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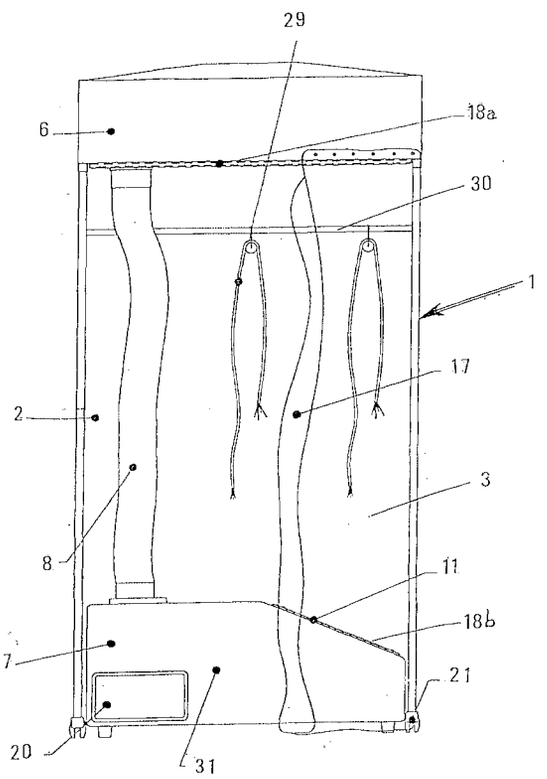
(54) Mechanized domestic drier

(57) A laundry dryer (1) for home use comprises a structure (2) provided with a compartment (3) for containing the laundry (29) to be dried, with mechanical ventilation means (15,16) and with means (5; 13) for heating the air contained in the internal compartment (3) of the structure (2). The laundry dryer (1) is provided with means (12) for the hygrometric treatment of air, also included in the structure (2), connected in a closed loop to the compartment (3) for containing the laundry (29), and travelled through by a flow of air repeatedly circulating at least between said containment compartment (3) and said hygrometric treatment means (12).

FIG. 1



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Description

[0001] The present invention relates to a mechanised laundry dryer, preferably, but non restrictively usable in the home environment.

[0002] Home laundry, commonly known as wash, is washed manually or by means of automatic machines. After the washing phase, the wash needs, as is well known, a drying phase aimed at extracting water from the fibres of the fabrics, and to allow the washed clothes to be worn.

[0003] Fabrics are dried: either naturally, in open environments with the combined effect of atmospheric agents, or with electromechanical laundry dryers located inside homes.

[0004] In the second case the extraction of water from the fabrics is achieved by means of a flow of warm air, produced by the combined effect of electrical resistors and electrically operated fans.

[0005] It is common practice to subdivide this type of laundry dryer in two categories. The first category is that of rotating drum laundry dryers, so called because the wash to be dried is introduced into a suitably constructed metal drum which, by rotating with appropriate motion transmission means, exposes the wash contained therein to the drying action of suitably provided ventilated warm air. The rotation effect causes the wash to be uniformly exposed to the drying effect of the warm air, reducing drying time. At the end of the drying operation, the wash must be extracted from the drum and subjected to an ironing action, because the combined effect of rotation and rubbing has created, in individual laundry items, an anti-aesthetic creased effect on the fabric.

[0006] This type of laundry dryer has rather high electrical power consumption. Moreover, the laundry is subjected to wear due to the successive and repeated drying operations and caused by the mutual rubbing of individual laundry items.

[0007] The second category of laundry dryer is the one commonly called closet dryer. In this type of laundry dryer, the entire wash is hung with of appropriate fastening means inside metal closets and dried with the aid of ventilated warm air that removes the water content from the laundry.

[0008] The laundry thus hung is not deteriorated and undergoes only minor creasing effects, also because individual laundry items are subjected to a natural stretching effect that allows to eliminate or simplify the subsequent ironing operation. However, in this case too air is heated by means of electrical resistors which cause high electrical consumption and which, during the drying process, tend to reduce the efficiency of the heat exchange because of the progressive saturation of air with the vapour from the water subtracted from the laundry being dried. The condensation that collects on the metal wall is then collected and evacuated outside the closet.

[0009] The aim of the present invention is to overcome these drawbacks by means of a laundry dryer, according to the preamble to claim 1, in which the laundry to be dried is contained in a compartment connected in closed loop to means for the thermo-hygrometric treatment of the air and to mechanical circulation means, said treatment means creating in mutual combination a flow of air with controlled temperature and humidity which is then made to circulate repeatedly, in closed cycle, between the interior compartment of the closet and the thermo-hygrometric treatment means.

[0010] Laundry dryers thus devised have high energy efficiency accompanied by very reduced electrical power consumption.

[0011] The technical features of the invention, according to the aforesaid aims, are clearly evident from the content of the claims set out below and its advantages shall become more readily apparent in the detailed description that follows, made with reference to the accompanying drawings, which represent an embodiment provided purely by way of non limiting indication, in which:

- Figure 1 is an overall elevation view of the invention;
- Figure 2 is an overall elevation view of the invention, shown with some parts removed the better to highlight others.

[0012] With reference to the accompanying drawings, the reference number 1 globally indicates a laundry dryer for home use 29, essentially comprising (Figure 1) a load bearing structure 2, internally provided with a compartment 3 for containing the laundry 29 to be dried, and fitted with a hood 6 for aspirating the air and with an internally hollow base 7, embodied by a metal case 31.

[0013] The hood 6 and the base 7, which are positioned respectively one superiorly and one inferiorly to the compartment 3, are mutually connected by means of a tubular conduit 8 and are also connected directly to the compartment 3 itself with which they inter-communicate through suitable walls 18a, 18b constituted by holed grids.

[0014] The drying compartment 3 can advantageously and economically be simply delimited peripherally by a closure case 17, positioned between the aspirating hood and the base 7 and made of deformable plastic material, with the conduit 8 also being made of deformable plastic material (see Figure 1).

[0015] The laundry dryer 1 is provided with mechanical ventilation means 15, 16, with means for heating the air - globally indicated as 5 - and with means 12 for the hygrometric treatment of the air of the interior compartment 3 of the structure 2, included in the load bearing structure 2 and operatively connected in closed loop. A flow of air repeatedly circulates between the containment compartment 3, the hood 6, the conveyor 8, the means 12 for the hygrometric treatment of the air and the heating means 5, as indicated with arrows A.

[0016] More in particular, the hood 6 houses the first means for the mechanical ventilation of the air of the compartment 3, embodied by an aspirating fan 16 that

draws the air from the underlying compartment 3 and mechanically accelerates it addressing it towards the tubular conduit 8.

[0017] The base 7 is inferiorly provided with wheels 21 for supporting and transferring the laundry dryer 1 and contains within it the means 12 for the hygrometric treatment of the air of the drying compartment 3, as well as the means 13 for warming said air. All these means are preferably embodied by a same and single heat pump apparatus 9 operating between a section 10 for the inlet of air into the base 7 and a section 11 for the outlet of air from the basement 7, towards the drying compartment 3.

[0018] The heat pump apparatus 9 (Figure 2) essentially comprises an evaporator 12, a condenser 13 and a hermetic compressor 14 connected in a closed loop, within which evolves a refrigerating fluid. The evaporator 12 is associated to the air conduit 8 that connects the hood 6 with the base 7; the condenser 13 is associated instead to the section 11 for the outlet of air from the base 7, towards the drying compartment 3.

[0019] The flow of circulating air, which comes from the conduit 8, travelling through the evaporator 12 is dehumidified, and being the sent onto the condenser 13, is heated therein, whereupon it is again re-introduced into the drying compartment 3 under thermo-hygrometric conditions that have been changed and are well predetermined relative to its own initial state.

[0020] The heat pump apparatus 9 also comprises control means 22; 24, 23 for respectively controlling the water content in the air and the maximum operating temperature of the positive displacement blower 14. The means for controlling the water content present in the air are preferably located in the hood 6, before the aspirating fan 16 (said means, being wholly conventional, are only symbolically shown in the drawings). The control means that instead control the maximum temperature of the positive displacement blower 14 are located in the base 7 and are preferably embodied by a temperature sensor 24 and by a by-pass valve 23, commanded by the sensor 24 and positioned in parallel to the positive displacement blower 14 between the related intake section 25 and delivery section 26 of the refrigerating fluid.

[0021] Inside the base 7 are also contained second ventilation means 15, embodied by a pusher fan 15 that aspirates the flow of air from the evaporator 12 and thrusts it, accelerating it, towards the interior of the drying compartment 3, to travel through the condenser 13.

[0022] The base 7 further contains a tray 19 for collecting the condensate of the evaporator 12 and is provided with an openable door 20 for the extraction of the tray 19.

[0023] In use, the laundry 29 to be dried is hung inside the compartment 3 with appropriate fastening means 30.

[0024] The warm air required to extract water from the fabrics is heated and dehumidified inside the base 7 by the heat pump apparatus contained therein. The related compressor 14 aspirates the refrigerating liquid in the vapour state contained in the related circuit, compresses, boosting its pressure and temperature, and sends it towards the condenser 13.

[0025] The superheated refrigerating vapour enters the upper part of the condenser 13, releases the heat it contained, and condenses to the state of warm liquid. By effect of the existing pressure differential, the refrigerating fluid in the warm liquid state moves from the condenser 13 towards the evaporator 12.

[0026] The air for cooling the condenser 13 is blown by the pusher fan 15. The air that exits the grid 18b has a temperature above that of the air in the home environment, since it has increased its temperature by removing heat from the hermetic compressor 14, the pusher fan 15 and the condenser 13.

[0027] An outlet temperature of the air of approximately 45-50°C is thereby obtained without using electrical resistors to heat the air.

[0028] The air, at the outlet of the condenser 13 and through the grid filtering element 18b, rises with velocity, blowing by the laundry 29 hung in the compartment 3 of the laundry dryer 1; it is enriched with water particles contained in the fibres of the fabrics and is aspirated, through the upper grid filtering element 18b.

[0029] The moist air drops with velocity and pressure through the tubular conduit 8, into the base 7 of the laundry dryer wherein it comes in contact with the cold surface of the evaporator 12. The water content of the air, which traverses the cold wall of the evaporator 12, condenses on its surface in the form of droplets.

[0030] The drops of condensed water fall, by gravitational effect, on the tray 19 for the collection of condensate. Over time, the recirculation of warm air progressively removes the water from the laundry 29.

[0031] The control means 22 verify the water content in the recirculating air and, below predefined values of relative humidity of the recirculating air, disconnect electrical power to the fan 16 or 15 or to the hermetic compressor 14. During the operation of the laundry dryer 1, the compressor 14 reaches a high temperature. The temperature sensor 24 placed in contact with the outer case of the hermetic compressor 14 detects this temperature.

[0032] Upon reaching appropriately predetermined temperature values of the hermetic compressor 14, the temperature sensor 24, appropriately calibrated, opens the by-pass valve 23 that connects the intake section 25 and the delivery section 26 of the refrigerating vapour. In this way, the electrical power absorbed by the internal motor of the hermetic compressor 14 decreases, the hermetic compressor 14 cools and hence the appropriately calibrated temperature sensor 24 closes the by-pass valve 23.

[0033] The invention thus conceived is suitable for evident industrial application; it can also be subject to numerous modifications and variations without thereby departing from the scope of the inventive concept. More-

over, all components can be replaced with technically equivalent elements.

Claims

1. A laundry dryer comprising a structure (2) provided with: a compartment (3) for containing the laundry (29) to be dried, mechanical ventilation means (15, 16) and means (5; 13) for heating the air contained in the interior compartment (3) of the structure (2); **characterised in that** it comprises means (12) for the hygrometric treatment of the air, also included in the structure (2), connected in closed loop to the compartment (3) for containing the laundry (29), and travelled through by a flow of air repeatedly circulating at least between said containment compartment (3) and said hygrometric treatment means (12).

2. A laundry dryer, as claimed in claim 1, **characterised in that** said structure (2) comprises a hood (6) and an internally hollow base mutually intercommunicating by means of a conduit (8), said hood (6) and said base (7) being directly connected to the compartment (3) and positioned respectively one superiorly, and the other inferiorly to the compartment (3) itself.

3. A laundry dryer as claimed in claim 2, **characterised in that** said hood (6) houses first means (16) for mechanically ventilating the air in the compartment (3) to route it towards the conduit 8.

4. A laundry dryer as claimed in claim 2, **characterised in that** said base (7) contains said means (12) for the hygrometric treatment of the air of the drying compartment (3).

5. A laundry dryer as claimed in claim 2, 3, or 4, **characterised in that** said heating means (5;13) and the means (12) for the hygrometric treatment of the air are embodied by a same heat pump apparatus (9) operating between a section (10) for the entrance of air into the base (7) and a section (11) for the exit of air from the base (7) and towards the drying compartment (3).

6. A laundry dryer as claimed in claim 5, **characterised in that** said heat pump apparatus (6) comprises an evaporator (12), a condenser (13) and a hermetic compressor (14) connected in a closed loop in which a refrigerating fluid evolves, said evaporator (12) being associated to the air conduit (8) that collects the hood (6) with the base (7), the condenser (7) being instead associated to the section (11) for the exit of air from the base (7) and towards the drying compartment (3), the flow of air coming from the conduit (8) traversing the evaporator (12) being dehumidified and being then sent onto the condenser (13), where it is heated, whereupon it is re-injected into the drying compartment (3).

7. A laundry dryer as claimed in claim 5 or 6, **characterised in that** said base (7) contains second ventilation means (15) able to accelerate the flow of dehumidified air and to force it to traverse the condenser (13).

8. A laundry dryer as claimed in any of the previous claims, **characterised in that** said drying compartment (3) is peripherally delimited by a case (17) positioned between the aspirating hood (6) and the base (7).

9. A laundry dryer, as claimed in claim 8, **characterised in that** said case (17) is made of deformable material.

10. A laundry dryer, as claimed in claim 2 or 6, **characterised in that** said conduit (8) is made of deformable material.

11. A laundry dryer as claimed in one of the previous claims 1, 2, 6, 7, 8 or 9, **characterised in that** said compartment (3) intercommunicates with the hood (6) and the base (7) through corresponding holed walls (18a, 18b).

12. A laundry dryer as claimed in one of the previous claims 2, 4, 5, 6, 7 or 11, **characterised in that** said base (7) contains a tray (19) for collecting the condensate water of the evaporator (12) and is provided with an openable door (20) for the extraction of the tray (19).

13. A laundry dryer as claimed in any of the previous claims, **characterised in that** said base (7) is provided with wheels (21) for its support and transfer.

14. A laundry dryer as claimed in the previous claim 5 or 6, **characterised in that** said heat pump apparatus (9) comprises means (22;24,23) for controlling the humidity content of the air and the operating temperature of the positive displacement blower (14).

15. A laundry dryer as claimed in claim 14, **characterised in that** said means for controlling the operating temperature of the positive displacement blower (14) include a temperature sensor (24) and a bypass valve (23) commanded by the temperature sensor (24) and positioned in parallel to the positive displacement blower (14) between its intake (25) and delivery (26) sections.

FIG. 1

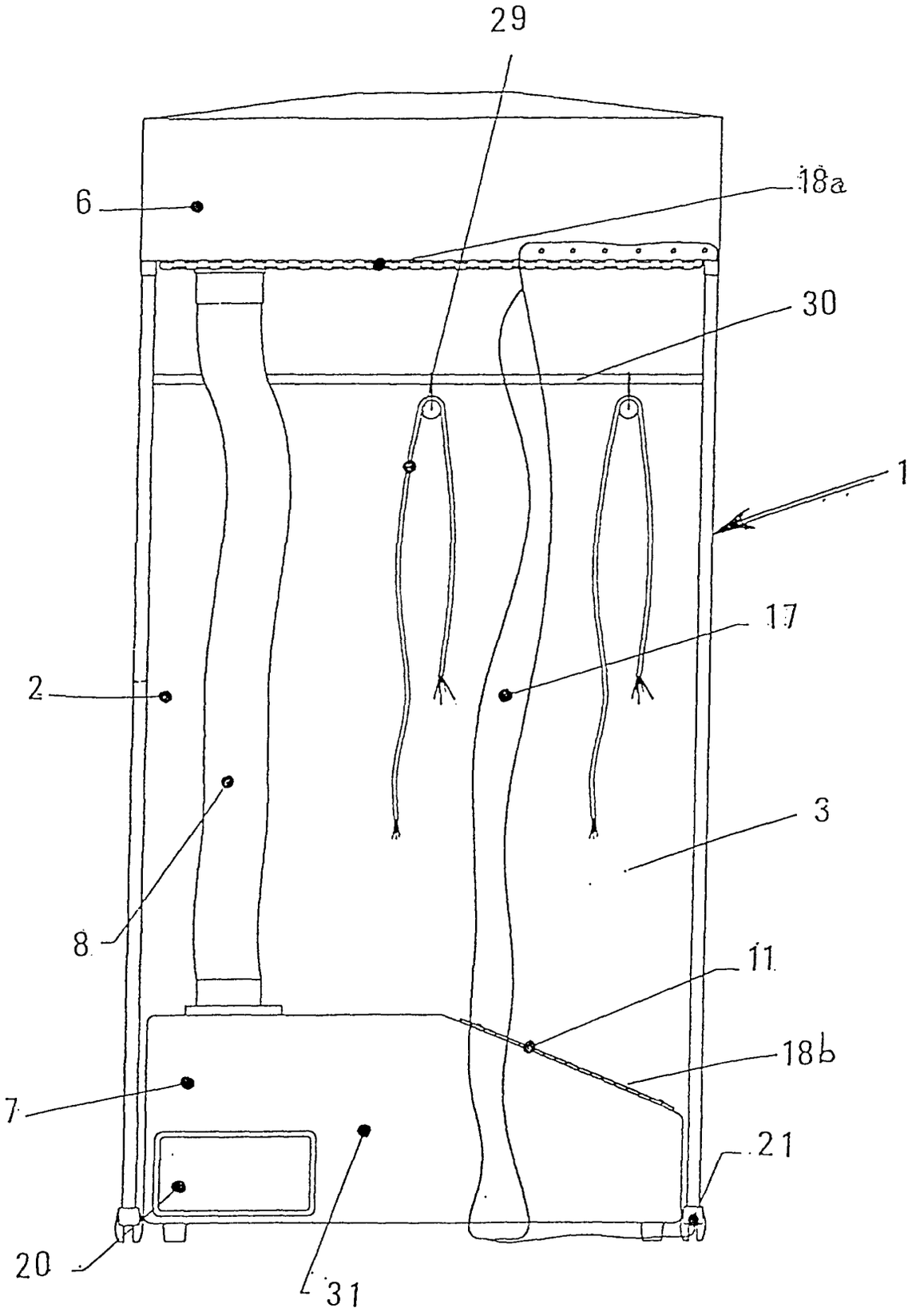

FIG. 2