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(54) **Laundry dryer with temperature-controlled supplementary compartment and method for drying in this compartment**

Wäschetrockner mit einem temperaturgesteuerten zusätzlichen Trocknungsschrank und Verfahren zur Trocknung in diesem Trocknungsschrank

Sèche-linge avec compartiment supplémentaire à température contrôlée et procédé pour sécher dans ce compartiment

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EP 1 990 464 B1

Description

[0001] The present invention relates to a laundry drying machine in which a flow of drying air is made to circulate in a closed path which comprises an electric fan for driving the said flow, a drum containing the washing to be dried with the corresponding loading door in the closed position, a detector of the moisture level of the flow, a battery of heaters for heating the flow of air, and a condenser for removing from the flow the moisture absorbed in its passage through the washing in the drum, and in which a flow of cooling air for the condenser is guided in a passage which has a first opening for the intake of the air and a second opening for discharge, both openings being in communication with the environment outside the drying machine, and which has a portion which passes through the said condenser, means for controlling the rate of flow of the cooling air flowing into the passage, and electric fan means for generating and propagating the flow in the said passage, the said laundry drying machine including at least one supplementary drying compartment incorporated in the circuit of the said cooling air flow and placed in a portion between the said condenser and the opening for discharge into the environment outside the machine.

[0002] In the prior art, a constant internal temperature is maintained in the supplementary compartment through which the cooling air flow passes after it has passed through the demoisturizing exchanger.

[0003] This compartment is therefore particularly useful for drying delicate or very delicate washing which requires no ironing, or very little ironing, but it is not so suitable for drying washing which needs to be ironed with the use of steam or adequate moisturizing.

[0004] Document US-A-2006 0137206 describes a laundry drying machine according to the preamble of claim 1.

[0005] The object of the present invention is therefore to increase the number of drying modes of the supplementary compartment of the laundry drying machine whose characteristics have been indicated in the preamble.

[0006] This and other objects which will be made clearer in the following description are achieved by the equipment according to Claim 1 and by a method according to Claim 5.

[0007] The features and advantages of the present invention will be made clearer by the following detailed description of an example of its application, with reference to the attached drawings in which:

- Figure 1 shows in a schematic way the equipment according to the invention;
- Figure 2 shows the variation of the drying air temperature as a function of time, and shows the region in which part of the flow is collected for injection into the supplementary drying compartment.

[0008] With reference to the aforesaid Figure 1, the number 1 indicates schematically the drum of a laundry drying machine M which can be of the static or rotary type. In a conventional way, the drum 1 is provided with a door (not shown) for loading the washing to be dried and for hermetically sealing the drum during the operation of the machine.

[0009] The drum 1 is included in a closed circuit formed by the portions of a passage 2 for the drying air, comprising a conventional filter 3, a heat exchanger 4 of the air/air type which condenses the moisture carried by the drying air flow, an electric fan 5 for circulating the air flow in the circuit, and a heater 6 of the conventional electrical resistance type, positioned, for example, immediately upstream of the drum 1.

[0010] The drying air flow circulates in the direction of the arrows F1 in Figure 1.

[0011] According to the invention, the equipment comprises a further circuit, formed by portions of passage 7 dedicated to the flow of the cooling air. This further circuit is provided with an opening 8 for the intake of air from the environment of the laundry drying machine, with members 9 for controlling the rate of the flow, with an electric fan 10 for generating and propagating the flow in the passages 7, and with an opening 11 for discharging the air again towards the environment of the machine.

[0012] The circuit formed by the passages 7 has a portion 7a which passes in a conventional way through the condensation exchanger 4, in such a way that the external heat exchange surface of the exchanger is contacted by the flow of cooling air whose direction of circulation is indicated by the arrows F2 in Figure 1.

[0013] The condensate which is formed in the condenser 4 as a result of the cooling flows in a conventional way into a collecting vessel 12 connected to the condenser 4 by a passage 12a.

[0014] Both the air intake opening 8 and the discharge opening 11 are positioned on the laundry drying machine M in positions spaced apart from each other and preferably in opposing positions, in the sense that, if the intake opening 8 is located on the front part of the machine, the discharge opening 11 is preferably positioned in the rear part.

[0015] Although the cooling air flow control member 9 is shown in Figure 1 in a position between the intake opening 8 and the electric fan 10, it can alternatively be placed in another position in the circuit formed by the passages 7, and particularly in the proximity of the discharge opening 11.

[0016] According to the invention, the laundry drying machine M has a supplementary compartment S, generally placed beside the main body of the machine. This supplementary compartment S is intended for drying delicate washing which does not need to be ironed, or alternatively, as explained in the following description, for drying items of washing for which ironing is preferably preceded by a suitable stage of moisturizing as in the case of steam ironing.

[0017] According to the invention, therefore, the passage 7 is provided with a switching valve 7c, by means of which the cooling air flow does not proceed directly towards the discharge 11, but is diverted into the portion 7d which opens into the supplementary compartment S from which it passes out through the opening shown schematically at 11a, following the path indicated by the arrows F3.

[0018] The laundry drying machine M is also provided with a supplementary passage 13 which runs through a valve 14 and opens into the supplementary compartment S with an aperture shown schematically at 15. This passage 13 connects the passage 2, immediately downstream of a moisture sensor 16 and upstream of the heat exchanger 4, with the inside of the supplementary compartment S.

[0019] When the valve 14, which can also be of the flow rate control type, is opened, a predetermined quantity of moist hot air from the drum 1 is injected into the supplementary compartment S and thus moisturizes the washing placed in the said compartment, causing the washing to have an adequate moisture level for ironing. The flow passes out of the compartment S through the aforementioned opening 11a.

[0020] Clearly, when a flow of hot moist air is supplied through the passage 13 to the supplementary compartment S, the cooling air flow from the passage 7d is normally diverted directly to the external environment by the diversion valve 7c through the opening 11. However, in specific cases, depending on the type of washing placed for drying in the supplementary compartment S, the supply of the cooling air flow, which has a moderate temperature because of its passage through the heat exchanger 4, can continue, although with a limited flow rate, in order to optimize the moisture content of the washing to be ironed at the end of the drying operation.

[0021] For this purpose, both the valve 7c and the valve 14 are controlled by an electronic programming and control unit 17, which also sets the member 9 to various degrees of opening between the closed position and the fully open position, according to an operating program provided and stored in the unit, and also according to the values of temperature and the level of moisture in the drying air flow detected by the conventional detector 16 placed in a portion of passage 2, for example immediately upstream of the exchanger 4.

[0022] The said programming and control unit 17 can also control the operation, stopping and speed of the electric fan 10, as an alternative to the control member 9, or in conjunction with it.

[0023] Additionally, the said programming and control unit 17 also determines the setting of the heater 6 so as to provide the drying air flow with any heat required for correct operation.

[0024] It is clear from the above description that the operation of the equipment includes the possibility of modulating the rate of the cooling flow directed into the supplementary compartment S, or interrupting it completely by diverting it to the outside of the machine, or finally the possibility of supplying the said supplementary compartment S, simultaneously or alternatively, with hot moist air taken from the passage 2 of the drying flow at the point where this flow has the highest moisture level.

[0025] The rate of this last-mentioned flow can also be controlled by means of the control valve 14.

[0026] The flow of hot moist air to the supplementary compartment S is supplied at suitable points in the machine cycle, preferably in the form of a pulsed supply controlled by a sequence of opening and closing of the valve 14.

[0027] In particular, according to a preferred aspect of the invention, the flow of hot moist air from the passage 2 is taken, as shown in Figure 2, after the drying air present in the drum 1 and in the circuit associated therewith has been brought to the specified temperature Tf from the ambient temperature Ta, and therefore after sufficient heat has been supplied by means of the heater 6.

[0028] When the temperature of the moist air flow present in the passage 2 is considered to be appropriate, and particularly when the air contains a high proportion of vapour due to the evaporation of the water contained in the wet washing placed in the drum 1, the programming and control unit 17 acts on the valve 14 to cause a series of opening and closing operations according to a cycle of programmed duration.

[0029] As shown in the graph in Figure 2, the supply of the flow of hot moist air to the supplementary compartment S, established by the control and programming unit 17, starts when the moist air flow is at the appropriate temperature Tf, equal to about 65°C, and takes place in a programmed number of predetermined time intervals t1, t2, ... tn of equal or different lengths, during one or more cycles, according to the drying conditions that are required in the supplementary compartment S.

[0030] These time intervals t1, t2, ... tn and their number are clearly dependent on the type of washing load placed in the supplementary compartment S, and also on the weight of the whole structure of the drying machine.

[0031] Preferably, but not necessarily, the supplementary compartment S is put into operation by a dedicated program which can terminate independently of the duration of the washing cycle taking place in the drum of the machine.

[0032] It will be clear from the above description that the laundry drying machine according to the invention makes it possible to carry out different kinds of drying in the supplementary compartment S, ranging from a condition of dry washing which does not require subsequent ironing to that of washing with a moisture level suitable for ironing, without necessarily making use of steam ironing.

[0033] Clearly, other variant embodiments, in addition to those described and illustrated, can be provided by those skilled in the art, without thereby departing from the scope of the present invention as claimed below.

Claims

1. Laundry drying machine (M) in which a flow of drying air is made to circulate in a closed path (2) which comprises an electric fan (5) for moving the said flow, a drum (1) containing the washing to be dried with a corresponding loading door in the closed position, a battery (6) of heaters for heating the flow of air, a condenser (4) for removing from the flow the moisture absorbed in its passage through the washing in the drum, and in which a flow of cooling air for the condenser (4) is guided in a passage (7) which has a first opening (8) for the intake of the air and a second opening (11) for discharge, both openings being in communication with the environment outside the drying machine, and which has a portion (7a) which passes through the said condenser (4), means (9) for controlling the rate of flow into the passage (7), and electric fan means (10) for generating and propagating the flow in the said passage (7), the said laundry drying machine (M) including at least one supplementary drying compartment (S), **characterized in that** the said supplementary compartment (S) is provided with a passage (13) connecting its interior with a point on the path (2) of the moist air flow from the drum (1) positioned upstream of the said condenser (4), the said passage (13) being provided with valve means (14) for shutting off the flow.

2. Laundry drying machine according to Claim 1, **characterized in that** the said supplementary compartment (S) is incorporated in the circuit (7) of the said cooling air flow, being placed in a portion between the said condenser (4) and the opening (11a) for discharge into the environment outside the machine, the said circuit comprising means (7c) for diverting the said flow outside the said supplementary compartment (S) when commanded to do so.

3. Laundry drying machine according to Claims 1 and 2, **characterized in that** it includes a control and programming unit (17) for operating the said diversion means (7c) and for causing the opening and closing of the said valve means (14) for shutting off the flow of hot moist air for periods of opening and closing, each of which periods has a predetermined and programmed duration.

4. Laundry drying machine according to any one of Claims 1 to 3, **characterized in that** the said valve means (14) for shutting off the flow of hot moist air are made operational by the said control and programming unit (17) as a result of a signal supplied by a detector (16) of the level of moisture present in the drying flow.

5. Method of drying washing in the supplementary compartment (S) of the laundry drying machine (M) according to claim 1, comprising the stage of supplying to the said supplementary compartment (S) a portion of the flow of hot moist drying air from the drum (1) of the machine (M) for time intervals (t1, t2, ... tn) of predetermined duration, the said portion of the flow being taken after the flow has been brought to a predetermined value of temperature and moisture by the provision of heat.

6. Method of drying washing according to Claim 5, **characterized in that** the supplementary compartment S is made operational by means of a dedicated program which can terminate independently of the duration of the drying cycle which takes place in the drum of the machine.

Patentansprüche

1. Wäschetrockner (M), in welchem ein Strom von Trocknungsluft dazu gebracht wird, in einem geschlossenen Weg (2) zu zirkulieren, umfassend einen elektrischen Ventilator (5) zum Bewegen des Stroms, eine Trommel (1), die die zu trocknende Wäsche enthält, wenn eine entsprechende Beladungstür in der geschlossenen Position ist, eine Gruppe (6) von Heizvorrichtungen zum Erwärmen des Luftstroms, einem Kondensator (4) zum Entfernen der Feuchtigkeit aus dem Strom, die während seines Durchgangs durch die Wäsche in der Trommel absorbiert wurde, wobei ein Strom von Kühlluft für den Kondensator (4) in einem Kanal (7) geführt ist, der eine erste Öffnung (8) für das Ansaugen der Luft und eine zweite Öffnung (11) zum Auslassen besitzt, wobei beide Öffnungen mit der Umgebung außerhalb des Trockners in Verbindung stehen, und der einen Abschnitt (7a), der durch den Kondensator (4) durchläuft, Mittel (9) zum Steuern der Flußrate in dem Kanal (7) und elektrische Ventilatormittel (10) zum Erzeugen und Vorantreiben des Stroms in dem Kanal (7) besitzt, wobei der Wäschetrockner (M) wenigstens eine zusätzliche Trocknungskammer (S) umfaßt, **dadurch gekennzeichnet, daß** die zusätzliche Trocknungskammer (S) mit einem Kanal (13) versehen ist, der ihre Innenseite mit einer Stelle an dem Weg (2) des feuchten Luftstroms aus der Trommel (1) stromaufwärts des Kondensators (4) verbindet, wobei der Kanal (13) mit Ventilmitteln (14) zum Ausschließen des Stroms versehen ist.

2. Wäschetrockner nach Anspruch 1, **dadurch gekennzeichnet, daß** die zusätzliche Kammer (S) in den strecke (7) des Kühlluftstroms eingebunden und in einem Abschnitt zwischen dem Kondensator (4) und der Öffnung (11a) zum Auslassen in die Umgebung außerhalb des Trockners angeordnet ist, wobei der Kanal Mittel (7c) umfaßt, um den Strom außerhalb der zusätzlichen Kammer (S) umzuleiten,

wenn sie einen Befehl dazu erhalten.

3. Wäschetrockner nach Anspruch 1 und 2, **dadurch gekennzeichnet, daß** er eine Steuer- und Programmiereinheit (17) zum Betreiben der Mittel (7c) zum Umleiten und zum Hervorrufen des Öffnens und Schließens der Ventilmittel (14) zum Ausschließen des Stromes von warmer feuchter Luft für Öffnungs- und Schließzeiträume umfaßt, wobei jeder Zeitraum eine vorbestimmte und programmierte Länge besitzt.

4. Wäschetrockner nach einen der Ansprüche 1 - 3, **dadurch gekennzeichnet, daß** die Ventilmittel (14) zum Ausschließen des Stromes von warmer feuchter Luft durch die Steuer- und Programmiereinheit (17) in Antwort auf ein von einem Detektor (16) zugeführtes Signal der in dem Trocknungsstrom vorhandenen Feuchtigkeitshöhe betätigt werden.

5. Verfahren zum Trocknen von Wäsche in der zusätzlichen Kammer (S) des Wäschetrockners (M) gemäß Anspruch 1, umfassend den Schritt des Zuführens eines Anteils des Stroms warmer feuchter Trocknungsluft aus der Trommel (1) des Trockners (M) für Zeitintervalle (t1, t2, ..., tn) vorbestimmter Länge zu der zusätzlichen Kammer (S), wobei der Anteil des Stroms abgezweigt wird, nachdem der Strom auf einen vorbestimmten Wert von Temperatur und Feuchtigkeit durch Zuführung von Wärme gebracht wurde.

6. Verfahren zum Trocknen von Wäsche gemäß Anspruch 5, **dadurch gekennzeichnet, daß** die zusätzliche Kammer (S) mittels eines dedizierten Programms betrieben wird, das unabhängig von der Länge eines Trocknungsganges, der in der Trommel des Trockners stattfindet, stoppen kann.

Revendications

1. Sèche-linge (M) dans lequel un courant d'air de séchage est amené à circuler suivant une trajectoire fermée (2), comprenant un ventilateur électrique (5) pour déplacer ledit courant, un tambour (1) qui, en position fermée d'une porte associée de chargement, contient le linge à sécher, un groupe (6) de dispositifs de chauffage pour chauffer le courant d'air, un condenseur (4) pour enlever du courant l'humidité qui a été absorbée par celui-ci en traversant le linge dans ledit tambour, un courant d'air de refroidissement pour le condenseur (4) est guidé dans un passage (7) lequel présente une première ouverture (8) d'aspiration de l'air et une seconde ouverture (11) d'évacuation, les deux ouvertures communiquant avec l'environnement à l'extérieur du sèche-linge, et lequel présente une portion (7a) qui passe à travers ledit condenseur (4), des moyens (9) pour commander le débit du courant dans le passage (7) ainsi que des moyens électriques formant ventilateur (10) pour la génération et l'acheminement du courant dans ledit passage (7), ledit sèche-linge (M) comprenant au moins un compartiment supplémentaire de séchage (S), **caractérisé par le fait que** ledit compartiment supplémentaire de séchage (S) est pourvu d'un passage (13) qui relie l'intérieur de celui-ci à un point sur la trajectoire (2) du courant d'air humide provenant du tambour (1) positionné en amont dudit condenseur (4), ledit passage (13) étant pourvu de moyens formant vanne (14) pour arrêter le courant.

2. Sèche-linge selon la revendication 1, **caractérisé par le fait que** ledit compartiment supplémentaire (S) est incorporé dans le circuit (7) du courant d'air de refroidissement et est disposé dans une section entre ledit condenseur (4) et l'ouverture (11a) d'évacuation dans l'environnement à l'extérieur du sèche-linge, ledit passage comprenant des moyens (7c) pour dériver le courant à l'extérieur dudit compartiment supplémentaire (S) lorsqu'ils sont incités à y procéder.

3. Sèche-linge selon la revendication 1 et 2, **caractérisé par le fait qu'**il comprend une unité de commande et de programmation (17) pour commander les moyens de dérivation (7c) et pour provoquer l'ouverture et la fermeture des moyens formant vanne (14) pour arrêter le courant d'air chaud humide pour des périodes d'ouverture et de fermeture, chaque période ayant une durée prédéterminée et programmée.

4. Sèche-linge selon l'une quelconque des revendications 1 à 3, **caractérisé par le fait que** lesdits moyens formant vanne (14) pour arrêter le courant d'air chaud humide sont commandés par ladite unité de commande et de programmation (17) en réponse à un signal fourni par un détecteur (16) du niveau d'humidité existant dans le courant de séchage.

5. Procédé de séchage de linge dans le compartiment supplémentaire (S) du sèche-linge (M) selon la revendication 1, comprenant l'étape d'alimentation dudit compartiment supplémentaire (S) en une portion du courant d'air chaud humide de séchage en provenance du tambour (1) du sèche-linge (M), pour des intervalles de temps (t1, t2, ..., tn) de durée prédéterminée, la portion du courant étant prélevée après que l'on avait fait passer le courant à une valeur prédéterminée de température et d'humidité par une adduction de chaleur.

6. Procédé de séchage de linge selon la revendication 5, **caractérisé par le fait que** ledit compartiment

supplémentaire (S) est opéré au moyen d'un programme dédié qui peut arrêter indépendamment de la durée d'un cycle de séchage qui a lieu dans le tambour du sèche-linge.

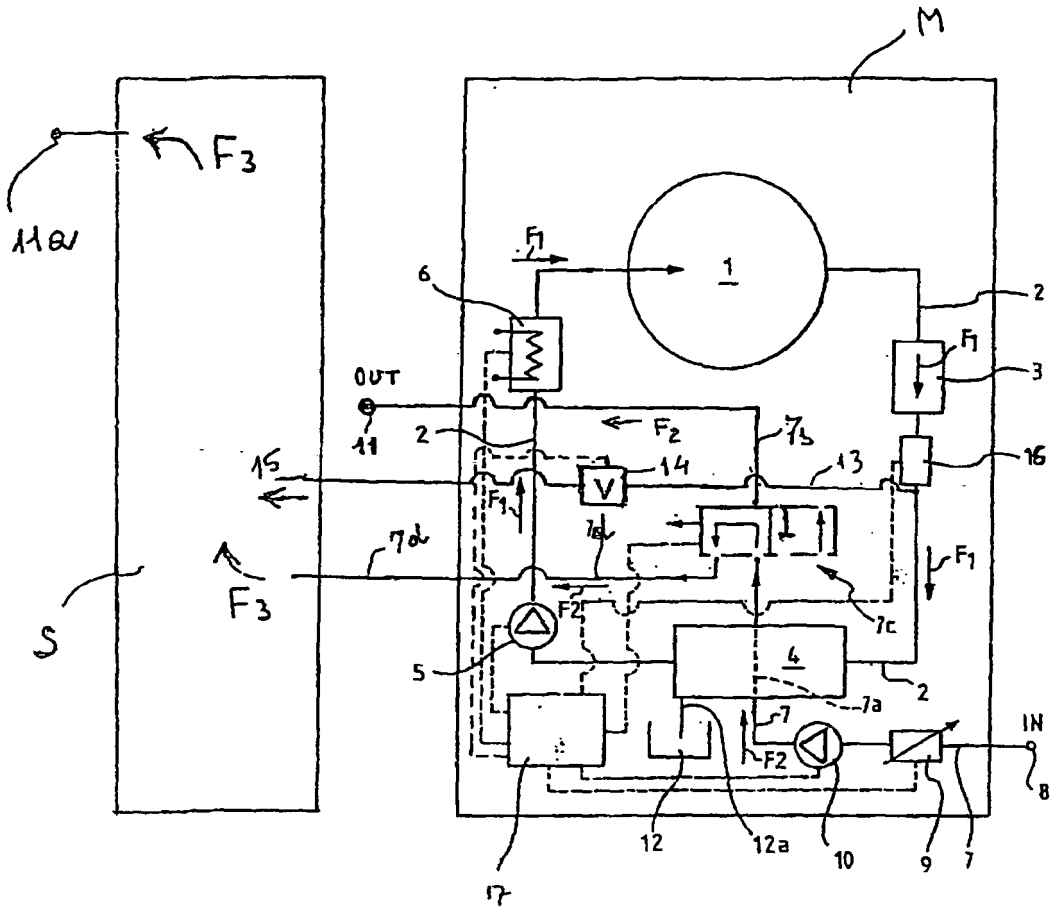

M
F3
11a
F1
1
6
2
F1
3
OUT
11
2
F2
7b
16
15
14
13
V
F1
7d
F1
F3
S
F2
7c
5
4
2
7a
7
IN
F2
8
12
12a
10
9
7
17

Fig. 1

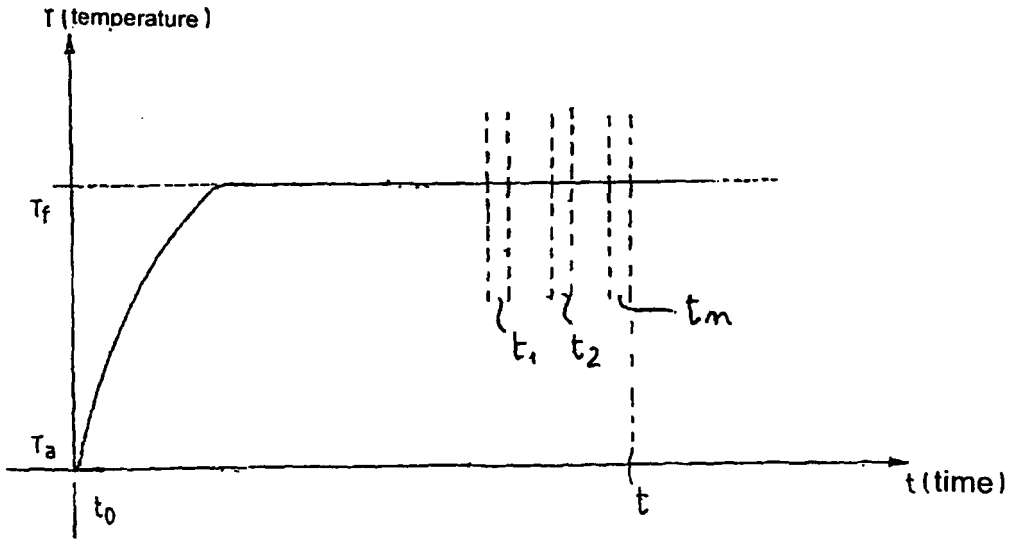

T (temperature)
Tf
Ta
t0
t1
t2
tm
t
t (time)

Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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