(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 234 794 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.08.2023 Bulletin 2023/35

(21) Application number: **23153229.2**

(22) Date of filing: **25.01.2023**

(51) International Patent Classification (IPC):
D06F 39/02 *(2006.01)* ***D06F 33/44*** *(2020.01)*
D06F 39/04 *(2006.01)* *D06F 103/16* *(2020.01)*
D06F 103/18 *(2020.01)* *D06F 105/02* *(2020.01)*
D06F 105/04 *(2020.01)* *D06F 105/42* *(2020.01)*

(52) Cooperative Patent Classification (CPC):
D06F 39/02; D06F 33/44; D06F 33/46; D06F 39/04; D06F 2103/16; D06F 2103/18; D06F 2105/02; D06F 2105/04; D06F 2105/42

(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 ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **25.02.2022 EP 22382164**

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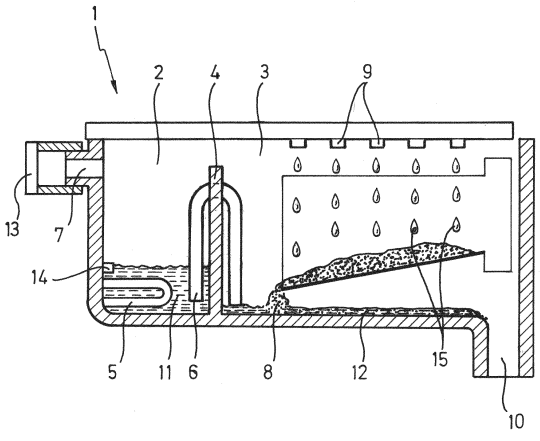
(54) **WASHING MACHINE WITH INTERNAL HOT WATER RESERVOIR AND PROCESS FOR ITS OPERATION**

(57) The invention relates to a washing machine with a tub in which a drum is rotatable arranged, comprising a tap water supply and an aqueous liquid container 1 for providing an aqueous detergent solution 12 into the tub, wherein the aqueous liquid container 1 contains a first compartment 2 and a second compartment 3, wherein the first compartment 2 contains an electrical resistance heater 5 and no supply device for detergent and wherein the second compartment 3 does not contain a heating device, but a supply device for detergent, wherein the first compartment 2 and the second compartment 3 are separated by a wall 4, and wherein a siphon 6 is provided in the first compartment 2 and the second compartment 3 such that it allows to automatically deliver water 11 from the first compartment 2 into the second compartment 3 when the water level in the first compartment 2 is equal or higher than a preset height h_{max}. The invention also relates to a process for operating such a washing machine.

Fig. 1



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Description

[0001] The invention relates to a washing machine with an internal hot water reservoir and a process for its operation. The invention relates more particularly to a washing machine with a tub in which a drum is rotatable arranged, comprising a tap water supply and an aqueous liquid container for providing an aqueous detergent solution into the tub, and a process for the operation of this washing machine.

[0002] It is known that detergents work better in a temperature range of 30 to 60 °C since their properties are then activated. It is thus desired to provide a sufficiently warm lye as soon as possible to improve a washing process with regard to time and detergent efficiency.

[0003] On the other hand it is desired to improve the energy efficiency of washing machines.

[0004] Moreover, bithermic washing machines are known. Such washing machines are especially useful when their users have a solar thermal system, a hybrid boiler or a heat pump for the production of domestic hot water. By taking advantage of hot water produced with renewable sources and thus at very low energy cost, it is possible to reduce the consumption of washing machines. Such washing machines have a double water connection so as to allow intelligent management of energy resources. Namely, in addition to presenting a connection for cold water which must then be heated by the electrical resistance of the appliance itself, a bithermic washing machine has an additional connection capable of withdrawing the already hot water produced at low cost.

[0005] The publication KR 20130017219A relates to a supply water control device of a drum washing machine and a method to supply heated water to a detergent case, thereby easily dissolving detergent. To this end, a heater is mounted on a supply water case. Water is heated by the heater. A temperature sensor detects water temperature in the supply water case. A valve supplies the water to a detergent case.

[0006] In view of this situation it was an object of the present invention to provide a washing machine in which a more efficient use can be made of a detergent that should be used in the washing process. Moreover, the washing machine should allow a more energy efficient operation. Preferably, the overall efficiency of the operation of the washing machine should be improved. A further object was the provision of a process for operating this washing machine.

[0007] This object is achieved according to the present invention by the washing machine and the process for its operation pursuant to the independent claims. Preferred embodiments of the washing machine according to the invention are indicated especially in the dependent claims. Preferred embodiments of the process correspond to preferred embodiments of the washing machine and vice versa, even if not expressly stated herein.

[0008] The invention is thus directed to a washing machine with a tub in which a drum is rotatable arranged, comprising a tap water supply and an aqueous liquid container for providing an aqueous detergent solution into the tub, wherein the aqueous liquid container contains a first compartment and a second compartment, wherein the first compartment contains an electrical resistance heater and no supply device for detergent and wherein the second compartment does not contain a heating device, but a supply device for detergent, wherein the first compartment and the second compartment are separated by a wall, and wherein a siphon is provided in the first compartment and the second compartment such that it allows to automatically deliver water from the first compartment into the second compartment when the water level h in the first compartment is equal or higher than a preset water level height h_{max}.

[0009] A preferred embodiment of the washing machine contains a load determination system for determining the load of the drum with laundry items to be washed. Preferably, the load determination system is a motor load determination system (MLD).

[0010] It is moreover preferred in the washing machine of the present invention that a total amount of water in the first compartment at the water level height h_{max} is in the range of from 0.5 to 1.5 liter.

[0011] Preferably, a first compartment valve is provided at a first water entrance to the first compartment. The first water entrance is in general connected to a water supply. The water supply can be a cold water supply or a hot water supply.

[0012] In a preferred embodiment which allows an economical use of the electrical resistance heater, the first compartment valve is adapted to provide hot water to the first compartment.

[0013] It is moreover preferred that a temperature sensor is provided in the first compartment of the washing machine.

[0014] Furthermore, a washing machine of the invention contains preferably a control unit that is adapted to open a first compartment valve to a tub water supply until a preset amount of water is introduced into the first compartment.

[0015] It is furthermore preferred that the washing machine of the present invention contains a triple valve for providing the aqueous liquid container with cold and/or hot tap water.

[0016] The invention is moreover directed to a process for the operation of a washing machine with a tub in which a drum is rotatable arranged, comprising a tap water supply and an aqueous liquid container for providing an aqueous detergent solution into the tub, wherein the aqueous liquid container contains a first compartment and a second compartment, wherein the first compartment contains an electrical resistance heating and no supply device for detergent and wherein the second compartment does not contain a heating device, but a supply device for detergent, wherein the first compartment and the second compartment are separated by a wall, and

wherein a siphon is provided in the first compartment and the second compartment such that it allows to automatically deliver water from the first compartment into the second compartment when the water level in the first compartment is equal to or higher than a preset water level height h_{max}. The process comprises the steps

(a) introducing water into the first compartment such that a height h of the water fulfils the requirement $h_{min} \leq h < h_{max}$, wherein h_{min} and h_{max} are preset values;
(b) heating the water to a predetermined extent;
(c) introducing more water into the first compartment such that the height h fulfils the requirement $h_{max} \leq h$ so that the water can flow by a pressure difference through the siphon from the first compartment into the second compartment.

[0017] In a preferred process, the temperature T of the water in the first compartment is measured and the heating of the water in step (b) is effected until a preset temperature T_{set} is reached.

[0018] In the process of the present invention it is especially preferred that an aqueous detergent solution having a temperature in the range of from 30 °C to 60 °C can be provided to the tub of the washing machine.

[0019] In a particularly preferred embodiment of the process of the present invention, the process comprises in addition the step (d),
(d) bringing the introduced warm water in the second compartment in contact with a detergent and cold water to form a warm aqueous detergent solution which is immediately thereafter transported to a tub of the washing machine.

[0020] A process is moreover preferred, wherein a load determination for determining a load with laundry items to be washed is conducted in a time interval Δt_{LD} that overlaps with the time interval Δt_{abc} that is used for carrying out the steps (a), (b) and (c). It is then preferred that a motor load detection MLD is carried out as a load determination and that steps (a) to (c) are performed during a time interval Δt_{MLD} used for the motor load detection MLD. The time interval Δt_{MLD} is usually in the range of from 60 to 120 seconds, for example 80 seconds.

[0021] The heating of the water in the first compartment is effected by means of an electrical resistance heater. Preferably, an electrical resistance heater is used with a power in the range of from 1500 to 2500 watts, preferably 1700 to 1900 watts, for example 1800 watts.

[0022] The present invention provides several advantages. Advantages of the invention include an improvement of the utilization of detergent. In embodiments of the invention, this improvement is especially useful if a determination of the load with laundry items to be washed is conducted ahead of the performance of the washing process, especially if a motor load detection MLD is carried out ahead of the washing process. The invention applies in this regard simple, cheap and quickly assembled means.

[0023] Another advantage is a faster economic return on the investment made for the purchase of a renewable plant that can be used in embodiments of the present invention where at least a part of the water is provided as already warm water to the first compartment. Those who have invested in the installation of a solar thermal system will be able to further exploit this technology.

[0024] A further advantage of the present invention is the simple and thus cheap realization of the transfer of the warm, detergent containing aqueous liquid into the tub. The transport of the water from the first chamber to the second chamber can be achieved by a pressure difference between the first and the second chamber. No specific electronic pump and thus no electronic control is required.

[0025] In embodiments of the invention, the time used for a motor load detection is efficiently used to heat the water and provide a warm detergent solution. Thus, time is won for improving the efficiency of the used detergent before it comes into contact with clothes.

[0026] The invention allows to improve the properties of the detergent from the very first moment in a washing process. It is useful mainly for powder detergents since powder detergents especially need a heating action for activating the active part of the detergents (tensoactive or surfactant), although the present invention is compatible with all detergent types such as liquid detergents.

[0027] The energy efficiency of a washing machine according to the invention is improved because the detergent can be activated with a smaller amount of water and in a shorter time. The detergent can enter the drum activated and mixed with water making easier the cleaning of the clothes.

[0028] In embodiments of the present invention which relate to the use of bithermic washing machines it is not only possible to reduce the electricity consumption by about 60%, but due to the limited use of the electrical resistance heater of the washing machine, there will be less wear. This is especially of advantage for those with limescale problems with hard water. Limescale deposits are mainly concentrated on the electrical resistance of the washing machine because cold water, to heat up, must come into contact with the incandescent resistance several times. In this step there is the formation of crystals of mineral salts dissolved in water responsible for limestone which are deposited over time on the resistance itself. The proper functioning of a washing machine might thus be impaired. But due to the provision of hot water in bithermic washing machines, the electrical resistance will be used less and will thus be less prone to wear.

[0029] A non-limiting example for important parts of a washing machine of the present which make a technical contribution to the invention and in which the process of the present invention can be implemented are shown in Fig. 1.

[0030] Fig. 1 thus shows an aqueous liquid container 1 which is used in an embodiment of the washing ma-

chine of the present invention in which the process of the present invention can be carried out. The washing machine which is not shown here has a tub in which a drum is rotatable arranged and which comprises a tap water supply and the aqueous liquid container 1 for providing an aqueous detergent solution 12 into the tub which cannot be seen here.

[0031] The aqueous liquid container 1 contains a first compartment 2 and a second compartment 3 which are separated by a wall 4. The first compartment 2 contains an electrical resistance heater 5 and the second compartment 3 contains a supply device for detergent which cannot be seen here. A siphon 6 is provided in the first compartment 2 and the second compartment 3 such that it allows to automatically deliver water 11 from the first compartment 2 into the second compartment 3 when the water level h in the first compartment 2 is equal or higher than a preset water level height h_{max}.

[0032] The total amount of water in the first compartment 2 at the water level height h_{max} is in the range of from 0.5 to 1.5 liter.

[0033] In the aqueous liquid container 1 shown in Fig. 1, a first compartment valve 13 is provided at a first water entrance 7 to the first compartment 2. In this embodiment, the first compartment valve 13 is adapted to provide hot water to the first compartment 2. In the shown embodiment, a temperature sensor 14 is also provided in the first compartment 2.

[0034] For completeness, although it cannot be seen here, it is noted here that the washing machine of this embodiment contains a control unit that is adapted to open the first compartment valve 13 to a tub water supply until a preset amount of water is introduced into the first compartment 2. The washing machine contains a triple valve for providing the aqueous liquid container 1 with cold and/or hot tap water.

[0035] By using the aqueous liquid container 1, a process for the operation of the washing machine can be carried out comprising the steps

(a) introducing water 11 into the first compartment 2 such that a height h of the water 11 fulfils the requirement $h_{min} \leq h < h_{max}$, wherein h_{min} and h_{max} are preset values;

(b) heating the water 11 to a predetermined extent which in this embodiment means a set temperature T which can be measured by means of the temperature sensor 14;

(c) introducing more water 11 into the first compartment 2 such that the height h fulfils the requirement $h_{max} \leq h$ so that the water 11 can flow by a pressure difference through the siphon 6 from the first compartment 2 into the second compartment 3; and

(d) bringing the introduced warm water 11 in the second compartment 3 in contact with a detergent and cold water 15 to form a warm aqueous detergent solution 12 which is immediately thereafter transported to a tub of the washing machine. In Fig. 1 the tub is placed after the exit 10 from the second compartment.

[0036] Thus, in the process carried out, the temperature T of the water 11 in the first compartment 2 is measured and the heating of the water 11 in step (b) is effected until a preset temperature T_{set} is reached. To this end, in this embodiment, an electrical resistance heater is used with a power of 1800 watts.

[0037] In the present embodiment, 1 l of water in the first compartment 2 is heated to 60 °C and the heated water is then transferred to the second compartment 3 where an additional amount of 4.5 l water with a temperature of 21.5 °C is added. The 1 liter of water is automatically delivered to the first compartment when the washing program is started thanks to the "theory of communicating vessels". When the washing machine demands water, hot water from the first compartment enters the washing machine through a siphon.

[0038] The additional amount of water 15 is introduced in the form of dropping water which comes from separate valves which are two in the case of cold water variants and three in the case of hot & cold water variants. As a result, the aqueous detergent solution 12 that enters into the tub has a final temperature of T = 30°C. It is noted that the mixture of detergent and water is made when the water drags the detergent inside the tub/drum.

LIST OF REFERENCE NUMERALS

[0039]

1	Aqueous liquid container
2	First compartment of liquid container
3	Second compartment of liquid container
4	Wall between first and second compartment
5	Electrical resistance heating
6	Siphon between first and second compartment
7	First water entrance; entrance to first compartment
8	Detergent powder
9	Second water entrance; entrance to second compartment
10	Exit from second compartment (leading to a drum/tub of a washing machine)
11	Water (to be heated) in the first compartment
12	Aqueous detergent solution
13	First compartment valve
14	Temperature sensor
15	Cold water entering the second compartment

Claims

1. A washing machine with a tub in which a drum is rotatable arranged, comprising a tap water supply and an aqueous liquid container (1) for providing an aqueous detergent solution (12) into the tub, **characterized in that** the aqueous liquid container (1)

contains a first compartment (2) and a second compartment (3), wherein the first compartment (2) contains an electrical resistance heater (5) and no supply device for detergent and wherein the second compartment (3) does not contain a heating device, but a supply device for detergent, wherein the first compartment (2) and the second compartment (3) are separated by a wall (4), and wherein a siphon (6) is provided in the first compartment (2) and the second compartment (3) such that it allows to automatically deliver water (11) from the first compartment (2) into the second compartment (3) when the water level in the first compartment (2) is equal or higher than a preset water level height h_{max}.

2. Washing machine according to claim 1, containing a load determination system for determining the load of the drum with laundry items to be washed.

3. Washing machine according to claim 2, wherein the load determination system is a motor load determination system (MLD).

4. Washing machine according to any of claims 1 to 3, wherein the total amount of water in the first compartment (2) at the water level height h_{max} is in the range of from 0.5 to 1.5 liter.

5. Washing machine according to any of claims 1 to 4, wherein a first compartment valve (13) is provided at a first water entrance (7) to the first compartment (2).

6. Washing machine according to any of claims 1 to 5, wherein the first compartment valve (13) is adapted to provide hot water to the first compartment (2).

7. Washing machine according to any of claims 1 to 6, wherein a temperature sensor (14) is provided in the first compartment (2).

8. Washing machine according to any of claims 1 to 7, wherein the washing machine contains a control unit that is adapted to open a first compartment valve (13) to a tub water supply until a preset amount of water is introduced into the first compartment (2).

9. Washing machine according to any of claims 1 to 8, wherein the washing machine contains a triple valve for providing the aqueous liquid container (1) with cold and/or hot tap water.

10. Process for the operation of a washing machine with a tub in which a drum is rotatable arranged, comprising a tap water supply and an aqueous liquid container (1) for providing an aqueous detergent solution (12) into the tub, wherein the aqueous liquid container (1) contains a first compartment (2) and a second compartment (3), wherein the first compartment (2) contains an electrical resistance heating (5) and no supply device for detergent and wherein the second compartment (3) does not contain a heating device, but a supply device for detergent, wherein the first compartment (2) and the second compartment (3) are separated by a wall (4), and wherein a siphon (6) is provided in the first compartment (2) and the second compartment (3) such that it allows to automatically deliver water (11) from the first compartment (2) into the second compartment (3) when the water level in the first compartment (2) is equal or higher than a preset water level height h_{max}, the process comprising the steps

(a) introducing water (11) into the first compartment (2) such that a height h of the water (11) fulfils the requirement $h_{min} \leq h < h_{max}$, wherein h_{min} and h_{max} are preset values;
(b) heating the water (11) to a predetermined extent;
(c) introducing more water (11) into the first compartment (2) such that the height h fulfils the requirement $h_{max} \leq h$ so that the water (11) can flow by a pressure difference through the siphon (6) from the first compartment (2) into the second compartment (3).

11. Process according to claim 10, wherein the temperature T of the water (11) in the first compartment (2) is measured and the heating of the water (11) in step (b) is effected until a preset temperature T_{set} is reached.

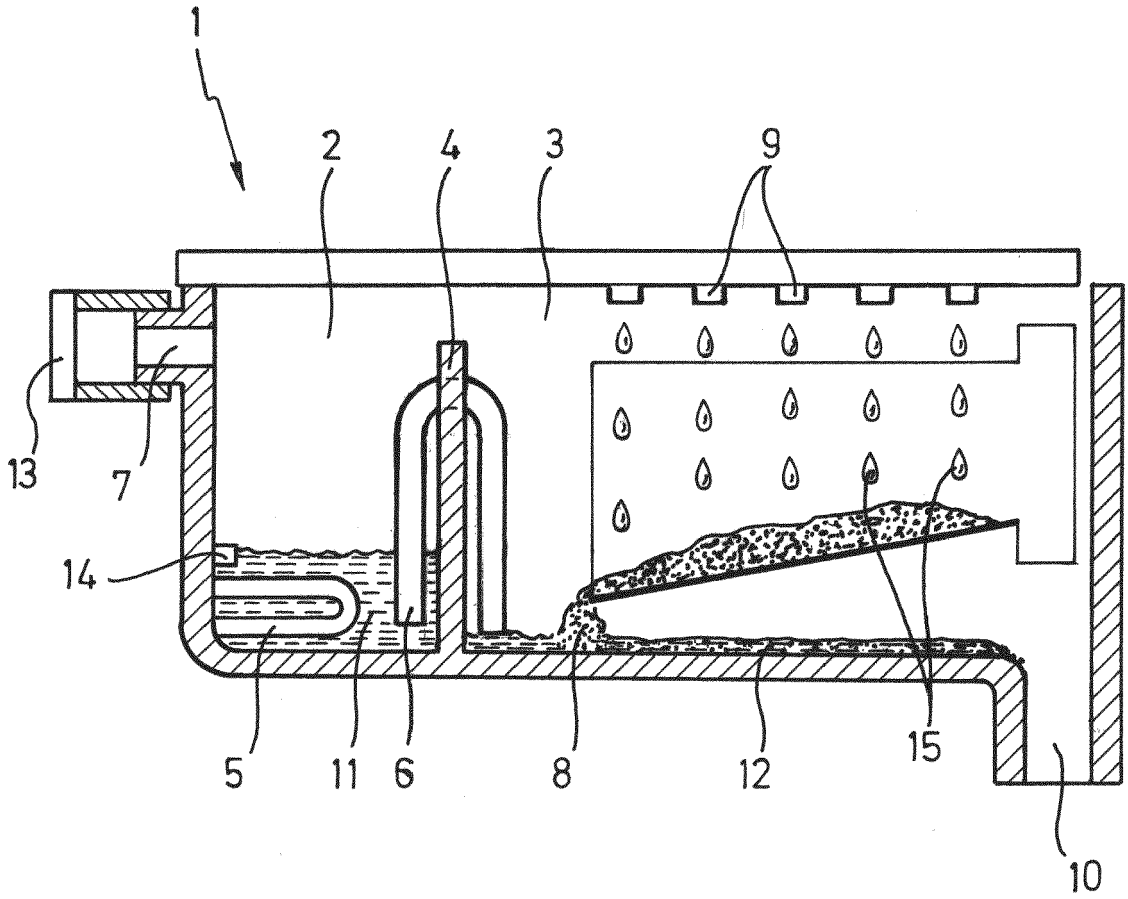
12. Process according to claim 10 or 11, comprising in addition the step (d),
(d) bringing the introduced warm water (11) in the second compartment (3) in contact with a detergent and cold water (15) to form a warm aqueous detergent solution (12) which is immediately thereafter transported to a tub of the washing machine.

13. Process according to any of claims 10 to 12, wherein a load determination for determining a load with laundry items to be washed is conducted in a time interval Δt_{LD} that overlaps with the time interval Δt_{abc} that is used for carrying out the steps (a), (b) and (c).

14. Process according to claim 13, wherein a motor load detection MLD is carried out as a load determination and the steps (a) to (c) are performed during a time interval Δt_{MLD} used for the motor load detection MLD.

15. Process according to any of claims 10 to 14, wherein an electrical resistance heater (5) is used with a power in the range of from 1500 to 2500 watts, preferably 1700 to 1900 watts.

Fig. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 23 15 3229

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	KR 2006 0128397 A (DAEWOO ELECTRONICS CORP [KR]) 14 December 2006 (2006-12-14) * figures 2-3 *	1-15	INV. D06F39/02 D06F33/44
A	US 2017/191207 A1 (MCCLOY JOHN [US]) 6 July 2017 (2017-07-06) * figure 1 *	1-15	ADD. D06F39/04 D06F103/16 D06F103/18
A	BE 527 197 A (MASCHINENFABRIK PETER PFENNINGSBERG GMBH) 31 March 1954 (1954-03-31) * figure 1 *	1-15	D06F105/02 D06F105/04 D06F105/42

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	10 July 2023	Werner, Christopher

CATEGORY OF CITED DOCUMENTS

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10-07-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20060128397 A	14-12-2006	NONE	
US 2017191207 A1	06-07-2017	NONE	
BE 527197 A	31-03-1954	NONE	

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