



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.04.2014 Bulletin 2014/15

(51) Int Cl.:
D06F 58/24 (2006.01)

(21) Application number: **13187574.2**

(22) Date of filing: **07.10.2013**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME

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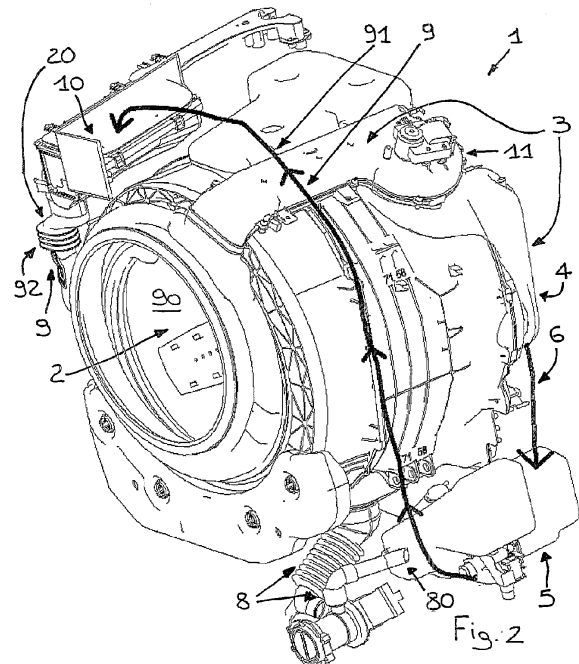
(30) Priority: **08.10.2012 IT PR20120005 U**

(54) **Electrical household appliance for washing and drying linen**

(57) An electrical household appliance for washing and drying linen comprising:

- i) a drying compartment (2);
- ii) a circulation line (3) which takes a gaseous fluid from the compartment (2) and re-introduces it into said compartment (2);
- iii) a condenser (4) which enables the condensation of at least a part of the vapour contained in the gaseous fluid; said condenser (4) comprising:
 - a first channel (41) for the passing of the gaseous fluid from the compartment (2); the first channel (41) being integrated into said circulation line (3);
 - a second channel (42) for the passing of a coolant liquid;

- iv) a tank (5) for storing a liquid;
- v) first hydraulic connection means (6) active at least between the second passing channel (42) and said tank (5) for performing a transfer of the liquid from the second passing channel (42) to the tank (5) in order to store the coolant liquid transiting in the second channel (42) to be used as a washing liquid.



Description

[0001] The present invention relates to an electrical household appliance for washing and drying linen (more commonly known as a washing machine) equipped with a water storage tank.

[0002] As is known, washing machines of the traditional type are electrical household appliances comprising:

- a washing compartment inside which there is a drum to contain the linen to be washed, rotatable about a horizontal axis;
- a water supply system which can be connected to the water mains and leads into the washing compartment;
- a unit for heating the water through an electrical resistance;
- a conduit for discharging the water from the washing compartment once the washing has finished.

[0003] The washing compartment is connected to counterweights (usually made of concrete) whose function is to stabilise the washing machine reducing the vibrations transmitted by the oscillating unit to the remaining parts of the washing machine frame.

[0004] So as to recover the water from one washing cycle to the next, some existing washing machines further comprise a water storage tank, connected to the drum in order to receive therefrom the linen rinsing water. This rinsing water, appropriately filtered, is then stored in the tank to then be reused in the subsequent washing cycle. A drawback of this washing machine is the need to filter the rinsing water once it has already come into contact with the linen to be washed and could therefore be dirty or contain textile residues detached from the linen and/or residues of undissolved detergent. This washing machine is therefore equipped with special filters which, as well as defining additional costs, also require periodic maintenance.

[0005] Dryers are also known comprising a drying compartment comprising a conduit for extracting a gaseous fluid from the drying compartment. Along such extraction conduit, a condenser is placed which determines the condensation of the particles of vapour carried by the fluid extracted from the drying compartment. Downstream of the condenser, there is a suction impeller which draws the fluid contained in the drying compartment. Downstream of the impeller there is a conduit for re-introducing the gaseous fluid into the drying compartment. Along said re-introduction conduit, there is normally an electrical element that heats the gaseous fluid. A drawback of such a dryer is connected with the consumption of the coolant water circulating in the condenser in order to determine the condensation of the vapour contained in the gaseous fluid.

[0006] The technical task of the present invention is therefore to provide an electrical household appliance for washing and drying linen that obviates the above-

described drawbacks.

[0007] The object of the present invention is to provide an electrical household appliance for washing and drying linen with greater construction simplicity and lower maintenance costs and times.

[0008] A further object of the present invention is to provide an electrical household appliance for washing and drying linen that enables the optimisation of water saving and also the energy for heating it.

[0009] The stated technical task and the specified objects are substantially reached by an electrical household appliance with the characteristics expressed in one or more of the appended claims.

[0010] Further characteristics and advantages of the present invention will become more apparent from the following indicative, and hence non-limiting, description of a preferred, but not exclusive, embodiment of an electrical household appliance as illustrated in the appended drawings, in which:

- Figure 1 shows a perspective view of an electrical household appliance according to the present invention;
- Figures 2 and 3 show perspective views of components of an electrical household appliance according to the present invention;
- Figures 4 and 5 show perspective views of a component of an electrical household appliance according to the present invention;
- Figure 6 shows a view of the component of Figures 4 and 5;
- Figures 7 and 8 respectively show a section view according to plane A-A and plane B-B of Figure 6.

[0011] In the accompanying drawings, no. 1 indicates an electrical household appliance for washing and drying linen. Typically such an electrical household appliance is known as a washer-dryer. It has the possibility to wash and subsequently dry linen.

[0012] Appropriately the electrical household appliance 1 comprises a compartment 2. Such compartment is a drying compartment. It coincides with the washing compartment. In technical jargon such compartment 2 is also called a tank. The compartment 2 contains a drum 90 intended to house the linen to be dried and/or washed. The drum 90 indicated above is therefore intended to contain the linen during a drying cycle and during a washing cycle. Appropriately the electrical household appliance 1 comprises a door 200 for accessing the drum 90; the door 200 contributes to delimiting the compartment 2. The electrical household appliance 1 further comprises a circulation line 3 which takes the gaseous fluid from the compartment 2 and re-introduces it into said compartment 2. Preferably, but not necessarily, the circulation line 3 develops starting from an end wall 201 opposite the door 200.

[0013] The electrical household appliance 1 comprises a condenser 4 which enables the condensation of at least

a part of the vapour contained in the gaseous fluid. The circulation line 3, downstream of the condenser 4 with respect to the flow of the gaseous fluid, preferably comprises a conduit for re-introducing the gaseous fluid into the compartment 2. Appropriately along the re-introduction conduit of the gaseous fluid into the compartment 2 the electrical household appliance 1 comprises means for heating the gaseous fluid (typically an electrical element). Normally along the re-introduction conduit the electrical household appliance 1 comprises means 11 for moving the gaseous fluid (typically a fan that aspirates the gaseous fluid from the compartment 2 through the condenser 4 and re-introduces it into the compartment 2 through the re-introduction conduit).

[0014] The condenser 4 comprises:

- a first channel 41 for the passing of the gaseous fluid from the compartment 2; the first channel 41 is integrated into the circulation line 3;
- a second channel 42 for the passing of a coolant liquid (typically water). The coolant liquid circulating in the second channel 42 takes heat away from the gaseous fluid circulating in the first channel 41 (the second channel 42 is schematically illustrated with a broken line in Figure 5). This determines the condensation of the vapour contained in the gaseous fluid extracted from the compartment 2.

[0015] The condenser 4 is preferably made of plastic. The condenser 4 preferably comprises a first and a second arm 12, 13, which develop from a common connection zone. The condenser 4 is therefore shaped like an "L". The first arm 12 comprises an inlet 120 of the gaseous fluid into the condenser 4, the second arm 13 comprises an outlet 130 of the gaseous fluid from the condenser 4. The second channel 42 develops along the first arm 12. Appropriately the first channel 41 also develops along the second arm 13 (as well as in the first arm 12). The portion of the condenser 4 which delimits said first channel 41 is advantageously a single part.

[0016] The electrical household appliance 1 further comprises a tank 5 for storing a liquid (it is a liquid that will then be used to wash the linen). Appropriately the tank 5 is made of plastic. Appropriately such a tank 5 has a capacity of over 10 litres, preferably over 15 litres (for the linen drying process up to 40 litres of water can be used).

[0017] Appropriately the electrical household appliance 1 comprises first hydraulic connection means 6 active at least between the second passing channel 42 and said tank 5 for performing a transfer of the liquid from the second passing channel 42 to the tank 5. This enables the coolant liquid transiting in the second channel 42 to be stored, in order to be used as a washing liquid. The first connection means 6 comprise a conduit. Appropriately the electrical household appliance 1 comprises a discharge conduit 8 of the electrical household appliance. The discharge conduit 8 is a conduit that enables the

evacuation of the washing liquid contained in the compartment 2.

[0018] The tank 5 comprises an overflow 80 which directs the excess liquid contained in the tank 5 towards the discharge conduit 8 of the electrical household appliance 1 (by-passing the compartment 2). In fact, whenever the volume of coolant liquid used in a drying cycle is higher than the volume of the tank 5, at least the excess coolant liquid must be disposed of (or alternatively recirculated - potentially after further cooling - in the second passing channel 42).

[0019] In addition or alternatively the first hydraulic connection means 6 comprise a valve which:

- in a first configuration directs said coolant liquid towards said tank 5;
- in a second configuration directs said coolant liquid towards the discharge conduit 8 of the electrical household appliance 1. During a drying cycle the valve therefore assumes the first configuration until a predetermined level in the tank 5 is reached. Upon reaching said predetermined level, the switching means make the valve assume the second configuration.

[0020] The electrical household appliance 1 further comprises a bin 10 for introducing a detergent. Such bin 10 allows the introduction of washing agents (actual detergent, fabric softener, bleach, etc.) needed during the implementation of a washing cycle.

[0021] Typically such a bin 10 is integrated into an extractable drawer (not illustrated in the attached figures).

[0022] Appropriately the electrical household appliance 1 comprises means 9 for feeding the washing liquid contained in the tank 5 into the compartment 2. Advantageously the feeding means 9 comprise:

- first means 91 for channelling the liquid contained in the tank 5 into the bin 10 (typically they comprise a first conduit and a pump for moving the liquid contained in the tank 5);
- second channelling means 92 into the compartment 2 of the liquid contained in the bin 10 (typically they comprise a second conduit 20 which leads directly into the washing/drying compartment 2; more generally it can be said that the movement pump is integrated into the feeding means 9 as long as it is arranged upstream of the bin 10).

[0023] The electrical household appliance 1 further comprises introduction means into the compartment 2 of mains water (typically solenoid valves). Appropriately the electrical household appliance 1 comprises sensor means operatively associated with the introduction means. The introduction means of the mains water are activated when a first predetermined condition arises.

[0024] In one embodiment the sensor means may comprise a pressure switch operatively associated with

the tank 5; in that case the first predetermined condition corresponds to the detection of a level in the tank 5 lower than a predetermined value at the start of a washing cycle.

[0025] In an alternative embodiment the sensor means comprise a pressure switch associated with the compartment 2. In this way, the level present in the compartment 2 can be determined after the transfer into said compartment 2 of at least a part of the liquid contained in the tank 5. In that case the first condition corresponds to the detection in the compartment 2 of a level lower than a predetermined value (by way of non-limiting example the first condition could also coincide with the detection of an increase in the level lower than a predetermined value). The electrical household appliance 1 could implement a procedure which envisages:

- activation, at the start of the washing cycle, of the feeding means 9 for transferring at least part of the liquid contained in the tank 5 into the compartment 2;
- verification through the pressure switch associated with the compartment 2 of the level in the compartment 2.

[0026] The introduction means indicated above may partly coincide with the second channelling means 92. With regard to the condenser 4 it could be of various kinds. However, in a preferred embodiment the condenser 4 comprises two overlapping metal sheets comprising a first zone in which they are in contact and a second zone in which they are spaced out to enclose between them at least one stretch of the second passing channel 42 of the coolant fluid. The two metal sheets are unambiguously connected to each other (according to a technique known as "roll-bond"). They are preferably made of aluminium.

[0027] Appropriately the condenser 4 comprises a removable door 14 for the access/protection of said two metal sheets (in Figure 7 a space 15 is highlighted in which the two sheets connected with the roll-bond technique are intended to be positioned; during the assembly of the two metal sheets the bulkhead indicated by reference number 16 is removed so as to allow direct contact of the gaseous fluid contained in the first channel 41 with at least one of said two metal sheets). Advantageously the second passing channel 42 of the coolant fluid is a winding shape in order to improve the heat exchange with the gaseous fluid contained in the first channel 41.

[0028] At least one of said metal sheets contributes to defining said first passing channel 41 of the gaseous fluid. Appropriately at least one of the metal sheets is licked by said gaseous fluid. In a particular embodiment both the metal sheets are licked by said gaseous fluid (in particular two opposite faces of a body defined by joining the two metal sheets are licked).

[0029] In a particular embodiment the electrical household appliance 1 comprises second hydraulic connection means 7 active at least between the first passing channel

41 of the gaseous fluid and the compartment 2 to create a transfer of the condensed vapour from said first passing channel 41 to the compartment 2 to allow the subsequent evacuation through the discharge conduit 8 (the second means 7 are only partly visible in Figure 8). In a further not particularly advantageous embodiment the condensed vapour could return directly into the compartment 2 running backwards along the circulation line 3. In a further embodiment the electrical household appliance 1 could comprise a conduit that places the circulation line 3 in communication with the discharge conduit 8 of the electrical household appliance 1 by-passing the drying compartment 2. According to one embodiment of the present invention in the tank 5 rinsing water coming from the compartment 2 and/or condensed water coming out of the first channel 41 can also be stored. In that case the water may be appropriately filtered before introduction into the tank 5.

[0030] An operating method of the electrical household appliance 1 comprises the following steps:

i) performing a drying cycle of linen placed in the compartment 2; the step of performing a drying cycle of the linen placed in the compartment 2 comprises at least the steps of:

- aspirating the gaseous fluid (moisture) from the compartment 2;
- making said gaseous fluid transit in the first channel 41 of the condenser 4;
- making said coolant fluid transit in the second channel 42 of the condenser 4 determining at least the partial condensation of the vapour contained in the gaseous fluid; -directing into said storage tank 5 at least a part of the coolant fluid that transits in said condenser 4;

ii) performing a washing cycle of further linen placed in the compartment 2; the step of performing a linen washing cycle comprises the step of taking at least a part of the washing liquid stored in said tank 5 and directing it into said compartment 2. This allows the washing liquid stored in the tank 5 to be used for washing or rinsing the linen.

[0031] The invention thus conceived enables multiple advantages to be attained.

[0032] First of all, it enables water to be saved since the mains water used during the drying as a coolant liquid in the condenser 4 is reused in a subsequent washing cycle. A second advantage is connected with the fact that the coolant liquid is clean water and therefore does not need to be filtered before being placed in the tank. This enables the use of filters to be avoided (which imply a cost and require maintenance). Furthermore, it prevents (as happens in traditional washing machines) the water stored in the tank previously coming into contact with linen being washed and therefore being potentially dirty

and containing textile fibres that have detached from the linen. Another important advantage is connected with energy saving. In fact, the water comes out of the second channel 42 at temperatures in the region of 40 °C therefore a remarkable energy saving can be obtained in the subsequent washing cycle if this is performed shortly after; however, even if the washing cycle is performed a considerable amount of time later, there would be an energy saving since at this point the water in the tank 5 is at ambient temperature, i.e. about 22 °C (and therefore still higher than the temperature of mains water which is equal to about 15 °C).

[0033] The invention thus conceived is susceptible of numerous modifications and variants, all falling within the scope of the inventive concept characterising it. Furthermore all the details can be replaced by other technically equivalent elements. In practice, all the materials used, as well as the dimensions, can be any according to requirements.

Claims

1. An electrical household appliance for washing and drying linen comprising:
 - i) a drying compartment (2);
 - ii) a circulation line (3) which takes a gaseous fluid from the compartment (2) and re-introduces it into said compartment (2);
 - iii) a condenser (4) which enables the condensation of at least a part of the vapour contained in the gaseous fluid; said condenser (4) comprising:
 - a first channel (41) for the passing of the gaseous fluid from the compartment (2); the first channel (41) being integrated into said circulation line (3);
 - a second channel (42) for the passing of a coolant liquid;
 - iv) a tank (5) for storing a liquid;
 - v) first hydraulic connection means (6) active at least between the second passing channel (42) and said tank (5) for performing a transfer of the liquid from the second passing channel (42) to the tank (5) in order to store the coolant liquid transiting in the second channel (42) to be used as a washing liquid.
2. The electrical household appliance according to claim 1, **characterised in that** it comprises second hydraulic connection means (7) active at least between the first passing channel (41) of the gaseous fluid and said tank (5) to create a transfer of the vapour condensed by said first passing channel (41) of the gaseous fluid to said tank (5).
3. The electrical household appliance according to claim 1 or 2, **characterised in that** said tank (5) comprises an overflow (80) which directs the excess washing liquid towards a discharge (8) of the electrical household appliance (1).
4. The electrical household appliance according to any one of the preceding claims, **characterised in that** the first hydraulic connection means (6) comprise a valve which:
 - in a first configuration directs said coolant liquid towards said tank (5);
 - in a second configuration directs said coolant liquid towards a discharge conduit (8) of the electrical household appliance (1).
5. The electrical household appliance according to any one of the preceding claims, **characterised in that** it comprises:
 - a washing compartment (2) coinciding with the drying compartment (2);
 - feeding means (9) into the compartment (2) of the liquid contained in the tank (5).
6. The electrical household appliance according to claim 5, **characterised in that** it comprises:
 - i) a bin (10) for introducing a detergent;
 - ii) said feeding means (9) comprising:
 - channelling means (91) into said bin (10) of the liquid contained in the tank (5);
 - channelling means (92) into the washing compartment (2) of the liquid contained in the bin (10).
7. The electrical household appliance according to claim 6, **characterised in that** the first channelling means (91) comprise a first conduit; the second channelling means comprise a second conduit; the first or second channelling means (91, 92) comprise a movement pump of the liquid contained in the tank (5).
8. The electrical household appliance according to any one of the preceding claims, **characterised in that** said condenser (4) comprises two overlapping metal sheets comprising a first zone (45) in which they are in contact and a second zone (46) in which they are spaced out to enclose between them at least one stretch of the second passing channel (42).
9. The electrical household appliance according to claim 8, **characterised in that** at least one of said metal sheets is licked by a gaseous fluid transiting in the first passing channel (41).

10. The electrical household appliance according to any one of the preceding claims, **characterised in that** said tank (5) has a capacity of more than 10 litres.
11. The electrical household appliance according to any one of the preceding claims, **characterised in that** it comprises:
- introduction means into the compartment (2) of mains water;
 - sensor means operatively associated with the feeding means, said introduction means of mains water being activated when a first pre-determined condition arises.
12. The electrical household appliance according to claim 11, **characterised in that** said sensor means comprise a pressure switch operatively associated with the compartment (2) to determine the level contained in the compartment (2) after the transfer into said compartment (2) of at least a part of the liquid contained in the tank (5).

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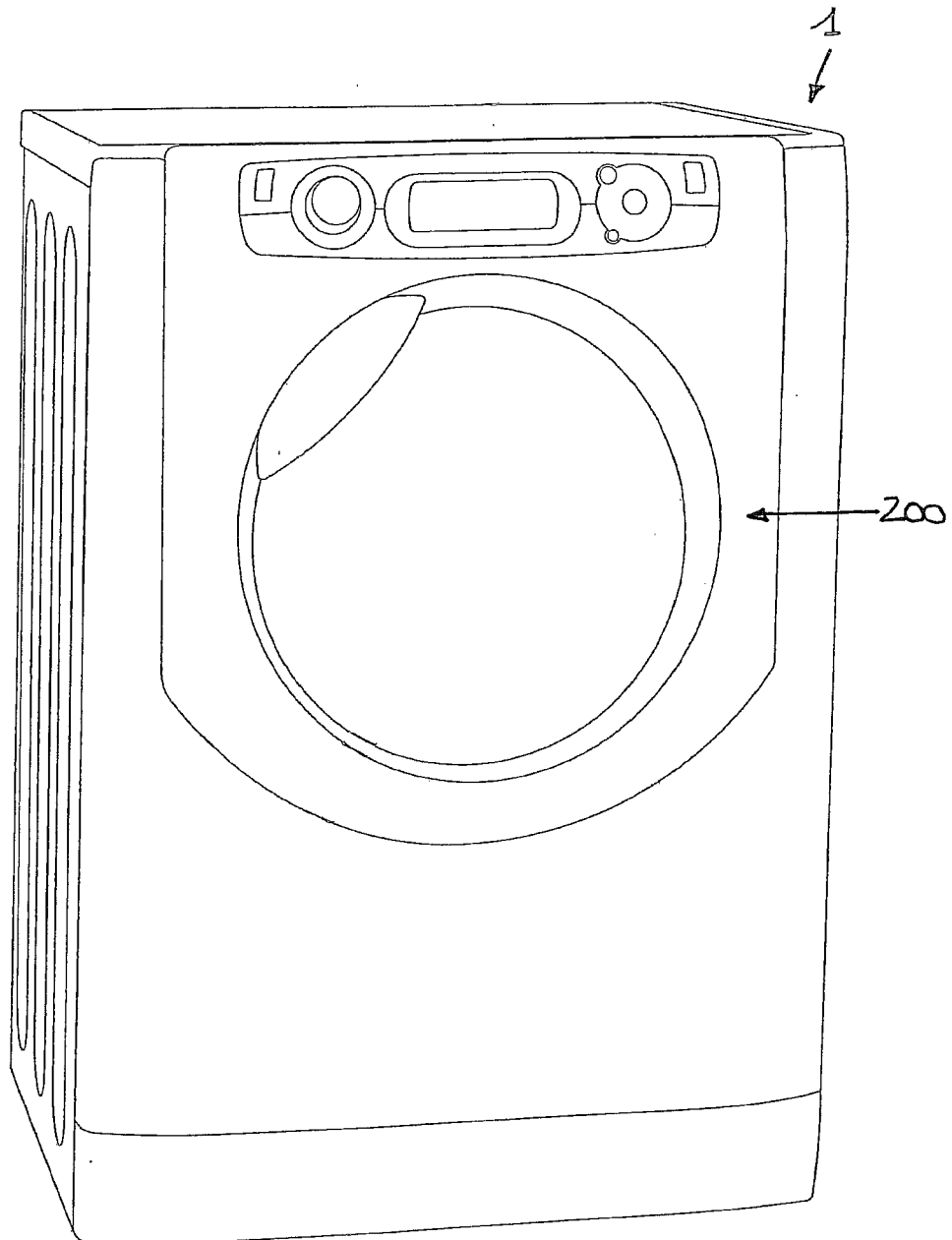


Fig. 1

