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(54) **Washing appliance with induction heating**

(57) A washing appliance, particularly a dishwashing machine, comprises a metal tub (10) and an induction heating system (14,14a) for heating water and/or air contained in the tub. Preferably the tub is heated directly by the induction heating element.

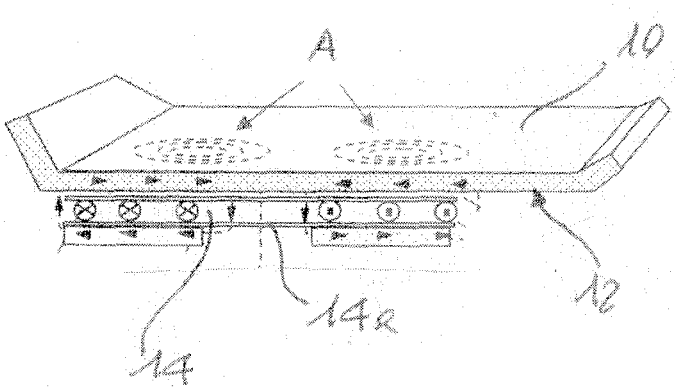

Fig. 2

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Description

[0001] The present invention relates to a washing appliance, particularly a dishwashing machine, comprising a tub and a heating system for heating water to be used in the washing cycle.

[0002] With the term "washing appliance" we mean every kind of appliance in which laundry or dishes are treated, either for washing of for drying purposes, i.e. for instance washing machine, dishwashing machine, clothes dryers, washing and drying machines.

[0003] Traditional water heating systems of washing machines and dishwashers are using electrical resistance devices. Different executions are available on the market: flow through heaters, tubular heaters, heaters mounted on the spray pump volute. In the heating system using separated heating elements inside tub, for instance heating rods, it is necessary to provide a safety area inside the tub. Moreover there is the risk of electrical insulation cracking during the life time, which could cause safety problems. When an in-line heating element outside a circulation pipe is used, additional hydraulic pipes are necessary for water flow through the device. Water consumption is increased due to a portion of hydraulic flow inside the heating pipe. Moreover there are energy losses due to limited thermal insulation of heating device, as well as risk of insulation cracking during the life time.

[0004] With the above known heating systems there is a problem in trying to increase the rate of water heating. In the known dishwashers it is presently possible to obtain heating up rates (with an installed power of 2 kW) of about 1,8-2°C per minute depending on the water content. Therefore program cycle time is limited by heating time.

[0005] It is an object of the present invention to provide a washing appliance, particularly a dishwashing machine, which does not present the above problems and is provided with a very efficient heating system.

[0006] The above object is reached thanks to the features listed in the appended claims.

[0007] According to the present invention, an induction heating element comprising a copper coil (bobbin) is used to generate an alternating magnetic field which induces eddy currents into the ferromagnetic material of the dishwasher tub, which heats up due to Joule effect. Since the material of the tub, preferably a ferritic stainless steel, heats up, the water inside the tub warms up as well until a predetermined temperature is reached. The bobbin of the induction heating element is energized and controlled by an electronic circuit of the dishwasher.

[0008] Due to the direct energy transfer by induction into the tub material, there is a very low energy loss from the induction bobbin. Such losses are much lower than by using traditional heating devices using electrical resistances. The heating rate is higher than the usual one; if compared to an existing product, the applicant has detected a 20% increase from 1,9°C/min to 2,2°C/min, with a relevant reduction of the overall length of the washing cycle.

[0009] According to an embodiment of the invention, the induction heating system can be split into sections, i.e. in different induction bobbins. The heating can therefore be applied at the most efficient areas of the dishwasher (tub bottom, top, side and rear walls). The split solution allows to control different induction zones at different wash cycle phases.

[0010] The bobbins of the induction heating systems do not need to have a circular shape. Any other shape or design is possible (for instance, the round conductor may have turns at substantially right angles to previous turn). One can design a zone of induction by shaping it rectangular, triangularly or ringshaped. The tri dimensional surface of the tub can be covered by the coil; therefore no flat bobbin design is required.

[0011] Due to the high efficient energy transfer, the program cycle time is shorter and performance data of the dishwasher are much better regarding energy consumption and cycle time. The saved energy can be used to improve the cleaning result, and/or for lower energy declaration.

[0012] According to another embodiment of the invention, the induction heating system can be easily used to generate steam into the tub. Control of one or multiple split coils to generate steam in certain areas is possible. Induced energy will heat up water and generate steam without hydraulic pump operation. Hot steam can be used for high performance cleaning programs. Also the drying phase of the machine is improved by conducting an air flow over induction heated area inside the tub. Air flow can be directed over the induction zone or multiple zones. Hot air also can be generated by using an air channel or pipe made from ferritic material in which energy is induced.

[0013] Further advantages and features according to the present invention will be clear from the following detailed description, provided by way of example, with reference to the attached drawings in which:

- figure 1 is a perspective view of a tub of a dishwasher according to the present invention;
- figure 2 is a schematic section view of a portion of the bottom part of tub shown in figure 1 according to a first embodiment of the invention;
- figure 3 is a schematic view similar to figure 2 according to a second embodiment of the invention and in a first configuration of use;
- figure 4 is a section view of the tub of figure 3 in a second configuration of use;
- figure 5 is a schematic section view of a portion of the bottom part of the tub shown in figure 1 according to a third embodiment of the invention;
- figure 6 is a schematic view showing the electrical system associated with the induction heating system of a dishwasher according to the invention;
- figure 7 is a perspective exploded view of a tub used in a dishwasher according to the present invention.

[0014] With reference to the drawings, a metal tub of a dishwasher is indicated with reference 10. The tub is composed by a L-shaped bottom back 10a and by a U-shaped wrapper 10b (figure 7). The two metal parts 10a and 10b are roll welded together.

[0015] On the metal tub 10 are identified several zones A where an induction heater can be associated with. With reference to figure 2, the bottom portion of the tub 10 is provided, on its outside surface 12, with an induction heating coil in form of a bobbin 14 housed in a bobbin supporting frame 14a. According to such first embodiment, in which at least the U-shaped wrapper 10a of the tub 10 is made of ferritic steel, for instance AISI 304, the portion A of the tub is heated directly on the basis of the physical principle of eddy current heating. The high-frequency changing field induces into ferritic tub bottom eddy currents which heat up the tub (and water contained therein). In figures 3 and 4 it is shown a second embodiment of the invention in which the tub 10 is provided with an added ferromagnetic plate 16 welded or glued to the tub and which is heated due to eddy currents induced by the bobbin 14. This embodiment is particularly indicated for laundry washing machines and for dishwashers having a tub made of polymeric material or of not ferromagnetic material (for instance austenitic stainless steel). In this case the plate and the induction heating element associated thereto may assume a curvilinear shape in order to cope with the shape of the tub. The plate 16 then heats by conduction the metal tub 10. In this embodiment the tub 10 does not need to be of ferromagnetic material, and can be also made of polymeric material or of austenitc stainless steel. In figure 3 it is shown the condition in which the tub 10 is filled with water W, and this configuration is typical of an early stage of the washing cycle when water is recirculated and sprayed on crockery. In figure 4 it is shown a configuration typical of the final drying stage, in which air is circulated on the surface of the tub 10 (arrow sin the drawings) and it is heated up by the hot surface of the tub heated by the induction heating coil.

[0016] In figure 5 it is shown a further embodiment in which only a portion of the tub 10, indicated with reference 11 in figure 5, is made of ferromagnetic material, for instance ferritic stainless steel. In this embodiment the portion or plate 11 is integrated into the tub bottom, and it is surrounded by a heat transfer insulation part 13. In this embodiment the tub may be made of austenitic stainless steel material, and only the portion 11, i.e. the very top layer of the induction heaters, is made of ferritic material and is visible by the user.

[0017] In figure 6 it is shown a schematic electrical circuit for the induction heating bobbin 14 underneath the bottom of the tub 10. The spiral-shaped inductor 14 acts as the primary circuit of a transformer whose secondary circuit is short-out, the secondary winding being the ferritic tub bottom or a heating plate. Between the bottom of the tub 10 and the bobbin 14 it is interposed a layer 15 of electrical non magnetic insulation. The inductor 14 implements an alternate current (AC) with a frequency between 25 and 35 kHz. The Inductor 14a is generating an oscillating circuit by a condenser 20. The needed power comes from an inverter circuit 22. It is not necessary to describe in detail the induction heating coil or the driving circuit thereof because these are well known to the experts in the art. The electronic control circuit of a dishwasher according to the invention comprises also a microprocessor for controlling the induction heating system, as well as a circuit for controlling the temperature reached by the tub. Such control circuit may comprise a temperature sensor (not shown) carried by a holder which is spring-biased into contact with the outside surface of the tub 10.

Claims

1. Washing appliance, particularly dishwashing machine, comprising a tub (10) and a heating system for heating water and/or air contained in the tub, **characterized in that** the heating system comprises at least an induction heating element (14, 14a) for heating at least a portion (A) of the tub (10, 10a, 10b) in contact with water and/or air.

2. Washing appliance according to claim 1, wherein the tub (10) has at least a metal portion which is directly heated by the induction heating element (14, 14a).

3. Washing appliance according to claim 1, wherein the induction heating element (14, 14a) is adjacent a metal plate (16) adapted to transfer heat to the tub (10).

4. Washing appliance according to any of the preceding claims, wherein the induction heating element (14, 14a) is placed under a bottom portion of the tub (10a).

5. Washing appliance according to claim 4, wherein the induction heating element (14, 14a) comprise a metal ferromagnetic portion (11) which is integrated into the tub bottom and it is insulated therefrom.

6. Washing appliance according to any of the preceding claims, wherein the tub (10) is made of ferritic stainless steel.

7. Dishwashing machine according to claims 2 and 4, wherein the bottom portion of the tub (10a) is made of ferritic stainless steel.

8. Dishwashing machine according to claim 4, wherein the tub (10) comprises a U-shaped element (10b) and a L-shaped element (10a) welded together by a roll welding process, the L-shaped element forming at least a part of the bottom portion of the tub (10).

9. Dishwashing machine according to claim 8, wherein the L-shaped element (10a) of the tub (10) is made of ferritic stainless steel.

10. Dishwashing machine according to any of the preceding claims, wherein the induction heating element (14, 14a) is adapted to generate steam.

11. Dishwashing machine according to any of the preceding claims, wherein the induction heating element (14, 14a) is associated to a channel where air is adapted to flow.

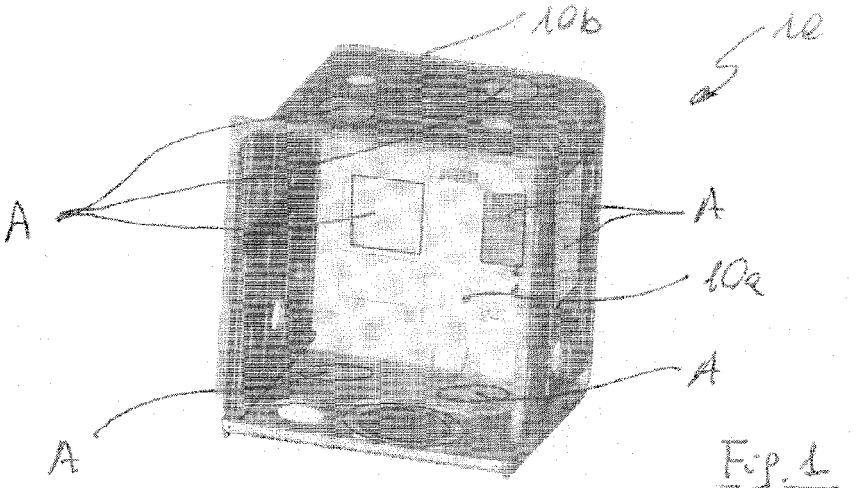

Fig. 1

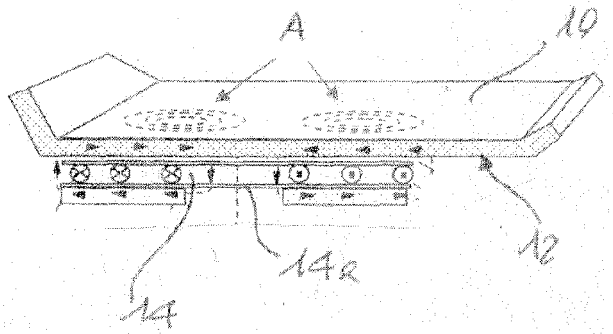

Fig. 2

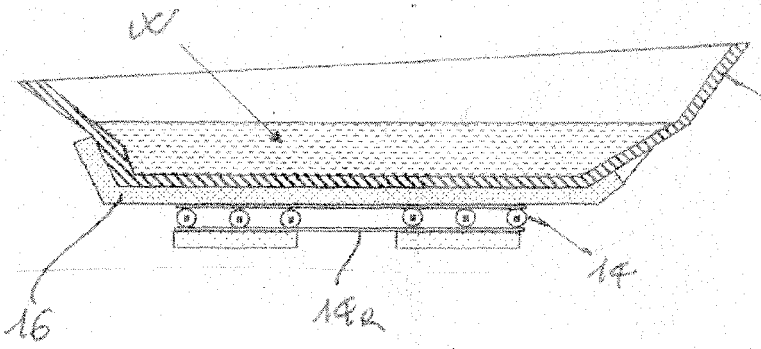

Fig. 3

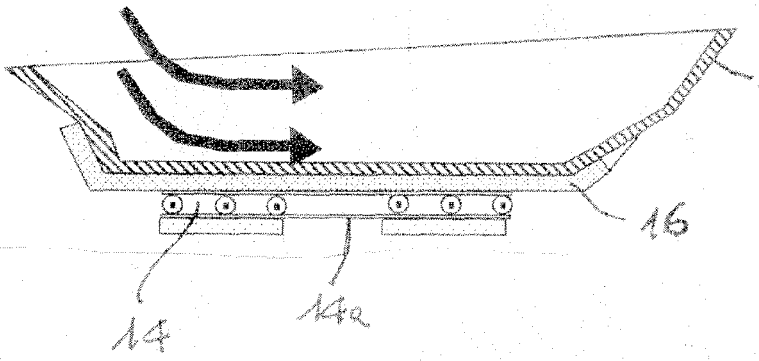

Fig. 4

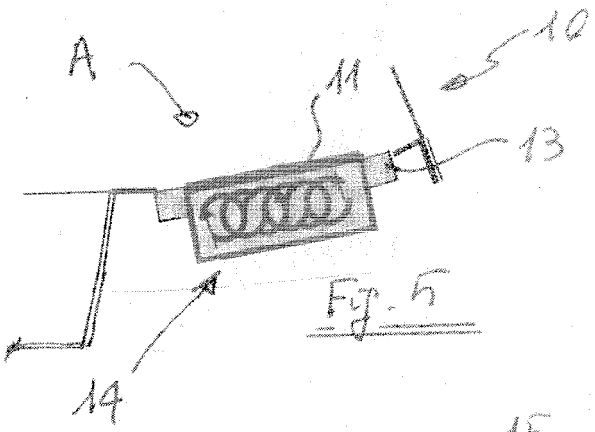

Fig. 5

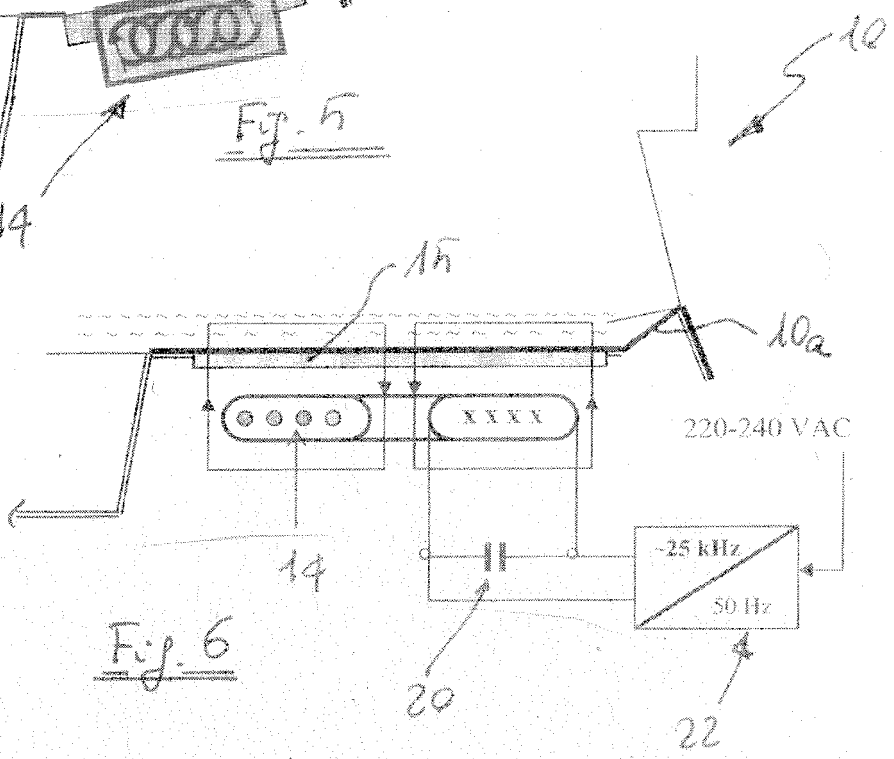

Fig. 6

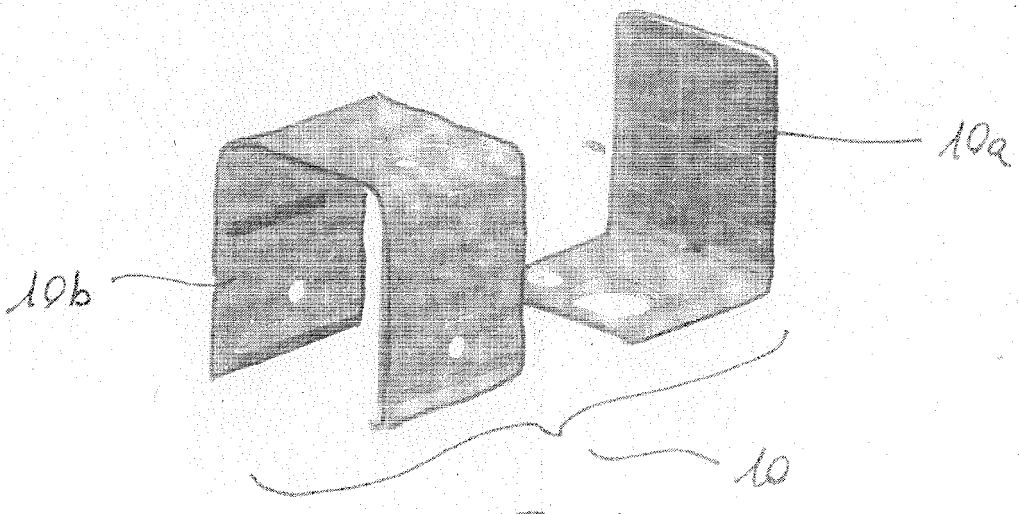

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 08 10 2497

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	EP 1 507 033 A (LG ELECTRONICS INC [KR]) 16 February 2005 (2005-02-16) * paragraph [0011] - paragraph [0012]; figure 3 *	10	

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A	US 2006/076037 A1 (KIM YONG G [KR] ET AL) 13 April 2006 (2006-04-13) * paragraph [0082] - paragraph [0083] *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)
A47L D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 August 2008	Hannam, Martin

CATEGORY OF CITED DOCUMENTS

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