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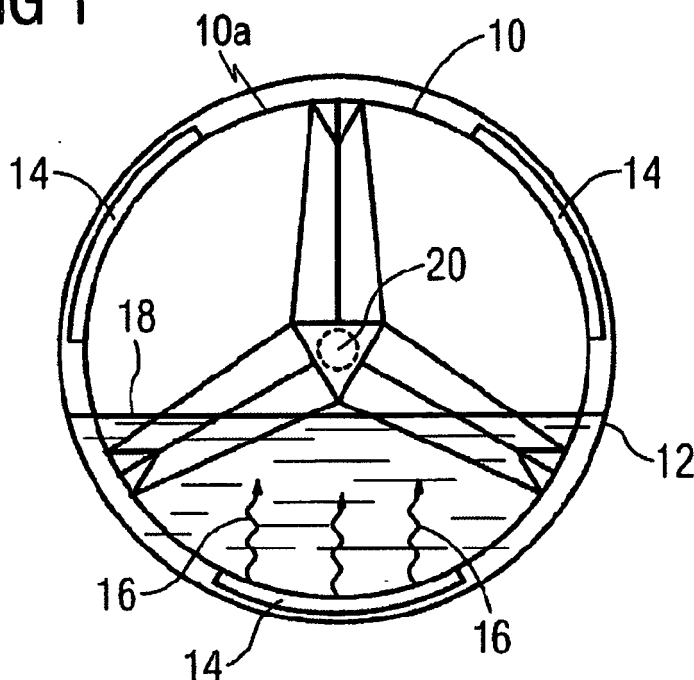
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(54) **Washing machine with improved heating system**

(57) The present invention relates to a washing machine including a washing tub (12), a washing drum (10) rotatably arranged within the washing tub (12), and at

least one electric heating element (14) associated to the washing drum (10). The at least one heating element (14) is arranged at the outer surface of a peripheral wall (10a) of the washing drum (10).

FIG 1



Description

[0001] The present invention relates to a washing machine with an improved heating system.

[0002] In a conventional washing machine the water is heated by an electric heating element arranged in the bottom of the washing tub. The heating element is sunk in the water when it is activated. Thus, the generated heat energy may be completely used for the washing purpose.

[0003] The heating element is usually formed as a wire. The radiant heating surface of the wire is very low in relationship to the volume of the water to be heated. Thus, the time for heating the required water is relative long.

[0004] After many washing cycles the heating element is clogged by fluff from the laundry and by limestone from the water. The fluff and the limestone affect negatively the efficiency of the heating element.

[0005] Additionally, this conventional heating element requires a sump in the bottom of the washing tub in order to house the heating element. The sump increases the volume of the water to be heated and therefore the power consumption. The sump increases also the time for heating the water.

[0006] In order to reduce the dimensions of the sump the heating element is usually set close to the plastic of the washing tub. In this case, it is necessary to increase the thickness of the plastic or to use additional parts for protecting the plastic. These additional parts may be made of steel.

[0007] JP 3-26292 discloses a drum type washing machine and dryer. The heating elements are arranged at the inner surface of the peripheral wall of the washing drum. The heating elements extend into the interior of the washing drum, so that they reduce the internal volume of the washing drum. A protective net lies on top of the heating elements, separating the latter from the laundry placed inside the washing drum.

[0008] The aim of the present invention is therefore to obtain a washing machine which reduces the energy consumption required for heating the washing water, without reducing the laundry loading capacity.

[0009] Within this aim, another object of the invention is to obtain a washing machine with a high efficiency and a reduced complexity.

[0010] Another object of the invention is to obtain a washing machine which reduces the water consumption with respect to the prior art solutions.

[0011] The aim and objects of the present invention, as well as others that will become better apparent hereinafter, are achieved by a washing machine according to claim 1.

[0012] According to the present invention the washing machine includes:

- a washing tub;
- a washing drum rotatably arranged within the washing tub;

- at least one electric heating element associated to the washing drum.

[0013] At least one heating element is arranged at the outer surface of a peripheral wall of the washing drum.

[0014] The main idea of the washing machine according to the present invention is the placement of the heating elements at the outer surface of the peripheral wall of the washing drum.

[0015] The inventive heating elements do not reduce the internal volume of the washing drum. Any protective elements between the heating elements and the laundry are not required.

[0016] The novel and inventive features believed to be the characteristic of the present invention are set forth in the appended claims.

[0017] Features and advantages of the present invention will anyway be more readily understood from the description that is given below by way of nonlimiting example with reference to the accompanying drawings, in which:

FIG 1 illustrates a schematic diagram of a sectional front view of the washing tub and of the washing drum of a washing machine according to a first embodiment of the present invention,

FIG 2 illustrates a schematic diagram of a sectional side view of the washing tub and of the washing drum according to FIG 1,

FIG 3 illustrates a schematic diagram of a more detailed sectional side view of the washing tub and of the washing drum of FIG 1 and FIG 2.

FIG 4 illustrates a schematic diagram of a sectional front view of a washing tub and of a washing drum of further embodiment of a washing machine according to the present invention;

FIG 5 illustrates a schematic diagram of a sectional front view of the washing tub of FIG 4, in which the heating elements haven't been represented.

[0018] FIG 1 illustrates a schematic diagram of a sectional front view of a washing tub 10 and of a washing drum 12 of a washing machine (of which only the washing tub 12 and the washing drum 10 have been illustrated) according to a first embodiment of the present invention.

[0019] The washing machine comprises an external casing, not illustrated, provided with a loading/unloading door, also not illustrated, which allows the access to the washing tub 12 which contains the rotatable washing drum 10 in which the laundry to be washed can be loaded. The washing drum 10 is marginally smaller than the washing tub 12.

[0020] The washing tub 12 is provided with a shaft 20 adapted to connect (directly, or via a suitable belt pulley) the washing drum 10 to an electric motor, not illustrated, adapted for rotating the washing drum 10.

[0021] The washing machine comprises at least one electric heating element 14 associated to the outer sur-

face of a peripheral wall 10a of the washing drum 10; in the embodiment illustrated in FIG 1 there are three electric heating elements 14, but there should be also another number of heating elements 14, for example one, two, four, five, etc.

[0022] Advantageously the shape of the heating elements 14 is adapted to the shape of the peripheral wall 10a of the washing drum 10; in other words the heating elements 14 are at least partially counter-shaped to the peripheral wall 10a of the washing drum 10.

[0023] In the embodiment of FIG 1, 2 and 3 the heating elements 14 are preferably formed as planar resistance elements, and they are advantageously adapted to the curve of the peripheral wall 10a of the washing drum 10.

[0024] The at least one heating element may be at least one electric conductor element, preferably, but not necessarily, embedded in a dielectric material. The dielectric material may be, for example, MgO, in particular highly pure MgO.

[0025] Preferably, but not necessarily, the heating elements 14 are arranged symmetrically at the peripheral wall 10a of the washing drum 10, so that the heating elements 14 are uniformly distributed along the circumferential direction of the peripheral wall 10a. In the embodiment illustrated in FIG. 1, in which there are three heating elements 14, each heating element 14 extends about 60 degrees along the circumferential direction of the peripheral wall 10a.

[0026] All the heating elements 14 can be contemporaneously supplied with electric power.

[0027] Alternatively, only those heating elements 14 which are sunk in the water are supplied with electric power. When one heating element 14 has leaved the water, its power supply is switched off. For example, in FIG 1 only the lower heating element 14, which is arranged below a water surface, schematically indicated in FIG. 1 with the line 18, is supplied with electric power. The heat radiation is represented by arrows 16.

[0028] The washing machine may comprise electronic equipments (for example a microprocessor, not illustrated) for controlling (e.g. activating or deactivating) the power supplies of the single heating elements 14. Thus, individual temperature profiles may be defined and activated.

[0029] In the inventive washing machine the distance between the heating elements 14 and the laundry is very small. This allows transferring the heat to the water bath close to the laundry. The heating elements 14 have advantageously big surfaces, so that the heat is radiated extensively.

[0030] Differently from the known washing machines, the inventive washing machine doesn't require a sump for housing the heating element, and therefore water and energy can be saved.

[0031] Since the heating elements 14 are moved with the washing drum 10, dirt and limestone depositions on the heating elements 14 are prevented. This enhances the water heating efficiency.

[0032] As illustrated in FIG 2, the washing machine according to the invention comprises one or more electric power supply lines 22 connected to the heating elements 14. Preferably the power supply lines 22 extend through the shaft 20 and through a drum back 10b.

[0033] As illustrated in FIG 3, the washing drum 10 is arranged within the washing tub 12, which is marginally bigger than the washing drum 10. The washing drum 10 is rotatable around the longitudinal axis of the shaft 20. The heating elements 14 are arranged at the outer surface of the peripheral wall of the washing drum 10. In FIG 3 only one heating element 14 and only one power supply line 22 is shown.

[0034] The shaft 20 is preferably, but not necessarily, supported by two bearings 24. Inside the shaft 20 there is a channel for the power supply lines 22. An inner end of the shaft 20 is connected to the washing drum 10. At an outer end of the shaft 20 a slip-ring device 26 may be advantageously assembled; in this case the power supply lines 22 extend through the slip-ring device 26.

[0035] In a further embodiment, not illustrated, the washing machine according to the invention comprises a suitable rotatable transformer, not illustrated, adapted to deliver electric energy to the power supply lines 22; the rotatable transformer comprises, for example, a first rotating wire coil, electrically connected to the power supply lines 22 and associated to the shaft 20 (and therefore rotatable with respect to the washing tub 10), and a second stationary wire coil (inductively coupled with the first wire coil), electrically connectable to the supply mains and stationary with respect to the washing tub 12; in this way electric power may be delivered to the power supply lines 22 by electromagnetic induction, and therefore without using a slip-ring device 26.

[0036] The washing machine according to the present invention may be a front-loading washing machine or a top-loading washing machine.

[0037] The washing machine according to the present invention may be a "simple" washing machine (i.e. a washing machine which can only wash and rinse the laundry) or a washing-drying machine (i.e. a washing machine which can also dry the laundry); in the case of a washing-drying machine, the heating elements 14 may be also used, during the drying cycle, for heating the laundry.

[0038] Advantageously the heating elements 14 are fixed to the outer surface of the peripheral wall of the washing drum 10 by any suitable fixation means, for example by screws, and/or by bolts, and/or by rivets, and/or by welding, and/or by glue.

[0039] FIG 4 and FIG 5 illustrate a further embodiment of the invention.

[0040] In the embodiment represented in FIG 4 and FIG 5 the washing drum 10 is also provided with lifters (or elevators) 40 adapted to improve the stirring of the laundry during the rotation of the washing drum 10; the lifters 40 are substantially prismatic elements protruding from the peripheral wall 10a of the washing drum 10, and

positioned with their longitudinal axis substantially parallel to the longitudinal axis of the shaft 20.

[0041] In the embodiment of FIG 4 and FIG 5 the washing drum 10 and the lifters 40 are arranged in such a way that the outer surface 40a of the lifters 40 substantially coincides with part of the outer surface of the peripheral wall 10a of the washing drum 10. This may be obtained by moulding the peripheral wall 10a of the washing drum 10 in such a way to obtain one or more lifters 40 forming a single-piece construction with the washing drum 10. In a further embodiment the peripheral wall 10a of the washing drum 10 may comprise two or more "half-shells" (i.e. cylindrical sectors) arranged in such a way that between each pair of "half-shells" there is a lifter 40 fixed to these "half-shells" (for example by welding, or by gluing, or by other suitable fixing means) in such a way that the outer surface 40a the lifters 40 substantially coincides with part of the outer surface of the peripheral wall 10a of the washing drum 10.

[0042] Advantageously, in the embodiment illustrated in Fig 4 and 5 one or more heating elements 14 are advantageously associated to the outer surface of the peripheral wall 10a of the washing drum 10 in correspondence to one or more of the lifters 40.

[0043] In this case the shape of each heating element 14 is adapted to the shape of the outer surface 40a of the respective lifter 40; in other words, each heating element 14 is at least partially counter-shaped to the outer surface 40a of the respective lifter 40. In this way the overall external encumbrance of the washing drum 10 may be reduced.

[0044] Clearly, even if the washing drum 10 is provided with one or more lifters 40, one or more heating elements 14 may be associated to the outer surface of the peripheral wall 10a of the washing drum 10 not in correspondence of a lifter 40, for example in the space between two neighbouring lifters 40.

[0045] It is seen therefore how the invention achieves the proposed aim and objects, there being provided a washing machine which, thanks to the particular position of the one or more heating elements allows reducing the energy consumption without reducing the loading capacity.

[0046] Moreover the complexity of the washing machine according to the invention is reduced.

[0047] In addition, since the one or more heating elements are placed on the outer surface of the peripheral wall of the washing drum, a sump for the heating element is not required in the bottom of the washing tub, and therefore the washing consumption is reduced.

[0048] Although two illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to those precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. All such changes and modifications are intended

ed to be included within the scope of the invention as defined by the appended claims.

5 Claims

1. Washing machine including:

- a washing tub (12);
- a washing drum (10) rotatably arranged within said washing tub (12);
- at least one electric heating element (14) associated to said washing drum (10);

characterized in that

said at least one heating element (14) is arranged at the outer surface of a peripheral wall (10a) of said washing drum (10).

2. Washing machine, according to claim 1, **characterized in that** said at least one heating element (14) is adapted to the shape of the outer surface of the peripheral wall (10a) of said washing drum (10).

3. Washing machine, according to claim 1, **characterized in that** said at least one heating element (14) is at least partially counter-shaped to said peripheral wall (10a) of said washing drum (10).

4. Washing machine, according to claim 1, 2 or 3, **characterized in that** said at least one heating element (14) is formed as a planar resistance element.

5. Washing machine, according to one or more of the preceding claims, **characterized in that** said at least one heating element (14) is adapted to the curve of the outer surface of the peripheral wall (10a) of said drum (10).

6. Washing machine, according to one or more of the preceding claims, **characterized in that** it comprises two or more heating elements (14) arranged symmetrically in respect of the circumferential direction of said washing drum (10).

7. Washing machine, according to one or more of the preceding claims, **characterized in that** said at least one heating element (14) is directly arranged at said outer surface of the peripheral wall (10a) of said washing drum (10).

8. Washing machine, according to one or more preceding claims, **characterized in that** it comprises a rotatable transformer adapted to deliver electric energy to said at least one heating element (14).

9. Washing machine, according to any one of the preceding claims, **characterized in that** it comprises electronic equipments for controlling the power sup-

plies of said at least one heating element (14).

10. Washing machine according to one or more of the preceding claims, **characterized in that** at least one heating element (14) is activable and/or deactivable in dependence of the rotational position of said washing drum (10). 5
11. Washing machine according to any one of the preceding claims, **characterized in that** it comprises at least a power supply line (22) for the electric supply of said at least one heating element (14), wherein said at least a power supply line (22) is assembled through a drum back (10b) and a shaft (20) of said drum (10). 10 15
12. Washing machine according to claim 11, wherein a slip-ring device (26) is arranged at the end of the shaft (20) of said washing drum (10), and said at least a power supply line (22) is assembled through said slip-ring device (26). 20
13. Washing machine, according to any one of the preceding claims, wherein said washing drum (10) is provided with one or more lifters (40) arranged in such a way that their outer surface (40a) substantially coincides with part of the outer surface of the peripheral wall (10a) of said washing drum (10), at least one heating element (14) being associated to said outer surface of said peripheral wall (10a) of said washing drum (10) in correspondence to one lifter (40). 25 30
14. Washing machine, according to claim 13, wherein the shape of a heating element (14) positioned in correspondence of one lifter (40) is at least partially counter-shaped to the outer surface (40a) of said lifter (40). 35
15. Washing machine, according to claim 13 or 14, wherein one or more heating elements (14) are associated to the outer surface of the peripheral wall (10a) of said washing drum (10) in the space between two neighbouring lifters (40). 40 45

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FIG 1

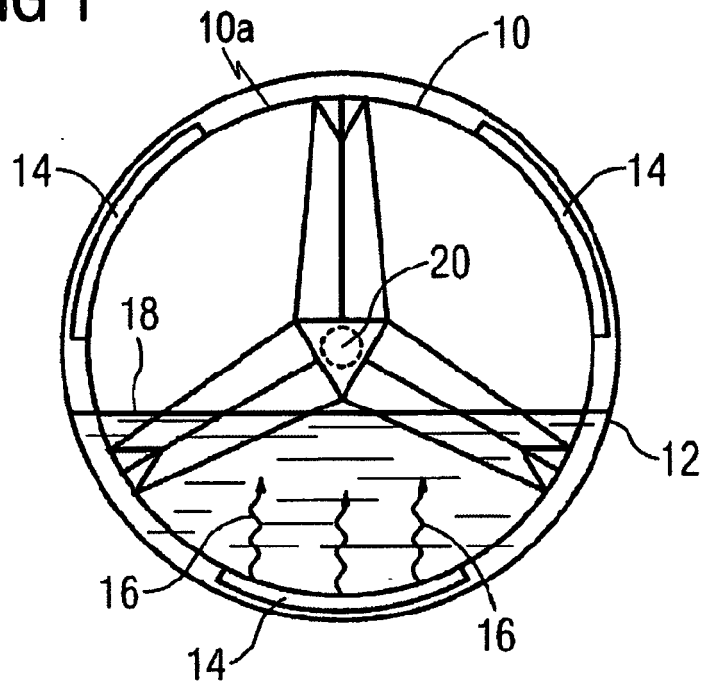


FIG 2

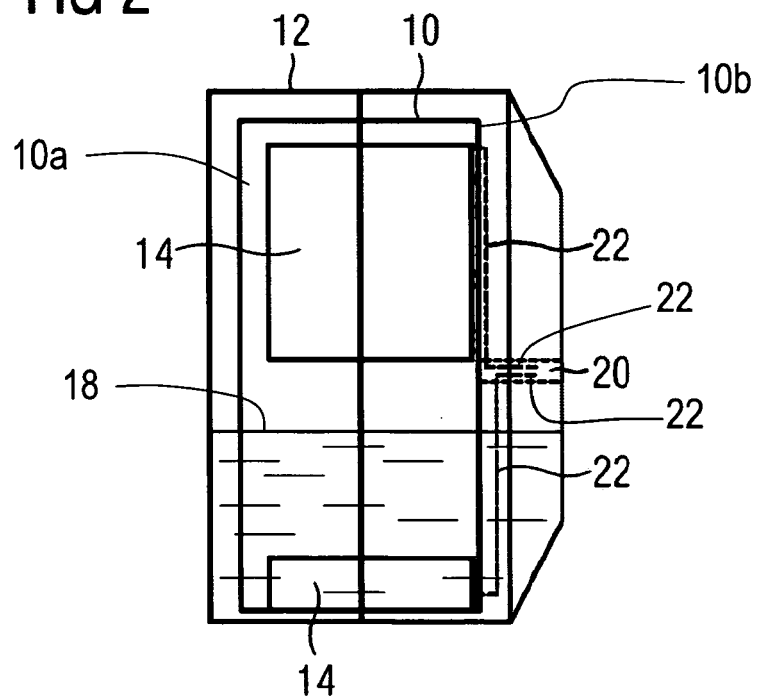


FIG 3

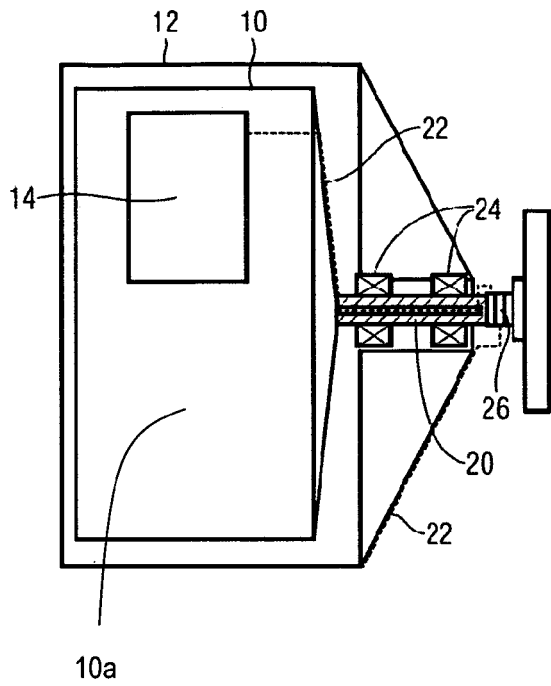


FIG 5

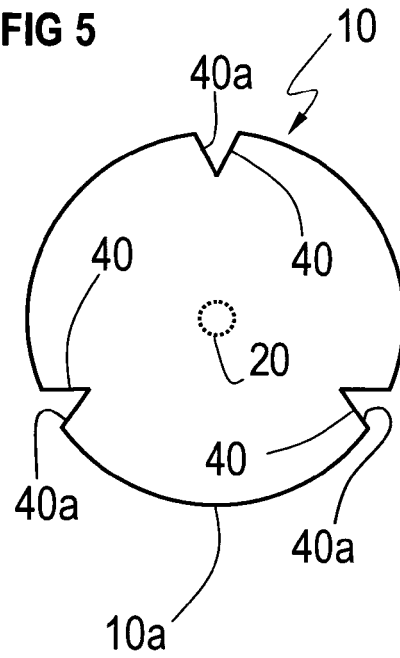
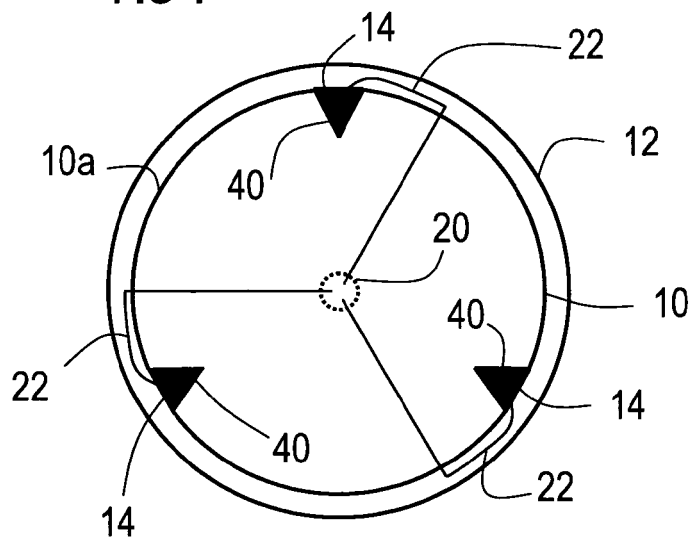


FIG 4





EUROPEAN SEARCH REPORT

Application Number
EP 09 01 2192

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KR 2007 0120401 A (KIM HYUNG WOO [KR]) 24 December 2007 (2007-12-24) * figures 1,3,5,7 * -----	1-15	INV. D06F39/04 D06F37/06
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 25 February 2010	Examiner Dupuis, Jean-Luc
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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25-02-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20070120401 A	24-12-2007	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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