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(54) **A HYBRID LAUNDRY DRYER**

EIN HYBRID WÄSCHETROCKNER

UN SÉCHOIR À LINGE HYBRIDE

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## Description

**[0001]** The present invention relates to a hybrid laundry dryer comprising a heat pump and a heater.

**[0002]** In heat pump laundry dryers, the hot and humid air drawn from the drum cools down and leaves its moisture while passing over the evaporator. The air dehumidified on the evaporator passes over the condenser afterwards. The condenser enables the air to be heated, thus increasing the dehumidification capacity thereof. The air passing over the condenser is delivered back onto the laundry in the tub. Thus, the drying cycle continues until the laundry is dry. In the hybrid laundry dryer, a resistance heater is provided in the air duct in addition to the heat pump system. The operation system is the same as that of the heat pump laundry dryer, and the resistance heater is used for heating the air together with the condenser. In the hybrid laundry dryer, the air dehumidified in the evaporator is heated while passing over the condenser and then reheated again by means of the resistance heater at the fan outlet, in other words at the drum inlet to be delivered onto the laundry. Thus, the drying time is shortened with respect to heat pump laundry dryers. In the heat pump and hybrid laundry dryers, the water condensed from the humid air in the evaporator is collected in a discharge duct at the rear side of the machine. Afterwards, said water is sent to the water tank at the upper side of the machine by means of the pump. The water condensing during the drying cycle is pumped into the water tank and collected therein. The water tank has a detachable structure. At the end of the drying process, the user takes the water tank out of the machine and empties and replaces the same. Emptying the water tank is not an easy operation for the users since the water tank is heavy. Moreover, the condensate is emptied without being benefited from.

**[0003]** The Patent No. EP2392717 (B1) relates to a laundry washer/dryer and the discharge method of the condensate.

**[0004]** The Patent No. EP3246456 (A1) relates to a control method for a clothes dryer and the clothes dryer.

**[0005]** The Patent No. EP2796614 (A1) relates to a clothes dryer and method of cleaning evaporator in clothes dryer.

**[0006]** The Patent No. EP1550829 (A1) relates to a drying apparatus having a heat pump.

**[0007]** The aim of the present invention is the realization of a laundry dryer wherein the water collected as a result of condensation is used.

**[0008]** The laundry dryer realized in order to attain the aim of the present invention is defined in claim 1. Preferred embodiments are defined in the dependent claims. Such a laundry dryer is of hybrid type and comprises a heat pump and a resistance heater. In the embodiment of the present invention, the water collected in the water tank which receives the condensate at the end of the drying process and which is emptied by the user is sent to the air duct, wherein the processing air is circulated,

by means of an auxiliary condensation system comprising a supply pump and a connection tube. The water sent to the air duct is sprayed into the air duct by means of nozzles and dehumidifies the processing air. The auxiliary condensation system is used instead of the evaporator in some drying processes wherein the heat pump is not activated and only the resistance heater is operated, and the processing air is dehumidified, thus providing the drying of the laundry. In the drying processes wherein the heat pump is active, the condensate, which is collected in the water tank and which would be emptied by the user, is used.

**[0009]** 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 the hybrid laundry dryer of the present invention.

**[0010]** The elements illustrated in the figures are numbered as follows:

1. Laundry dryer
2. Drum
3. Air duct
4. Fan
5. Heater
6. Compressor
7. Evaporator
8. Condenser
9. Discharge duct
10. Water tank
11. Discharge pump
12. Supply pump
13. Connection tube
14. Nozzle
15. Discharge valve
16. Sensor unit
17. Heat pump
18. Auxiliary condensation system

**[0011]** The hybrid laundry dryer (1) with heat pump (17) and resistance heater (5), comprises a body; a tub (2) wherein the laundry to be dried is loaded; an air duct (3) wherein the processing air (drying air) cycle is performed; a fan (4) providing the circulation of the processing air; a resistance heater (5) which is disposed in the air duct (3) at the inlet of the drum (2); a compressor (6) which provides the refrigerant cycle, an evaporator (7) which is disposed in the air duct (3) and which condenses the humid processing air, a condenser (8) which is disposed in the air duct (3) and which heats the processing air dehumidified in the evaporator (7) and a discharge duct (9) which is disposed at the lower side of the body and wherein the water condensing in the evaporator (7) is collected, which all together form the heat pump (17) which provides the heating and dehumidification of the processing air; a detachable water tank (10) which is disposed at the upper side of the body, which receives the condensate and which is afterwards emptied by the user;

and a discharge pump (11) which pumps the water in the discharge duct (9) into the water tank (10).

**[0012]** In the hybrid laundry dryer (1), the hot and humid air drawn from the drum (2) cools down and leaves its moisture while passing over the evaporator (7). The air dehumidified in the evaporator (7) heats up while passing over the condenser (8), and the temperature of the processing air at the inlet of the drum (2) is increased by operating the heater (5) if required. The water condensed from the humid air in the evaporator (7) is collected in the discharge duct (9) under the evaporator (7) and then sent from here to the water tank (10) by means of the discharge pump (11). The water condensed during the drying cycle is collected in the water tank (10), and then the water tank (10) is taken outside and emptied by the user.

**[0013]** The laundry dryer (1) of the present invention comprises an auxiliary condensation system (18) having a supply pump (12) which delivers the condensate collected in the water tank (10) to the air duct (3), a connection tube (13) and at least one nozzle (14) which is connected to the end of the connection tube (13), which extends into the air duct (3) and which sprays the water taken from the water tank (10) into the air duct (3).

**[0014]** In the laundry dryer (1), in some drying processes wherein the heat pump (17) is not active, for example in case quick drying is required or in the drying process after the drying process wherein the heat pump (17) is operated, the heater (5) and the auxiliary condensation system (18) are activated instead of the heat pump (17). The processing air circulated in the air duct (3) by means of the fan (4) is heated by means of the heater (5) at the inlet of the drum (2) instead of the condenser (8), the air gathering moisture while passing over the laundry is condensed by means of the water which is taken from the water tank (10) by means of the auxiliary condensation system (18) and sprayed into the air duct (3).

**[0015]** In an embodiment of the present invention, the laundry dryer (1) comprises a discharge valve (15) with one inlet and two outlets which is disposed at the outlet of the discharge pump (11), which guides the water condensing in the evaporator (7) and collected in the discharge duct (9) to the water tank (10) when the heat pump (17) is active and which enables the water collected in the discharge duct (9) to be discharged via the water outlet to the outer environment when the heater (5) and the auxiliary condensation system (18) are active.

**[0016]** In the drying process wherein the heat pump (17) is active, the discharge valve (15) guides the water pumped from the discharge duct (9) by means of the discharge pump (11) to the water tank (10). Thus, in the next drying process, the water is collected in the water tank (10) to be used in the auxiliary condensation system (18). In the drying process wherein the heat pump (17) is not active, the heater (5) and the fan (4) are operated and the auxiliary condensation system (18) is activated. The water collected in the water tank (10) in the previous

drying cycle is sent into the drying duct (3) by means of the supply pump (12) and the connection tube (13) and sprayed into the air duct (3) by means of the nozzles (14). The water condensing while the heater (5) and the auxiliary condensation system (18) are active is collected again in the discharge duct (9), and the water pumped from the discharge duct (9) by the discharge pump (11) is this time discharged via the water outlet by means of the discharge valve (15).

**[0017]** In another embodiment of the present invention, the auxiliary condensation system (18) sprays water by means of the nozzles (14) into the part of the air duct (3) which is before the evaporator (7) in the air flow direction and which is the narrowest cross-section of the air duct (3). Since the air flow rate increases at this region, the rate of condensation gets higher.

**[0018]** In another embodiment of the present invention, the laundry dryer (1) comprises a sensor unit (16), for example an ammeter, which is electrically connected to the supply pump (12), which determines the amount of water pumped from the water tank (10) into the air duct (3) and whether the water has run out by measuring the current drawn by the supply pump (12), and which provides that the supply pump (12), hence the auxiliary condensation system (18), is deactivated and the heat pump (17) is activated when the water in the water tank (10) has run out. When the sensor unit (16) detects that the water in the water tank (10) has run out and the supply pump (12) "runs idle," the supply pump (12) is stopped and the auxiliary condensation system (18) is deactivated. Then, by activating the heat pump (17), the processing air is condensed by the evaporator (7). When the auxiliary condensation system (18) is active, the water pumped from the discharge duct (9) by the discharge pump (11) is discharged by means of the discharge valve (15). When the heat pump (17) is activated, the water pumped from the discharge duct (9) by the discharge pump (11) is sent to the water tank (10) and collected therein.

**[0019]** In the hybrid heat pump (17) laundry dryer (1), the condensate collected in the water tank (10) is used in the dehumidification process in the next drying cycle. In some special drying processes, the heat pump (17) is not operated, and the processing air is heated only by the heater (5) and the processing air is dehumidified by the auxiliary condensation system (18). By using the condensate, savings are provided.

## 50 Claims

1. - A laundry dryer (1) **comprising** a drum (2) wherein the laundry to be dried is loaded; an air duct (3) wherein the processing air cycle is performed; a fan (4) providing the circulation of the processing air; a heater (5) which is disposed in the air duct (3) at the 5 inlet of the drum (2); a compressor (6), an evaporator (7), a condenser (8) and a discharge duct (9)

wherein the water condensing in the evaporator (7) is collected, which all together form the heat pump (17); a water tank (10) which receives the condensate and which is emptied by the user; and a discharge pump (11) which pumps the water in the discharge duct (9) into the water tank (10), **characterized by**

- an auxiliary condensation system (18) having a supply pump (12) which delivers the condensate collected in the water tank (10) to the air duct (3), a connection tube (13) and at least one nozzle (14) which is connected to the end of the connection tube (13), which extends into the air duct (3) and which sprays the water taken from the water tank (10) into the air duct (3), wherein the auxiliary condensation system (18) is used to dehumidify the processing air in a drying process where the heat pump (17) is not activated and only the heater (5) is operated, thus providing the drying of the laundry.

2. - A laundry dryer (1) as in Claim 1, **characterized by** a discharge valve (15) with one inlet and two outlets which is disposed at the outlet of the discharge pump (11), which guides the water collected in the discharge duct (9) to the water tank (10) when the heat pump (17) is active and which enables the same to be discharged via the water outlet to the outer environment when the heater (5) and the auxiliary condensation system (18) are active.
3. - A laundry dryer (1) as in Claim 1 or 2, **characterized by** the auxiliary condensation system (18) which sprays water by means of the nozzles (14) into the part of the air duct (3) which is before the evaporator (7) in the air flow direction and which is the narrowest cross-section of the air duct (3).
4. - A laundry dryer (1) as in Claim 1 or 2, **characterized by** a sensor unit (16) which is electrically connected to the supply pump (12), which determines the amount of water pumped from the water tank (10) into the air duct (3) by measuring the current drawn by the supply pump (12), and a control unit which provides that the auxiliary condensation system (18) is deactivated and the heat pump (17) is activated when the water in the water tank (10) has run out.

#### Patentansprüche

1. - Ein Wäschetrockner (1) umfasst eine Trommel (2), in die die zu trocknende Wäsche geladen wird; einen Luftkanal (3), in dem der Prozessluftkreislauf durchgeführt wird; ein Ventilator (4), der für die Zirkulation der Prozessluft sorgt; einen Heizer (5), der im Luftkanal (3) am Einlass der Trommel (2) angeordnet

ist; einen Kompressor (6), einen Verdampfer (7), einen Kondensator (8) und eine Ablassleitung (9), in der das im Verdampfer (7) kondensierende Wasser gesammelt wird, die alle zusammen die Wärmepumpe (17) bilden; einen Wassertank (10), der das Kondensat aufnimmt und vom Benutzer entleert wird; und eine Ablasspumpe (11), die das Wasser im Ablassleitung (9) in den Wassertank (10) pumpt, **gekennzeichnet ist es dadurch, dass**

- dass ein Hilfskondensationssystem (18) mit einer Versorgungspumpe (12), die das im Wassertank (10) gesammelte Kondensat in den Luftkanal (3) fördert, einem Verbindungsrohr (13) und mindestens einer Düse (14), die an das Ende des Verbindungsrohrs (13) angeschlossen ist, die in den Luftkanal (3) hineinragt und das aus dem Wassertank (10) entnommene Wasser in den Luftkanal (3) einsprüht, wobei das Hilfskondensationssystem (18) dazu dient, die Prozessluft in einem Trocknungsprozess zu entfeuchten, bei dem die Wärmepumpe (17) nicht aktiviert ist und nur der Heizer (5) betrieben wird, und so für die Trocknung der Wäsche zu sorgen.

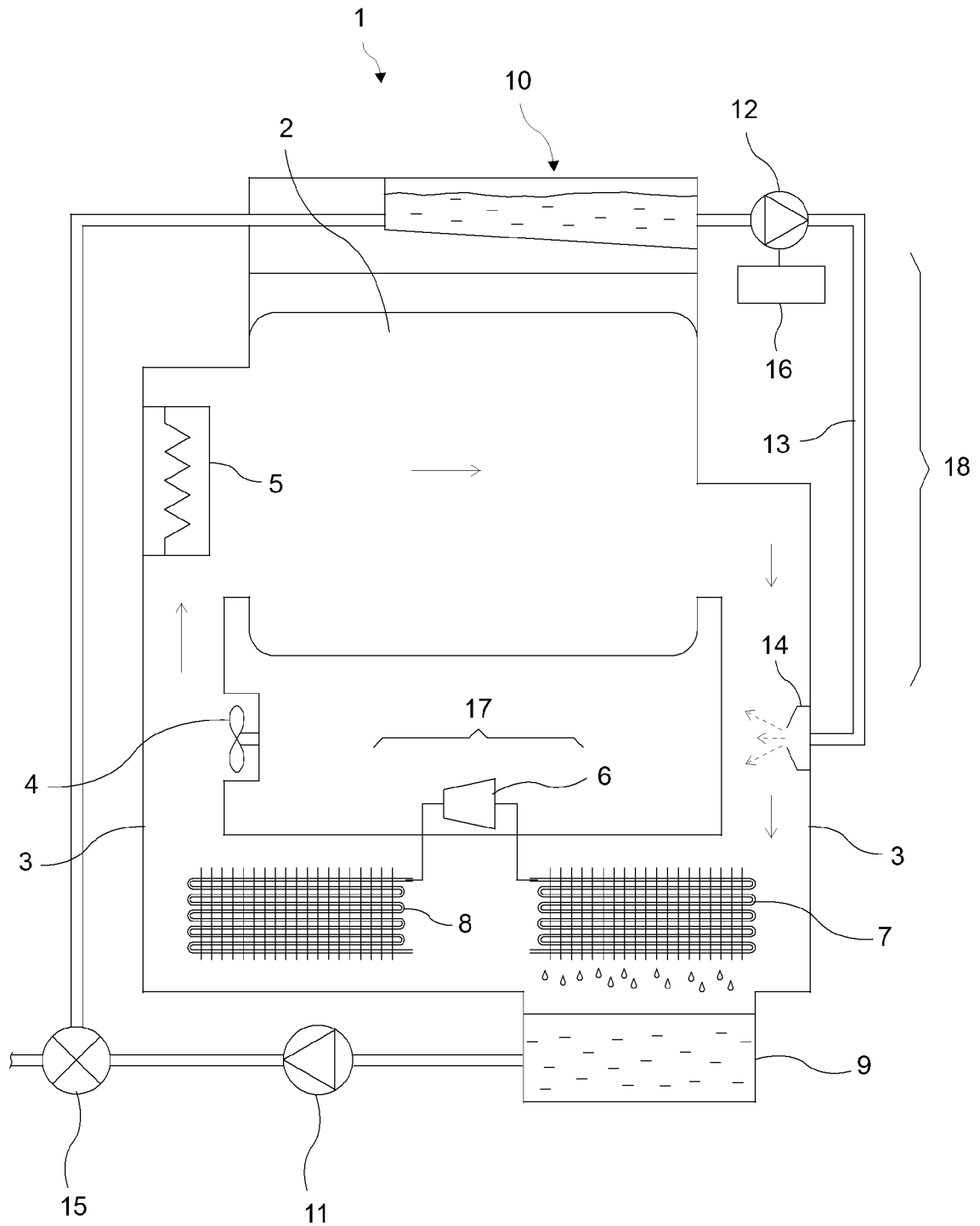
2. - Ein Wäschetrockner (1) wie in Anspruch 1 aufgeführt, **ist dadurch gekennzeichnet, dass** ein Ablassventil (15) mit einem Einlass und zwei Auslässen am Auslass der Ablasspumpe (11) angeordnet ist, dass das in der Ablassleitung (9) gesammelte Wasser zum Wassertank (10) leitet, wenn die Wärmepumpe (17) aktiv ist, und dass es ermöglicht, dass dasselbe über den Wasserauslass an die äußere Umgebung abgegeben wird, wenn der Heizer (5) und das Hilfskondensationssystem (18) aktiv sind.
3. - Ein Wäschetrockner (1) wie in Anspruch 1 oder 2 aufgeführt, **ist dadurch gekennzeichnet, dass** das Hilfskondensationssystem (18), das mittels der Düsen (14) Wasser in den Teil des Luftkanals (3) sprüht, der sich in Luftströmungsrichtung vor dem Verdampfer (7) befindet und der der engste Querschnitt des Luftkanals (3) ist.
4. - Ein Wäschetrockner (1) wie in Anspruch 1 oder 2 aufgeführt, **ist dadurch gekennzeichnet, dass** eine Sensoreinheit (16), die elektrisch mit der Versorgungspumpe (12) verbunden ist, die die aus dem Wassertank (10) in den Luftkanal (3) gepumpte Wassermenge durch Messung des von der Versorgungspumpe (12) entnommenen Stroms bestimmt, und eine Steuereinheit, die dafür sorgt, dass das Hilfskondensationssystem (18) deaktiviert und die Wärmepumpe (17) aktiviert wird, wenn das Wasser im Wassertank (10) verbraucht ist.

## Revendications

1. - Un sèche-linge (1) **comprenant** un tambour (2) dans lequel le linge à sécher est chargé ; un conduit d'air (3) dans lequel le cycle de traitement de l'air est effectué ; un ventilateur (4) assurant la circulation de l'air de traitement ; un chauffage (5) qui est disposé dans le conduit d'air (3) à l'entrée du tambour (2) ; un compresseur (6), un évaporateur (7), un condenseur (8) et un conduit de décharge (9) dans lequel l'eau condensée dans l'évaporateur (7) est collectée, formant ensemble la pompe à chaleur (17) ; un réservoir d'eau (10) qui reçoit le condensat et qui est vidé par l'utilisateur ; et une pompe de décharge (11) qui pompe l'eau dans le conduit de décharge (9) dans le réservoir d'eau (10), **caractérisé par**
  - un système de condensation auxiliaire (18) comprenant une pompe d'alimentation (12) qui transporte le condensat collecté dans le réservoir d'eau (10) vers le conduit d'air (3), un tube de connexion (13) et au moins une buse (14) qui est connectée à l'extrémité du tube de connexion (13), qui s'étend dans le conduit d'air (3) et qui pulvérise l'eau prélevée dans le réservoir d'eau (10) dans le conduit d'air (3), le système de condensation auxiliaire (18) étant utilisé pour déshumidifier l'air de traitement dans un processus de séchage où la pompe à chaleur (17) n'est pas activée et seul le chauffage (5) est actionné, assurant ainsi le séchage du linge.
  
2. - Un sèche-linge (1) tel que revendiqué dans la revendication 1, **caractérisé par** une vanne de décharge (15) avec une entrée et deux sorties qui est disposée à la sortie de la pompe de décharge (11), qui guide l'eau collectée dans le conduit de décharge (9) vers le réservoir d'eau (10) lorsque la pompe à chaleur (17) est active et qui permet la même d'être évacuée via la sortie d'eau vers l'environnement extérieur lorsque le chauffage (5) et le système de condensation auxiliaire (18) sont actifs.
  
3. - Un sèche-linge (1) tel que revendiqué dans la revendication 1 ou 2, **caractérisé par** le système de condensation auxiliaire (18) qui pulvérise de l'eau au moyen des buses (14) dans la partie du conduit d'air (3) qui se trouve avant l'évaporateur (7) dans le sens de l'écoulement d'air et qui est la section transversale la plus étroite du conduit d'air (3).
  
4. - Un sèche-linge (1) tel que revendiqué dans la revendication 1 ou 2, **caractérisé par** une unité de capteur (16) qui est électriquement connectée à la pompe d'alimentation (12), qui détermine la quantité d'eau pompée du réservoir d'eau (10) dans le conduit d'air (3) en mesurant le courant prélevé par la pompe d'alimentation (12), et une unité de comman-

de qui assure que le système de condensation auxiliaire (18) est désactivé et que la pompe à chaleur (17) est activée lorsque l'eau dans le réservoir d'eau (10) est épuisée.

Figure 1



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- EP 2392717 B1 **[0003]**
- EP 3246456 A1 **[0004]**
- EP 2796614 A1 **[0005]**
- EP 1550829 A1 **[0006]**