUFTGEKÜHLTEN KONDENSATOR

SÈCHE-LINGE AYANT UN CONDENSEUR REFROIDI PAR AIR

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(56) References cited:
EP-A1- 0 467 188 EP-A1- 1 441 058
EP-A1- 2 072 656 EP-A1- 2 103 730
EP-A1- 2 196 577 WO-A1-2011/154336

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Description

[0001] The present invention relates to a laundry dryer comprising an air-cooled condenser.

[0002] In laundry dryers wherein the drying air is circulated within a closed cycle, the drying air activated by a fan dehumidifies the laundry by being passed over the laundry and the water vapor in the air is condensed at the condenser. The drying air dehumidified at the condenser is then heated by being passed over the heater, thus hot and dry air is delivered onto the laundry. As the load on the air-cooled condenser increases, the amount of water kept in the condenser increases and the efficiency of the condenser decreases, the desired condensation cannot be provided, the operation time of the heater is prolonged and the total energy consumption of the laundry dryer increases.

[0003] In the European Patent No. EP2072656, a laundry dryer is explained which comprises an air-cooled condenser and the energy consumption of which is decreased.

[0004] The aim of the present invention is the realization of a laundry dryer which comprises an air-cooled condenser and wherein the efficiency of the condenser is increased.

[0005] In the laundry dryer realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, the processing air providing the laundry to be dried is sent to the drum by means of a drying duct and a drying fan. The processing air is dehumidified by an air-cooled condenser and the processing air is heated by a heater. The condenser is cooled by means of a cooling fan and an outside air duct. The laundry dryer, furthermore, comprises an opening arranged on the drying duct, providing the processing air to be partly discharged from the drying duct inside the body.

[0006] In an embodiment of the present invention, the opening is arranged after the condenser in the drying duct and the air, the humidity of which is decreased in the condenser, is sent from the drying duct to the inside of the body.

[0007] In another embodiment of the present invention, the opening is arranged on the part of the drying duct after the drying fan and thus the processing air is partly discharged through the opening with the effect of the pressure applied by the drying fan.

[0008] In another embodiment of the present invention, some of the processing air is provided to be directed to the opening in the drying duct by means of a guide which extends from the side of the opening to the inside of the drying duct.

[0009] In accordance with the present invention, the laundry dryer comprises a by-pass line, one end of which is connected to the opening and the other end to the cooling duct. In an embodiment of the present invention, the by-pass line is connected to the cooling duct before the cooling fan and the cooling fan is provided to suck

the processing air through the opening.

[0010] In another embodiment of the present invention, the laundry dryer comprises an additional condenser which is placed on the cooling duct before or after the main condenser and the by-pass line passes through the additional condenser.

[0011] In another embodiment of the present invention, the laundry dryer comprises a supply line which provides the compensation of the processing air discharged from the drying duct by means of the opening, with one end connected to the cooling duct and the other end to the drying duct. The supply line is connected to the drying duct before the drying fan and to the cooling duct after the main condenser and the additional condenser.

[0012] In the laundry dryer of the present invention, some of the processing air is discharged out of the drying cycle, the dry cooling air is received instead of the discharged humid air and the condensation efficiency is increased by reducing the load on the condenser. The humidity of the discharged processing air does not disturb the user. The operation time of the heater is shortened and energy saving is provided.

[0013] The laundry dryer realized in order to attain the aim of the present invention is illustrated in the attached figure, where:

Figure 1 - is the schematic view of a laundry dryer.

[0014] The elements illustrated in the figure are numbered as follows:

1. Laundry dryer
2. Body
3. Drum
4. Drying duct
5. Heater
6. Condenser
7. Drying fan
8. Cooling fan
9. Cooling duct
10. Opening
11. Guide
12. By-pass line
13. Additional condenser
14. Supply line

[0015] The laundry dryer (1) comprises a body (2), a drum (3) wherein the laundry is placed, a drying duct (4) wherein the processing air (PA) is circulated in order to dry the laundry, a heater (5) which heats the processing air (PA), a condenser (6) which reduces the humidity of the processing air (PA), a drying fan (7) which circulates the processing air (PA) in the drying duct (4) and the drum (3), a cooling fan (8) which cools the condenser (6) and a cooling duct (9) which directs the cooling air (CA) sucked from the outside environment by the cooling fan (8) onto the condenser (6).

[0016] In the laundry dryer (1), the processing air (PA)

activated by means of the drying fan (7) exits the drum (3) and reaches the condenser (6) by means of the drying duct (4), is heated by passing through the heater (5) after being dehumidified in the condenser (6) and the dry and hot processing air (PA) is delivered onto the laundry inside the drum (3). The cooling air (CA) sucked from the outside environment by means of the cooling fan (8) and the cooling duct (9) is delivered to the outside environment again after being passed through the condenser (6), thus the condenser (6) is cooled and the processing air (PA) passing therethrough is provided to be condensed.

[0017] The laundry dryer (1) of the present invention comprises an opening (10) arranged on the drying duct (4), providing the processing air (PA) to be partially discharged from the drying duct (4) inside the body (2).

[0018] In an embodiment of the present invention, the opening (10) is arranged on the part of the drying duct (4) after the condenser (6), thus the processing air (PA), the humidity of which is reduced while passing through the condenser (6), is provided to be discharged from the drying duct (4) by passing through the opening (10).

[0019] In another embodiment of the present invention, the opening (10) is arranged on the part of the drying duct (4) after the drying fan (7), between the drying fan (7) and the drum (3). In this embodiment, the pressure effect of the drying fan (7) is utilized in order to discharge the processing air (PA) through the opening (10).

[0020] In another embodiment of the present invention, the laundry dryer (1) comprises a guide (11) which extends from the side of the opening (10) to the inside of the drying duct (4) and guides the processing air (PA) partially to the opening (10) inside the drying duct (4).

[0021] Some of the processing air (PA) circulated in the drying duct (4) by means of the drying fan (7) during the drying process applied in the laundry dryer (1) is delivered to the environment inside the body (2) through the opening (10) after passing through the condenser (6). The amount of the processing air (PA) partially discharged from the drying duct (4) is adjusted by changing the dimensions of the opening (10) and the location of the guide (11). Thus, by separating some of the humid processing air (PA) flowing in the drying duct (4) from the drying cycle, the load on the condenser (6) is reduced and the condensation efficiency is increased. Since the opening (10) is arranged after the condenser (6), the humidity of the processing air (PA) is reduced in the condenser (6) in advance, thus the humidity ratio of the processing air (PA) entering the body (2) is decreased. For example, when there is a circulation of processing air (PA) with a flow rate of 50 l/min in the drying duct (4), processing air (PA) with a flow rate of 3 l/min is discharged from the drying duct (4) into the body (2) by means of the opening (10).

[0022] In an embodiment of the present invention, the laundry dryer (1) comprises a by-pass line (12), one end of which is connected to the opening (10) and the other end to the cooling duct (9).

[0023] By means of the by-pass line (12), the processing air (PA) partially discharged through the opening (10) is mixed with the cooling air (CA) discharged to the outer environment from the cooling duct (9), thus sent to the outer environment through the cooling duct (9) outlet with reduced humidity. The humidity rate of the air (PA + CA) sent to the outer environment is reduced significantly, thus doesn't disturb the user.

[0024] In another embodiment of the present invention, the by-pass line (12) is connected to the cooling duct (9) before the cooling fan (8) in the direction of the cooling air (CA) flow, thus the suction effect of the cooling fan (8) is utilized for discharging the processing air (PA) partially through the opening (10).

[0025] In another embodiment of the present invention, the laundry dryer (1) comprises an additional condenser (13) which is disposed at the cooling duct (9), cooled by the cooling fan (8) together with the condenser (6), through which the by-pass line (12) passes, which exchanges heat with the by-pass line (12) and which reduces the humidity of the processing air (PA) passing through the by-pass line (12). The processing air (PA) discharged from the drying duct (4) is condensed by means of the additional condenser (13), thus sent to the outer environment with a humidity rate that doesn't disturb the user.

[0026] In another embodiment of the present invention, the additional condenser (13) is disposed on the cooling duct (9), between the cooling fan (8) and the condenser (6) (not shown in the figures). In this embodiment, first the additional condenser (13) is cooled by the cooling fan (8), the condensation efficiency of the additional condenser (13) is increased, and thus the humidity of the processing air (PA) which is partially discharged to the outer environment is efficiently reduced.

[0027] In another embodiment of the present invention, the additional condenser (13) is disposed on the cooling duct (9), after the cooling fan (8) and the condenser (6) (Figure 1). In this embodiment, first the condenser (6) is cooled by the cooling fan (8), the condensation efficiency of the condenser (6) is increased, and thus the humidity of the processing air (PA) which circulates in the drying duct (4) is efficiently reduced.

[0028] In another embodiment of the present invention, the laundry dryer (1) comprises a supply line (14), one end of which is connected to the cooling duct (9) and the other end to the drying duct (4) and which provides the cooling air (CA) passing through the cooling duct (9) to be partially mixed with the processing air (PA) passing through the drying duct (4).

[0029] In another embodiment of the present invention, the supply line (14) is connected to the drying duct (4) before the drying fan (7) in order to benefit from the suction effect of the drying fan (7) and some of the cooling air (CA) passing through the cooling duct (9) is provided to be sucked from the supply line (14) and mixed with the processing air (PA) passing through the drying duct (4).

[0030] In another embodiment of the present invention, the supply line (14) is connected to the cooling duct (9) after the condenser (6) and the additional condenser (13) and the cooling air (CA) heated while passing through the condenser (6) and the additional condenser (13) is mixed with the processing air (PA) passing through the drying duct (4), thus increasing the capacity of the processing air (PA) to retain humidity.

[0031] In this embodiment, in the laundry dryer (1), instead of the processing air (PA) partially discharged from the drying duct (4) by means of the opening (10), the by-pass line (12) and the cooling duct (9), the dry cooling air (CA) is supplied to the drying duct (4) by means of the supply line (14), and the processing air (PA) lost by being sent to the outer environment is compensated with the cooling air (CA). For example, taking into consideration that the total flow rate of the processing air (PA) is 50 l/min, processing air (PA) with a flow rate of 3 l/min is discharged and cooling air (CA) again with a flow rate of 3 l/min is added to the drying cycle by means of the supply line (14) instead of the discharged processing air (PA), thus maintaining the total flow rate. Thus, pressure drops in the drying duct (4) are prevented, the humidity of the processing air (PA) is decreased, and the drying performance is improved.

[0032] In the laundry dryer (1) of the present invention, the condensation efficiency is increased by reducing the load on the condenser (6). The humidity in the processing air (PA) that is partially discharged in order to reduce the load on the condenser (6) is reduced and prevented from disturbing the user. The operation time of the heater (5) is shortened and energy saving is provided.

[0033] It is to be understood that the present invention is not limited by the embodiments disclosed above and a person skilled in the art can easily introduce different embodiments. These should be considered within the scope of the protection disclosed by the claims of the present invention.

Claims

1. A laundry dryer (1) comprising a body (2), a drum (3) wherein the laundry is placed, a drying duct (4) wherein the processing air (PA) is circulated in order to dry the laundry, a heater (5) which heats the processing air (PA), a condenser (6) which condenses the processing air (PA), a drying fan (7) which circulates the processing air (PA) in the drying duct (4) and the drum (3), a cooling fan (8) which cools the condenser (6), a cooling duct (9) which directs the cooling air (CA) sucked from the outside environment by the cooling fan (8) onto the condenser (6), an opening (10) arranged on the drying duct (4), providing the processing air (PA) to be partially discharged from the drying duct (4) inside the body (2), **characterized in that** the laundry dryer (1) further comprises a by-pass line (12), one end of which is

connected to the opening (10), the other end to the cooling duct (9).

2. A laundry dryer (1) as in Claim 1, **characterized in that** the opening (10) is arranged on the part of the drying duct (4) after the condenser (6).
3. A laundry dryer (1) as in Claim 1 or 2, **characterized in that** the opening (10) is arranged on the part of the drying duct (4) after the drying fan (7).
4. A laundry dryer (1) as in any one of the above claims, **characterized in that** the laundry dryer (1) further comprises a guide (11) which extends from the side of the opening (10) to the inside of the drying duct (4) and guides the processing air (PA) partially to the opening (10) inside the drying duct (4).
5. A laundry dryer (1) as in any one of the above claims, **characterized in that** the by-pass line (12) is connected to the cooling duct (9) before the cooling fan (8).
6. A laundry dryer (1) as in any one of the above claims, **characterized in that** an additional condenser (13) is disposed at the cooling duct (9), cooled by the cooling fan (8) together with the condenser (6) and through which the by-pass line (12) passes.
7. A laundry dryer (1) as in Claim 6, **characterized in that** the additional condenser (13) is disposed on the cooling duct (9), between the cooling fan (8) and the condenser (6).
8. A laundry dryer (1) as in Claim 6, **characterized in that** the additional condenser (13) is disposed on the cooling duct (9), after the cooling fan (8) and the condenser (6).
9. A laundry dryer (1) as in any one of the above claims, **characterized in that** the laundry dryer (1) further comprises a supply line (14), one end of which is connected to the cooling duct (9) and the other end to the drying duct (4) and which provides the cooling air (CA) passing through the cooling duct (9) to be partially mixed with the processing air (PA) passing through the drying duct (4).
10. A laundry dryer (1) as in Claim 9, **characterized in that** the supply line (14) is connected to the drying duct (4) before the drying fan (7).
11. A laundry dryer (1) as in Claim 9 or 10, with claim 9 being dependent on any one of the claims 6 to 8, **characterized in that** the supply line (14) is connected to the cooling duct (9) after the condenser (6) and the additional condenser (13).

Patentansprüche

1. Wäschetrockner (1), umfassend einen Gehäusekörper (2), eine Trommel (3), in die die Wäsche gegeben wird, einen Trocknungskanal (4), in dem die Prozessluft (PA) zirkulieren gelassen wird, um die Wäsche zu trocknen, eine Heizeinrichtung (5), die die Prozessluft (PA) erwärmt, einen Kondensator (6), der die Prozessluft (PA) kondensiert, ein Trocknungsgebläse (7), das die Prozessluft (PA) in dem Trocknungskanal (4) und der Trommel (3) zirkulieren lässt, ein Kühlgebläse (8), das den Kondensator (6) kühlt, einen Kühlungskanal (9), der die Kühlluft (CA), die von dem Kühlgebläse (8) von außen angesaugt wird, auf den Kondensator (6) lenkt, eine Öffnung (10), die an dem Trocknungskanal (4) angeordnet ist und dafür sorgt, dass die Prozessluft (PA) teilweise durch den Trocknungskanal (4) im Gehäusekörper (2) abgelassen wird, **dadurch gekennzeichnet, dass** der Wäschetrockner (1) ferner eine Umgehungsleitung (12) umfasst, deren eines Ende mit der Öffnung (10) und deren anderes Ende mit dem Kühlungskanal (9) verbunden ist. 5
2. Wäschetrockner (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Öffnung (10) an dem Teil des Trocknungskanals (4) nach dem Kondensator (6) angeordnet ist. 10
3. Wäschetrockner (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Öffnung (10) an dem Teil des Trocknungskanals (4) nach dem Trocknungsgebläse (7) angeordnet ist. 15
4. Wäschetrockner (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der Wäschetrockner (1) ferner eine Führung (11) umfasst, die sich von der Seite der Öffnung (10) zum Inneren des Trocknungskanals (4) erstreckt und die Prozessluft (PA) teilweise zur Öffnung (10) im Trocknungskanal (4) führt. 20
5. Wäschetrockner (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Umgehungsleitung (12) vor dem Kühlgebläse (8) mit dem Kühlungskanal (9) verbunden ist. 25
6. Wäschetrockner (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** ein weiterer Kondensator (13) an dem Kühlungskanal (9) angeordnet ist, der zusammen mit dem Kondensator (6) von dem Kühlgebläse (8) gekühlt wird und durch den die Umgehungsleitung (12) verläuft. 30
7. Wäschetrockner (1) nach Anspruch 6, **dadurch gekennzeichnet, dass** der weitere Kondensator (13) zwischen dem Kühlgebläse (8) und dem Kondensator (6) an dem Kühlungskanal (9) angeordnet ist. 35

8. Wäschetrockner (1) nach Anspruch 6, **dadurch gekennzeichnet, dass** der weitere Kondensator (13) zwischen dem Kühlgebläse (8) und dem Kondensator (6) an dem Kühlungskanal (9) angeordnet ist. 40
9. Wäschetrockner (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der Wäschetrockner (1) ferner eine Zuführleitung (14) umfasst, deren eines Ende mit dem Kühlungskanal (9) und deren anderes Ende mit dem Trocknungskanal (4) verbunden ist und die dafür sorgt, dass die Kühlluft (CA), die durch den Kühlungskanal (9) strömt, teilweise mit der Prozessluft (PA) vermischt wird, die durch den Trocknungskanal (4) strömt. 45
10. Wäschetrockner (1) nach Anspruch 9, **dadurch gekennzeichnet, dass** die Zuführleitung (14) vor dem Trocknungsgebläse (7) mit dem Trocknungskanal (4) verbunden ist. 50
11. Wäschetrockner (1) nach Anspruch 9 oder 10, wenn Anspruch 9 von einem der Ansprüche 6 bis 8 abhängig ist, **dadurch gekennzeichnet, dass** die Zuführleitung (14) nach dem Kondensator (6) dem weiteren Kondensator (13) mit dem Kühlungskanal (9) verbunden ist. 55

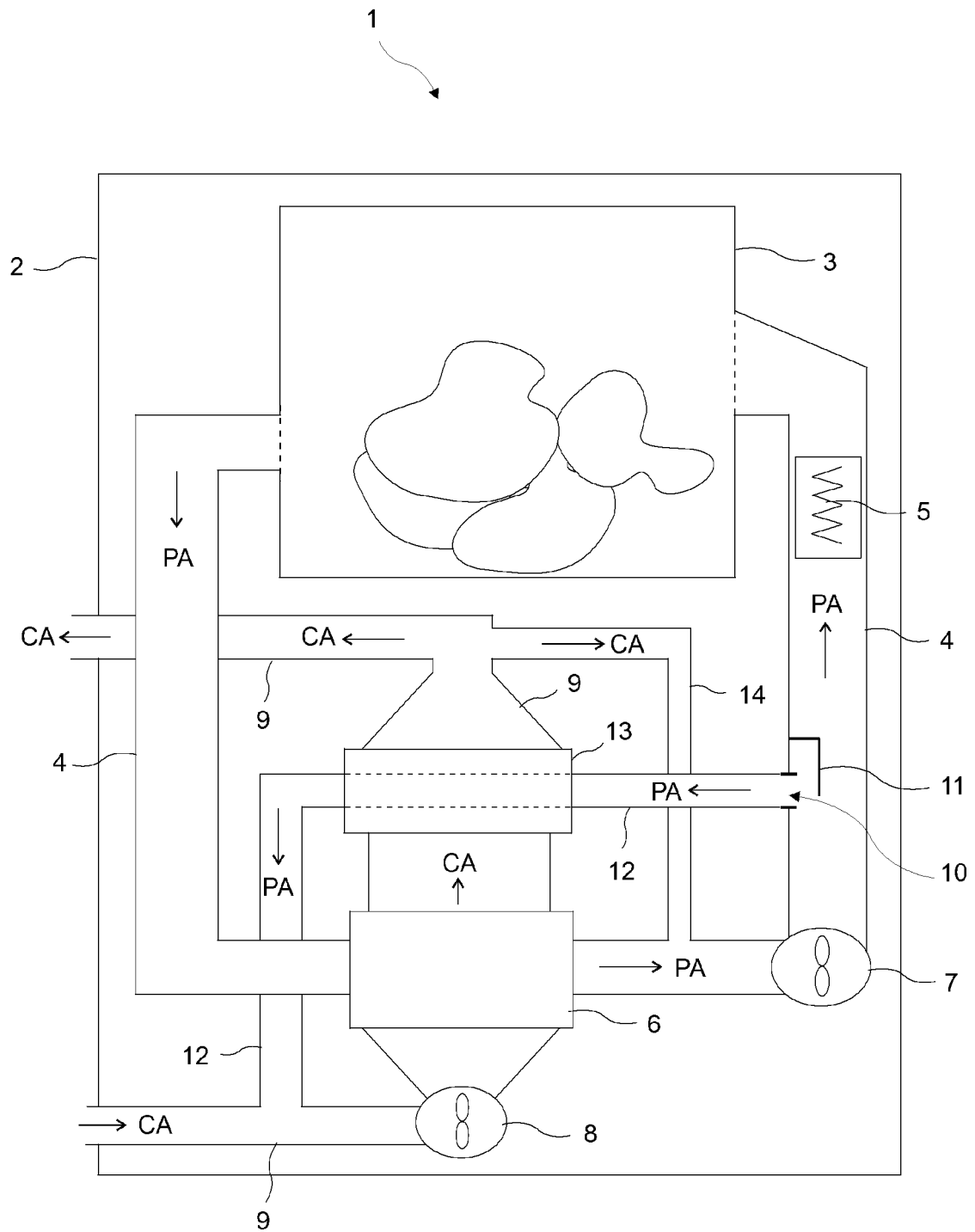
Revendications

1. Un sèche-linge (1) comprenant un corps (2), un tambour (3) où le linge est placé, un conduit de séchage (4) où l'air de processus (PA) est circulé afin de sécher le linge, un dispositif de chauffage (5) qui chauffe l'air de processus (PA), un condenseur (6) qui condense l'air de processus (PA), un ventilateur de séchage (7) qui circule l'air de processus (PA) dans le conduit de séchage (4) et le tambour (3), un ventilateur de refroidissement (8) qui refroidit le condenseur (6), un conduit de refroidissement (9) qui dirige l'air de refroidissement (CA) aspiré à partir de l'environnement extérieur par le ventilateur de refroidissement (8) sur le condenseur (6), une ouverture (10) qui est arrangée sur le conduit de séchage (4) et qui permet à l'air de processus (PA) d'être déchargé partiellement du conduit de séchage (4) dans le corps (2), **caractérisé en ce que** le sèche-linge (1) comprend en outre une ligne de by-pass (12) dont une extrémité est reliée à l'ouverture (10) et l'autre extrémité est reliée au conduit de refroidissement (9). 5
2. Un sèche-linge (1) selon la Revendication 1, **caractérisé en ce que** l'ouverture (10) est arrangée sur la partie du conduit de séchage (4) après le condenseur (6). 10
3. Un sèche-linge (1) selon la Revendication 1 ou 2, **caractérisé en ce que** l'ouverture (10) est arrangée 15

sur la partie du conduit de séchage (4) après le ventilateur de séchage (7).

4. Un sèche-linge (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le sèche-linge (1) comprend en outre un guide (11) qui s'étend à partir du côté de l'ouverture (10) à l'intérieur du conduit de séchage (4) et guide l'air de processus (PA) partiellement à l'ouverture (10) dans le conduit de séchage (4). 5
10
5. Un sèche-linge (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la ligne de by-pass (12) est reliée au conduit de refroidissement (9) avant le ventilateur de refroidissement (8). 15
6. Un sèche-linge (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** un condenseur supplémentaire (13) est disposé au conduit de refroidissement (9), refroidi par le ventilateur de refroidissement (8) avec le condenseur (6) et à travers lequel la ligne de by-pass (12) passe. 20
7. Un sèche-linge (1) selon la Revendication 6, **caractérisé en ce que** le condenseur supplémentaire (13) est disposé sur le conduit de refroidissement (9) entre le ventilateur de refroidissement (8) et le condenseur (6). 25
30
8. Un sèche-linge (1) selon la Revendication 6, **caractérisé en ce que** le condenseur supplémentaire (13) est disposé sur le conduit de refroidissement (9) après le ventilateur de refroidissement (8) et le condenseur (6). 35
9. Un sèche-linge (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le sèche-linge (1) comprend en outre une ligne d'alimentation (14) dont une extrémité est reliée au conduit de refroidissement (9) et l'autre extrémité est reliée au conduit de séchage (4) et qui permet à l'air de refroidissement (CA) passant à travers le conduit de refroidissement (9) d'être mélangé partiellement avec l'air de processus (PA) passant à travers le conduit de séchage (4). 40
45
10. Un sèche-linge (1) selon la Revendication 9, **caractérisé en ce que** la ligne d'alimentation (14) est reliée au conduit de séchage (4) avant le ventilateur de séchage (7). 50
11. Un sèche-linge (1) selon la Revendication 9 ou 10, avec la Revendication 9 étant dépendante de l'une des revendications de 6 à 8, **caractérisé en ce que** la ligne d'alimentation (14) est reliée au conduit de refroidissement (9) après le condenseur (6) et le condenseur supplémentaire (13). 55

Figure 1



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2072656 A [0003]