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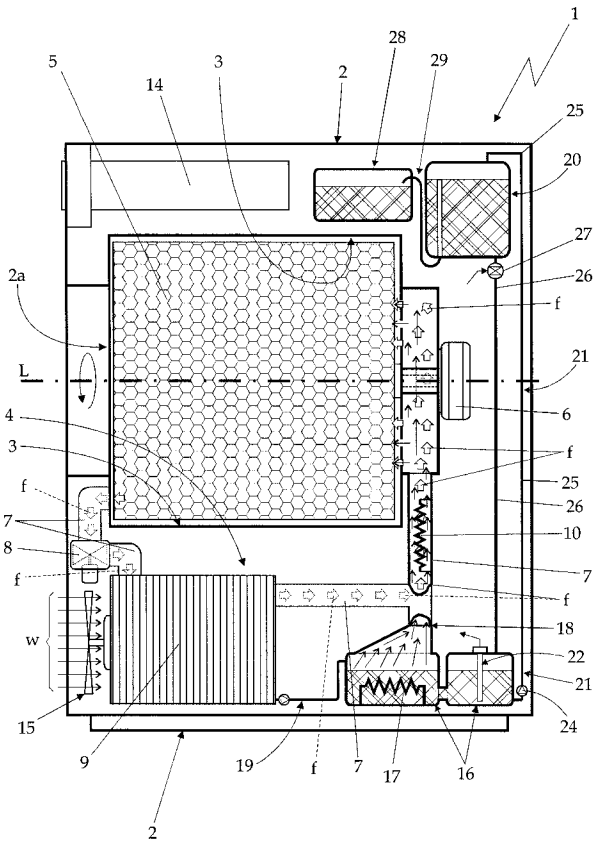
(54) Home laundry drier

(57) A home laundry drier (1) having a drying tub (3) for housing the laundry to be dried, and a closed-circuit, hot-air generator (4) for circulating a stream of hot air into the drying tub (3). The hot-air generator (4) has a tank (16) containing a predetermined amount of water; an auxiliary heater (17) for converting the water in the tank (16) to steam; and a steam exhaust manifold (18) which communicates with the air recirculating conduit (7), between the condenser (9) and the main heater (10) of the hot-air generator (4), to feed the steam produced in the tank (16) into the drying tub (3) via the end portion of the air recirculating conduit (7).



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Description

[0001] The present invention relates to a home laundry drier.

[0002] More specifically, the present invention relates to a rotary-drum home laundry drier, to which the following description refers purely by way of example.

[0003] As is known, rotary-drum laundry driers substantially comprise a substantially parallelepiped-shaped outer box casing; a cylindrical laundry drying tub fixed horizontally inside the casing, directly facing a laundry loading and unloading opening formed in the front face of the casing; a door hinged to the front face of the casing to rotate to and from a work position closing the opening in the front face to seal the cylindrical tub; a cylindrical, perforated-wall, laundry drum housed in axially rotating manner inside the drying tub; and an electric motor for rotating the laundry drum about its longitudinal axis inside the drying tub.

[0004] Rotary-drum laundry driers of the above type also comprise a closed-circuit, hot-air generator designed to circulate inside the drying tub a stream of hot air with a low moisture level and which flows through the laundry drum and over the laundry inside the drum to rapidly dry the laundry.

[0005] In the most widely marketed driers, the closed-circuit, hot-air generator comprises an air/air heat exchanger and an electric heater located one after the other along an air recirculating conduit, the two ends of which are connected to the drying tub, on opposite sides of the laundry drum. The air/air heat exchanger provides for rapidly cooling the airflow from the drying tub to condense the surplus moisture in the airflow; and the heater provides for rapidly heating the airflow from the heat exchanger back to the drying tub, so that the air flowing into the drying tub is heated rapidly to a temperature higher than or equal to that of the same air flowing out of the drying tub.

[0006] Some more recently marketed rotary-drum driers also feature a pressurized-steam generator which, at the end of the drying cycle, feeds a jet of steam into the drying tub to eliminate or at least greatly reduce creasing of the fabrics during the drying cycle.

[0007] Unfortunately, the steam generators currently used in driers have substantially the same structure as ordinary irons with a separate boiler, and so have all the drawbacks typically associated with them : first and foremost, compulsory use of demineralized water in the boiler to prevent the formation of lime scale, which could impair operation of the steam generator.

[0008] In addition, tests show that, to cover all the laundry inside the drum, the steam jet must be injected into the drying tub at relatively high pressure and temperature, which are potentially dangerous to the laundry items closest to the nozzle injecting the steam jet into the tub.

[0009] Moreover, boilers capable of producing steam at the pressure and temperature demanded for use in driers are extremely expensive, and so greatly increase the overall manufacturing cost of the drier.

[0010] It is an object of the present invention to provide a home laundry drier comprising a steam generator, which is gentler on the fabrics inside the drying tub, and which is also cheaper than those currently used for the purpose.

[0011] According to the present invention, there is provided a home laundry drier as claimed in Claim 1 and preferably, though not necessarily, in any one of the Claims depending directly or indirectly on Claim 1.

[0012] The present invention will be described with reference to the attached drawing, which shows a side view, with parts in section and parts removed for clarity, of a home laundry drier in accordance with the teachings of the present invention.

[0013] Number 1 in the attached drawing indicates as a whole a home laundry drier substantially comprising a preferably, though not necessarily, parallelepiped-shaped outer box casing 2; an airtight, preferably, though not necessarily, cylindrical laundry drying tub or chamber 3 for housing the laundry to be dried, and which is fixed substantially horizontally inside casing 2, directly facing a laundry loading and unloading opening 2a formed in the front face of casing 2; a door (not shown) hinged to the front face of casing 2 to rotate to and from a work position closing opening 2a in the front face to seal the laundry drying tub 3; and a closed-circuit, hot-air generator 4 housed inside casing 2 and designed to circulate inside drying tub 3 a stream of hot air having a low moisture level, and which flows over and rapidly dries the laundry inside the tub.

[0014] Drier 1 preferably, though not necessarily, also comprises a preferably, though not necessarily, cylindrical laundry drum 5 for housing the laundry to be dried, and which has perforated walls, or at least walls permeable to air, and is housed in axially rotating manner and preferably, though not necessarily, horizontally inside drying tub 3; and an electric motor 6 or similar, for rotating laundry drum 5 about its longitudinal axis L inside drying tub 3. In the example shown, longitudinal axis L coincides with the longitudinal axis of drying tub 3.

[0015] Casing 2, drying tub 3, the door, laundry drum 5, and electric motor 6 are commonly known parts in the industry, and therefore not described in detail.

[0016] With reference to the attached drawing, closed-circuit, hot-air generator 4 provides for gradually drawing air from drying tub 3; extracting surplus moisture from the hot air drawn from drying tub 3; heating the dehumidified air to a predetermined temperature, normally higher than the temperature of the air from drying tub 3; and feeding the heated, dehumidified air back into drying tub 3, where it flows over, to rapidly dry, the laundry inside the tub.

[0017] In other words, hot-air generator 4 provides for continually dehumidifying and heating the air circulating inside drying tub 3 to rapidly dry the laundry inside the tub, and substantially comprises:

an air recirculating conduit 7, the two ends of which are connected to drying tub 3 preferably, though not necessarily, on opposite sides of laundry drum 5;

an electric centrifugal fan 8, or other type of air circulating pump, located along recirculating conduit 7 to produce, inside recirculating conduit 7, an airflow f, which flows into drying tub 3 and over the laundry inside the tub;

an air/air heat exchanger 9 - commonly referred to as a condenser - which is located along recirculating conduit 7 so that the airflow f from drying tub 3 and a cold airflow w from outside casing 2 flow through it simultaneously, and which is designed so that the cold airflow w rapidly cools the airflow f from drying tub 3 to condense the surplus moisture inside airflow f; and

an electric heater 10 (in the example shown, a resistor) located along recirculating conduit 7, downstream from heat exchanger 9, and which provides for rapidly heating the airflow f from heat exchanger 9 back to drying tub 3, so that the air flowing into drying tub 3 is heated rapidly to a temperature preferably, though not necessarily, higher than or equal to that of the same air flowing out of drying tub 3.

[0018] Like any other recently marketed electric household appliance, drier 1 also comprises an electronic central control unit 14, which controls electric motor 6, fan 8, heat exchanger 9 (or, rather, the cooling fan 15 of heat exchanger 9, which generates cold airflow w through the exchanger) and heater 10 in predetermined manner, as memorized inside it, to perform the user-selected drying cycle.

[0019] Unlike known closed-circuit, hot-air generators, hot-air generator 4 also comprises a water tank 16 containing a predetermined amount of preferably, though not necessarily, demineralized water; an electric heater 17 (in the example shown, a resistor) housed inside tank 16 to boil and convert the water inside tank 16 to steam; and a steam exhaust manifold 18 connected to recirculating conduit 7 preferably, though not necessarily, upstream from heater 10 to feed the steam produced in tank 16 to drying tub 3 via the end portion of recirculating conduit 7.

[0020] More specifically, in the example shown, steam exhaust manifold 18 defines, with the end portion of recirculating conduit 7, a straight, substantially vertical portion, which feeds the steam produced in tank 16 to drying tub 3 by exploiting the flue effect produced by the lower density of the hot air produced at heater 10.

[0021] Electronic central control unit 14 obviously controls heater 17 and the other component parts of hot-air generator 4, such as fan 8 and/or fan 15 of heat exchanger 9, so as to only feed steam into drying tub 3 when required, and possibly also regulate the amount of steam produced as a function of the selected drying cycle.

[0022] With reference to the attached drawing, hot-air generator 4 preferably, though not necessarily, also comprises a process water recovery circuit 19, which, under the control of electronic central control unit 14, extracts the liquid distilled water produced, when the drier is running, at the bottom of heat exchanger 9 by condensation of the surplus moisture in airflow f from drying tub 3, and feeds the distilled water to tank 16 for use in producing steam.

[0023] In the example shown, process water recovery circuit 19 is defined by an electric pump, the intake side of which is connected to the bottom of heat exchanger 9 by a first connecting pipe, and the delivery side of which is connected to tank 16 by a second connecting pipe.

[0024] Alternatively, the bottom of heat exchanger 9 may be higher than tank 16, and process water recovery circuit 19 is defined by a connecting pipe connecting the two components directly, so that the distilled water flows directly by force of gravity into tank 16. In which case, tank 16 therefore also acts as a catch vessel for the distilled water produced by condensing the surplus moisture in airflow f from drying tub 3.

[0025] Finally, in the example shown, hot-air generator 4 also comprises an auxiliary water tank 20 placed inside casing 2 above tank 16, and a water draining circuit 21 which, under the control of electronic central control unit 14, drains the water from tank 16 to tank 20 so as to adjust the level of distilled water inside tank 16.

[0026] More in details, hot-air generator 4 is provided with a water level sensor 22 located inside tank 16 and connected to central control unit 14, whereas water exhaust circuit 21 comprises an electric pump 24 having its intake side in direct communication with the bottom of tank 16, and a first connecting pipe 25 which connects the delivery side of pump 24 directly to tank 20. Central control unit 14 switches on and off the electric pump 24 on the basis of the signals received by the water level sensor 22.

[0027] Preferably, though not necessarily, water exhaust circuit 21 also comprises a second connecting pipe 26 which connects the bottom of tank 20 to the tank 16 down below, and an electric actuated valve 27 which is placed along the connecting pipe 26 and controls the outflow of the water from tank 20 to tank 16. In this case, central control unit 14 is also capable of opening and closing valve 27 on the basis of the signals received by the water level sensor 22

[0028] More in details, central control unit 14 switches on pump 24 when the water level inside tank 16 exceeds a predefined upper threshold value, and opens the electric actuated valve 27 to feed the water again into tank 16 when the water level inside tank 16 lowers below a predefined lower threshold value. Obviously, central control unit 14 switches off pump 24 before the water level inside tank 16 lowers below the lower threshold value, and closes the electric actuated valve 27 to stop the flow of distilled water into tank 16 before the water level inside tank 16 exceeds the upper threshold value.

[0029] In other words, under the control of electronic central control unit 14, water draining circuit 21 keeps the level of the distilled water inside tank 16 between the

upper and the lower threshold value so as to avoid overheating of electric heater 17 and overfilling of tank 16.

[0030] With reference to the attached drawing, optionally the water exhaust circuit 21 is also provided with an auxiliary removable water tank 28 which is located inside casing 2 in easy removable manner, and is in communication with tank 20 via a siphon spillway 29 or similar so as to receive the water from tank 20 when the water level inside tank 20 exceeds a predefined upper limit.

[0031] Operation of drier 1 will be clear from the above description, with no further explanation required, other than to state that the steam produced in tank 16 has a temperature of about 100°C, is at ambient pressure, and is fed to drying tub 3 by convection by airflow f.

[0032] Integrating the steam generator in hot-air generator 4 has countless advantages: first and foremost, the availability of a large amount of ambient-pressure steam at roughly 100°C means drying tub 3 can be filled completely at the end of the drying cycle using the airflow f produced by fan 8, and with no risk of singeing the laundry.

[0033] Secondly, hot-air generator 4 uses the moisture condensed in heat exchanger 9 to produce the steam required to eliminate, or at least greatly reduce, creasing of the fabrics during the drying cycle, thus saving the user the inconvenience of periodically filling tank 16 with distilled/demineralized water.

[0034] Moreover, the vertical portion defined by exhaust manifold 18 and the end portion of recirculating conduit 7 provides for feeding back into tank 16 the steam droplets condensed on the walls of recirculating conduit 7 when feeding the steam into drying tub 3, with all the advantages this entails in terms of process efficiency.

[0035] Clearly, changes may be made to laundry drier 1 as described herein without, however, departing from the scope of the present invention.

Claims

1. A home laundry drier (1) comprising a drying tub (3) for housing the laundry to be dried; and a hot-air generator (4) for circulating a stream of hot air into the drying tub (3); the hot-air generator (4) comprising an air recirculating conduit (7) connected at both ends to the drying tub (3), a heat exchanger (9) located along said recirculating conduit (7) to cool the airflow (f) from the drying tub (3) and condense the surplus moisture in said airflow (f), and first heating means (10) located along said recirculating conduit (7) to heat, on command, the airflow (f) flowing out of the heat exchanger (9) and back into the drying tub (3); said laundry drier being **characterized in that** the hot-air generator (4) also comprises a first tank (16) containing a predetermined amount of water; second heating means (17) for converting the water in said first tank (16) to steam; and a steam exhaust manifold (18) communicating with said recirculating conduit (7) to feed the steam produced in the first tank (16) into the drying tub (3) via the end portion of said recirculating conduit (7).

2. A laundry drier as claimed in Claim 1, **characterized in that** said exhaust manifold (18) forms a straight, substantially vertical portion with the end portion of said recirculating conduit (7).

3. A laundry drier as claimed in Claim 1 or 2, **characterized in that** said exhaust manifold (18) is connected to said recirculating conduit (7) upstream from the first heating means (10).

4. A laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said hot-air generator (4) also comprises a process water recovery circuit (19), which extracts the water formed in the heat exchanger (9) by condensation of the surplus moisture in the airflow (f) from the drying tub (3), and feeds said water into said first tank (16) for use in producing steam.

5. A laundry drier as claimed in any one of the foregoing Claims, **characterized by** also comprising a laundry drum (5) for housing the laundry to be dried, and which has walls permeable to air, and is housed in axially rotating manner inside said drying tub (3); and a drive unit (6) for rotating said laundry drum (5) about its longitudinal axis (L) inside the drying tub (3).

6. A laundry drier as claimed in Claim 5, **characterized in that** the two ends of said recirculating conduit (7) are connected to the drying tub (3) on opposite sides of said laundry drum (5).

7. A laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said second heating means (17) are housed inside said first tank (16), and comprise an electric heater (17).

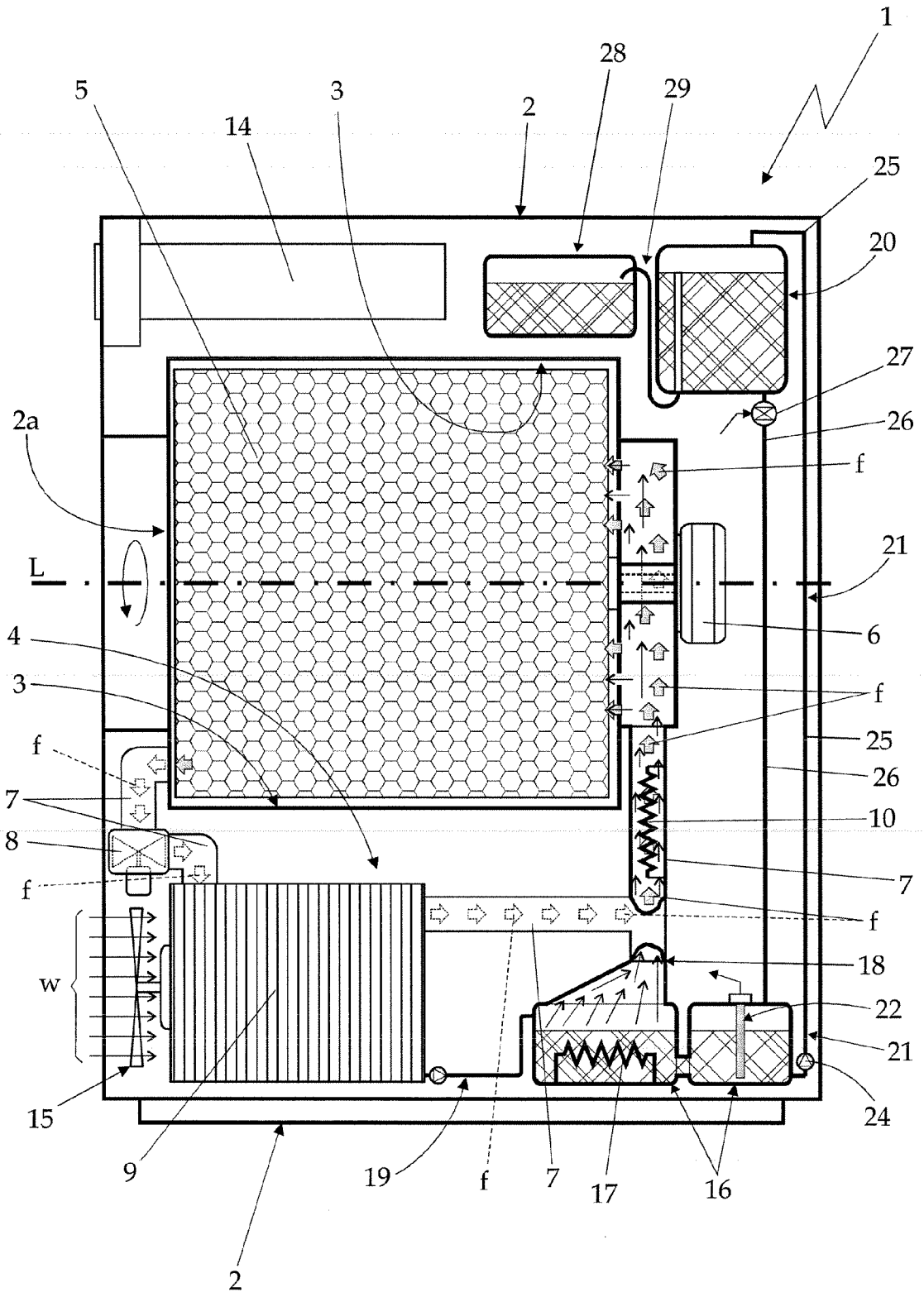
8. A laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said hot-air generator (4) also comprises a second water tank (20) which is placed inside the laundry dyer casing (2) above said first tank (16), and a water draining circuit (21) which is able to drain the water from said first tank (16) to said second tank (20), so as to adjust the water level inside said first tank (16) under the control of an electronic central control unit (14).

9. A laundry drier as claimed in Claim 8, **characterized in that** said hot-air generator (4) is provided with a water level sensor (22) located inside said first tank (16) and connected to said central control unit (14), and **in that** said water exhaust circuit (21) comprises an electric pump (24) having its intake side in direct communication with the bottom of said first tank (16),

and a first connecting pipe (25) which connects the delivery side of the electric pump (24) directly to said second tank (20); the central control unit (14) being capable of switching on and off said electric pump (24) on the basis of the signals received by said water level sensor (22).

10. A laundry drier as claimed in Claim 9, **characterized in that** said water exhaust circuit (21) is also provided with a second connecting pipe (26) which connects the bottom of the second tank (20) to the first tank (16) down below, and an electric actuated valve (27) which is placed along the second connecting pipe (26) and controls the outflow of the water from said second tank (20) to said first tank (16); the central control unit (14) being capable of opening and closing said electric actuated valve (27) on the basis of the signals received by said water level sensor (22).

11. A laundry drier as claimed in Claim 8, 9 or 10, **characterized in that** said water exhaust circuit (21) also comprises a removable water tank (28) which is located inside the laundry drier casing (2) in easy removable manner, and is in communication with said second tank (20) via a siphon spillway (29) or similar so as to receive the water from the second tank (20) when the water level inside said second tank (20) exceeds a predefined upper limit.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EUROPEAN SEARCH REPORT

Application Number
EP 07 10 4075

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2005 053702 A1 (LG ELECTRONICS INC [KR]) 22 June 2006 (2006-06-22) * paragraph [0118] * * paragraph [0127] - paragraph [0140]; figure 9 *	1-7	INV. D06F58/26
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TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 August 2007	Hannam, Martin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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