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(54) Apparatus and method for heating a working fluid in washing machines

(57) The present invention relates to an apparatus for heating a working fluid circulating within a hydraulic circuit of a washing machine (1), of a type comprising an element (20) having a thermal exchange surface (20S) operationally in contact with said working fluid during at least one heating phase of said working fluid of said machine (1).

The peculiarity of the invention is that the apparatus (A) is associated by co-molding with a component (3) of said hydraulic circuit of said washing machine (1).

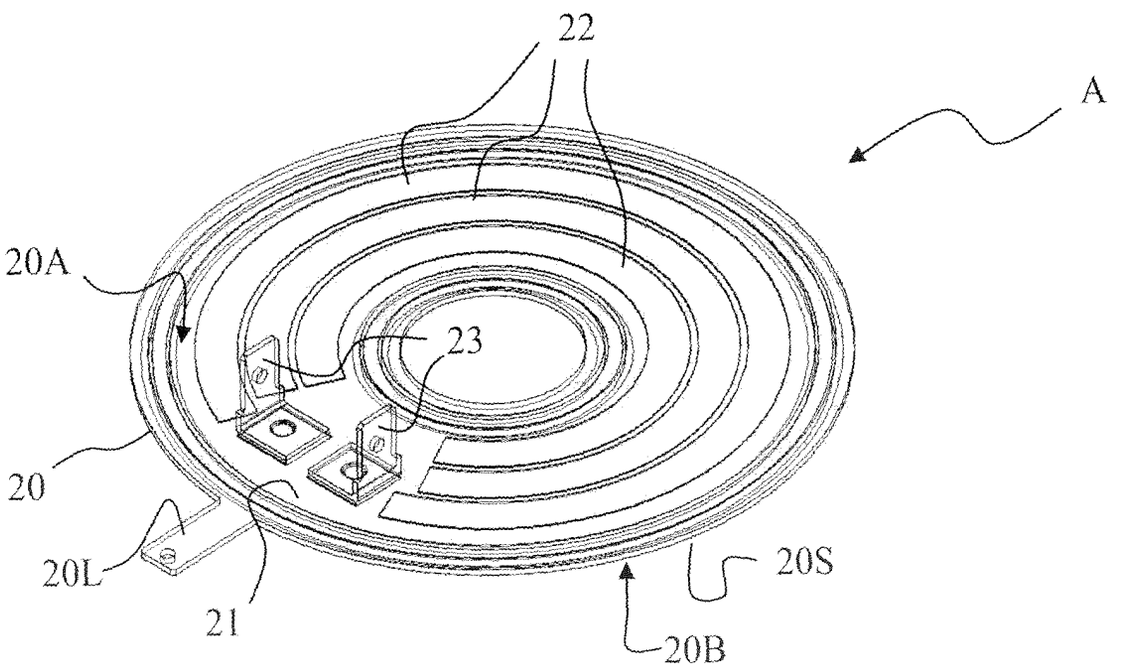

Fig. 3

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Description

[0001] The present invention relates to an apparatus for heating a working fluid circulating within a hydraulic circuit of a washing machine, a method for manufacturing and assembling said apparatus, and a washing machine comprising said heating apparatus and implementing said method.

[0002] More specifically, the inventive idea is applied to household washing machines, in particular a dishwasher or a laundry washing machine; in this case, the working fluid is water taken from the main, eventually washing agents to be added.

[0003] Every washing machine comprises a hydraulic circuit wherein a working fluid circulates which, during at least one operating phase of the machine, is heated by means of suitable devices.

[0004] In order to provide an example of a hydraulic circuit of a washing machine, the following describes a hydraulic circuit of a dishwasher, which uses water supplied from the main as a working fluid for crockery washing. Said hydraulic circuit is generally composed of:

- a supply duct for the water from the main, to which a series of known safety and adjustment devices are associated, such as, for example, the so-called "air break" device, the wash water softening device, and the anti-flooding safety device;
- a tub, where during at least one operating phase of the dishwasher the wash water is sprayed over the crockery under the control of suitable wash programs;
- a pit, located underneath the tub, having the function of collecting and filtering the water both coming from the supply duct and sprayed in the tub, after it has circulated within the hydraulic circuit of the machine;
- a wash pump, connected to the pit, which when operated, it works in order to allow the continuous circulation of the water within the hydraulic circuit;
- means for heating the circulating water, which will be described more in detail later;
- spraying means, which convey the pressurized water onto the crockery to be washed;
- a drain circuit, wherein a drain pump, when activated, drains away the wash water being present in the pit by delivering it to a drain duct.

[0005] If we look at the technologies generally used at present for heating working fluids in washing machines, and in particular the water circulating within the hydraulic circuit of a dishwasher, we can substantially identify two categories of devices extensively and generally used for the purpose:

1) Armored resistances,
2) Silk-screened resistances.

[0006] Armored resistances, which have been used since the very start of the production of these machines, consist of a tubular element that may be heated by Joule effect. Said tubular element can be bent and shaped in various ways in order to provide a length and so a heat exchange area with water as large as possible, in order to transmit as much caloric power as possible by direct contact with the fluid.

[0007] Armored resistances can be directly positioned in the wash tub close to the pit, and in such a way to be always covered by fluid when they are in the operating condition, i.e. during the water heating phase. In this condition, these resistances have the drawback of taking up considerable room on the tub bottom.

[0008] Another drawback is the fact that a resistance of this type is a hot element which is potentially harmful for a user opening the dishwasher door while the resistance is still hot.

[0009] Another drawback is the fact that these resistances are visible to the user when the wash tub is opened; therefore they are aesthetically unpleasant, also because with time going by they tend to change color, giving the user an impression of poor quality of the whole machine.

[0010] Other solutions with armored resistances imply that these resistances are wound around a metal element of the hydraulic circuit, e.g. a metal pipe inserted in the circuit section downstream the wash pump. A solution of this type has the often significant drawback of taking up much room in the undertub area of the dishwasher, which is generally rather crowded with components. Furthermore, because the resistance needs the presence of a metal pipe to be wound around, said pipe must be inserted into an hydraulic circuit, therefore interrupting the continuity of connections and fittings, that for the totality of machines are normally made by plastic material elements.

[0011] Thus, another drawback of this arrangement of armored resistances is that it requires the interruption of the continuity of the plastic ducts making up the normal connections among the hydraulic parts of the circuit. A construction complication is therefore introduced in the hydraulic circuit, which increases the number of parts constituting the washing machine, with consequent higher management and supply costs. As a consequence the hydraulic circuit assembly times are affected becoming inevitably longer.

[0012] Such an application also has a number of other technical drawbacks. The metal pipes, around which the cumbersome armored resistances are wound, are rather big and heavy, and represent hot points not always in direct contact with the fluid to be heated, thus reducing the system efficiency.

[0013] It should also be underlined that the water is heated dynamically within the pipe around which the resistance is wound; therefore the liquid absorbs heat only when, passing through that particular section of the circuit, it comes in contact with the hot pipe, and so for a

short time. Besides, there are also heat losses along the outer surface of said pipe. Consequently, it is not possible to transfer a high caloric power to the water.

[0014] In conclusion, the employment of armored resistances wound around a metal pipe inserted in the hydraulic circuit of a washing machine offers a lower thermal efficiency in respect to, for example, a system with a visible resistance located on the tub bottom. Moreover, the presence of hot metal pipes represents a further heat source to be suitably insulated from the plastic materials with which said pipes are associated in the assembly, thus presenting a technical complication from this point of view.

[0015] The second typology of resistances used at present in the art is that of silk-screened resistances, i. e. formed by using a silk-screening technique directly on a compact material, generally a metal material, being said resistances appropriately insulated electrically from said material. Silk-screened resistances are in general applied externally to metal pipes inserted in the hydraulic circuit, as an alternative to the above-described armored resistances.

[0016] Compared to armored resistances, silk-screened resistances have definitely smaller external dimensions. Said pipes are usually inserted in the fittings located in the undertub area of the washing machine, but other alternative solutions are also known which have, for example, pipes with very long silk-screened resistances mounted on the hydraulic duct section supplying water from the wash pump to the upper sprayer.

[0017] Silk-screened resistances, cited in the above applications, have however the same drawbacks as armored resistances in terms of manufacturing complexity and low wash water heating efficiency, which are substantially due to the dynamic-type heating of the water circulating within the circuit.

[0018] Furthermore, such resistances require higher production costs than the classic solution with armored resistances, being said costs only partially justified and justifiable by lower weights and smaller overall dimensions.

[0019] The main aim of the present invention is to solve the above-mentioned problems by providing a washing machine, in particular a dishwasher, comprising an apparatus for heating a working fluid circulating within said machine, as well as an improved method for manufacturing and assembling said apparatus in the same machine of improved typology.

[0020] A further aim of the present invention is to provide a washing machine comprising an apparatus for heating a working fluid having improved characteristics.

[0021] In this frame, an aim of this invention is to provide an efficient and safe heating of the working fluid for a user, e.g. a child, who inexpertly opens the washing machine when the resistance is still hot and therefore potentially harmful.

[0022] A further aim is to keep the number of components of the washing machine hydraulic circuit as low as possible, thereby simplifying and economizing on the assembly operations on the production line and on the supply and management of the various components.

[0023] Another aim of the present invention is to provide an apparatus for heating a fluid, or wash water, being as small as possible, in order to obtain an optimum exploitation of the washing machine volume, both within and without the wash tub.

[0024] A further aim is to implement means for heating wash water, or a working fluid for a generic washing machine, which integrates the functions of a number of components of the washing machine, in order to attain the utmost rationalization and economization of resources.

[0025] In order to achieve such aims, it is the object of the present invention an apparatus for heating a working fluid circulating within a washing machine, a method for manufacturing and assembling said apparatus, as well as a washing machine including said apparatus and implementing said method, incorporating the features of the annexed claims, which form an integral part of the present description.

[0026] Further objects, features and advantages of the present invention will become apparent from the following description of a preferred embodiment thereof and from the annexed drawings, which are supplied by way of non-limiting example, wherein:

- Fig. 1 shows a perspective view of the tub bottom of a dishwasher including a wash water heating apparatus according to the invention;
- Fig. 2 shows a different sectional perspective view of a detail of the tub bottom illustrated in Fig. 1;
- Fig. 3 shows a perspective view of a detail of the tub bottom illustrated in Fig. 1.

[0027] All listed illustrations show a heating apparatus A applied to a dishwasher, indicated as a whole with 1 and not represented in its entirety for simplicity's sake, whose working fluid is water supplied from the main to which the machine 1 is connected; washing agents may also be added to said water.

[0028] Fig. 1 shows a perspective view of a tub bottom 2 of the dishwasher 1, on the underside of which a pit can be discerned, indicated as a whole with reference number 3, the bottom of which incorporates the heating apparatus A. Also on the bottom and in fluid connection with the inside, the pit 3 has two branches. The first branch, indicated with 3A, is in fluid connection with the suction side of a drain pump 4 of the machine 1, in order to drain away the water from the hydraulic circuit to the outside; the second branch, not shown in the illustration, is in connection with the suction side of a wash pump of the same machine 1.

[0029] The wash pump outlet is connected, in a known way not detailed here for simplicity's sake, to a first sprayer 6 and a further branch 7, which delivers the

wash water to a second sprayer, not detailed here as well
for simplicity's sake.

[0030] The remaining hydraulic circuit of the dishwasher 1 is not illustrated, being widely known in the art. Besides, the hydraulic circuit has already been described in the introductory section of the present description.

[0031] The figure also shows, underneath the tub bottom 2, a water collecting concave surface 8 terminating in the pit 3, which surface conveys the water contained in the tub toward a hole 9 located centrally with respect to said pit 3.

[0032] Fig. 2 shows a perspective view of the pit 3 of the tub bottom 2, wherein said pit is sectioned with respect to a longitudinal intermediate plane crossing the tub bottom 2. A filtering element 10 is vertically arranged, centered in the pit 3, starting from the hole 9 being present in the surface 8 of the tub bottom 2. The outer surface of the filtering element 10 is extensively holed so as to create a wide mesh, for the purpose of collecting and filtering crockery residues having large dimensions.

[0033] Outside the filtering element 10 there is a swiveling filter 11, having a substantially cylindrical shape and being tight against both the surface 8 and a horizontal plane 12. Said plane 12 divides the pit 3 internally into two areas, i.e. an upper area 3S and a lower area 3I, the latter having the function of collecting the filtered water. The swiveling filter 11, having a fine mesh for providing an accurate filtration of the deposits contained in the collected water, allows the water being present in the filtering element 10 to pass into the annular sector 3SA, which is outside the upper area 3S of the pit 3, and from there to flow down by gravity into the lower area 3I through the passages 12P being present in the horizontal plane 12 of the pit 3.

[0034] On the bottom of the pit 3, and more in particular in the lower area 3I, there is the heating apparatus A, illustrated in detail in Fig. 3. It comprises a disk-shaped element or disk 20 being substantially centered with respect to the pit 3. The disk 20 has a thermal exchange surface 20S located on its side 20B, hereafter called "second side".

[0035] Said disk 20 represents, in particular through its thermal exchange surface 20S, the interface between the wash water, collected in the lower area 3I of the pit 3, and the heating apparatus A. It tends to have such a shape and an extension as to occupy substantially the entire bottom surface of the pit 3 of the dishwasher 1, in order to maximize the heat exchange area and thus increase the caloric power that the apparatus A is capable to exchange through the surface 20S.

[0036] The above disk-shaped element 20 may however have any other shape, in so far as the size and functionality of the heating apparatus A allow.

[0037] The particular shape of the disk-shaped element 20 has been chosen to maximize the thermal exchange area in contact with the water, which is in contact with the disk-shaped element 20 when the apparatus A is in the operating position, and compatibly with the necessity of having:

- a consolidated shape of the pit 3 of the dishwasher 1, in order to obtain savings in the production processes for the pit 3 including the heating apparatus A being the object of the present invention;
- an arrangement of the same element 20 on the bottom of the pit 3, where wash water is always present during the operation of the dishwasher;
- a geometry of the disk-shaped element 20 which is simple, economical to produce and easy to adapt to the part of the hydraulic circuit of the dishwasher 1 it is inserted into, and specifically the pit 3.

[0038] The need of arranging the disk 20 of the heating apparatus A on the bottom of the pit 3 is due to the particular conditions and characteristics of the wash water in such a position:

- the water mass in the pit is larger than that being present in any other point of the entire hydraulic circuit of the dishwasher;
- wash water is always present in the pit, and is in static condition when the wash pump is off, with the consequent advantage of the possibility of applying high caloric power, thus obtaining a quick and uniform heating of the large water mass being present in the pit;
- when the wash pump is on, the whirling motion of the water within the pit facilitates the thermal exchange among the various fluid layers of the water mass, thus helping achieve a uniform and effective heating of said water mass.

[0039] The heating apparatus A is incorporated within the bottom of the lower area 3I of the pit 3; this feature is well illustrated in Fig. 2. The above assembly, which is preferably obtained on manufacturing the part forming the pit 3, is accomplished through a process for co-molding the heating apparatus A within said pit 3; at the end of this process, the heating apparatus A is buried in a polymeric matrix or in general in a matrix made of a plastic material, in particular polypropylene or polycarbonate with reinforcement matrixes.

[0040] During the co-molding process, the heating apparatus A is put into one of the two half-shells making up the mold for the pit 3, being so positioned that the following injection of the plastic material forming the housing of the pit 3 leaves a whole side of the disk 20 exposed. With particular reference to Figs. 2 and 3, the injection of the material leaves the second side 20B exposed, specifically the heating surface 20S of said disk 20, i.e. the side opposite to that where the electric resistances 22 are located, as described below. The remaining parts of the heating apparatus A stay buried in

the plastic matrix forming the pit 3.

[0041] The cited method for co-molding materials of various types with plastic materials forming a particular element, is well known in the art and will not be detailed any further for simplicity's sake. Notoriously, co-molding advantageously allows to obtain accurate couplings between the co-molded elements, at the same time saving resources during the assembly process in comparison with other known techniques.

[0042] Fig. 3 shows a perspective view of the heating apparatus A, which is buried in the mold and therefore in the plastic matrix forming the pit 3 of the dishwasher 1. In this illustration, the disk 20 of the heating apparatus A is shown upside down with respect to the orientation of the disk 20 in Fig.2.

[0043] It has a first side 20A facing up, being opposite to the second side 20B from which the thermal exchange surface 20S is obtained, i.e. the surface that, in the operating condition, is to come in contact with the wash water to be heated in the pit 3.

[0044] On the disk 20 an insulating element 21 is applied, which is made up of various layers of insulating or dielectric material printed or silk-screened on the same disk 20. The electric resistances 22 are in turn silk-screened on said insulating element 21, according to a method known in the art, for generating heat by Joule effect. In the configuration shown in Fig. 3, said silk-screened resistances 22 have a circular ring shape and cover most of the outer surface of the first side 20A. The ends of these rings making up the resistances 22 are connected to the respective ends of a pair of terminals 23, and therefore each terminal is in electric connection with one end of all the circular sectors making up the silk-screened resistances 22, thus ensuring a flow of electricity. Said electric connection is provided through channels made of conductive material obtained inside or outside the layers making up the insulating element 21, always ensuring their electric insulation from the disk 20. The above electrically conductive channels, also conveniently manufactured through printing or silk-screening, are not shown in Fig. 3 for simplicity's sake.

[0045] By means of a suitable connector, in the operating condition of the washing machine 1 a potential difference is applied to said pair of terminals 23, enabling the circulation of electric current within the resistances 22, thereby heating them.

[0046] Being the resistances 22 silk-screened on the outer side of the insulating element 21, and therefore on the side opposite to the second side 20B of the disk 20, there is no electric contact between them and the disk 20. The silk-screened resistances 22 are then appropriately covered externally with another electrically and thermally insulating material, in order to avoid the dissipation of electricity and heat to the outside, thereby allowing the heat to be directed toward the second side 20B of the disk 20 and therefore to the wash water through the interface surface 20S.

[0047] The pair of terminals 23, in the condition shown in Fig. 2, with the apparatus A joined to the pit 3, conveniently protrudes under the pit 3 into a suitable seat 3C. Clearly, the realization of said seat 3C is taken into account when co-molding the heating apparatus A in the pit 3.

[0048] This allows an operator, during the assembly phase of the dishwasher 1, to connect to the pair of terminals 23 a suitable connector which in turn is connected to the electric supply of the washing machine 1. Said electric supply, driven by a control logic, during the wash water heating phase commands the application of a suitable potential difference to the terminals 23 and therefore to the silk-screened resistances 22 for a time calculated and programmed in the control unit that manages the system.

[0049] With reference to Fig. 3, the resistances 22 obtained by silk-screening are distributed on the first side 20A of the disk 20, so as to occupy substantially most of the available surface of the same face 20A, thereby maximizing the caloric power to be transmitted to the water. In the assembled condition of the apparatus A co-molded in the pit 3, the resistances 22 are positioned, as regards the part not touching the first side 20A of the disk 20, completely buried in the matrix being the material of the pit 3. Said resistances 22 are completely insulated electrically beforehand, e.g. by applying a film of an electrically insulating material over them; any dispersion of electricity is thus avoided when an electric potential difference is applied to the terminals 23.

[0050] The disk 20 of the heating apparatus A has a protruding part 20L from the disk 20 itself, to facilitate its correct positioning during the co-molding operation within the pit 3.

[0051] Typically the disk 20 is made of stainless steel; some variants employ quartz glass and/or ceramic materials. Such materials have better characteristics in terms of weight and electric insulation from the water in contact with the surface 20S of the second side 20B when the apparatus A is in the operating condition.

[0052] The operation of the heating apparatus A inserted in a washing machine 1, in this particular case a dishwasher, as well as the method for heating the water circulating within the hydraulic circuit of such a machine are described below.

[0053] When a logic control of a management and check system of the washing machine 1, in particular a dishwasher, is programmed to start a wash water heating phase, a potential difference suitable for causing the circulation of electric current within the silk-screened resistances 22 is applied to the terminals 23, through known connector means not represented here for simplicity's sake, thereby heating said resistances. It should be remembered that the resistances 22, as described, are insulated only electrically, not thermally, from the disk 20 of the heating apparatus A through the insulating element 21, and therefore heat the entire disk 20. The thermal flow is then transferred to the wash water in contact with the thermal exchange surface 20S. This proc-

ess lasts the time necessary to implement the wash fluid heating phase, and takes place according to the instructions programmed in the control logic of the management and control system of the machine 1.

[0054] It must be highlighted that the heating apparatus A, which is the object of the present invention, is designed and made in such a way as to be completely integrated, and so produced as one unit, with an element of the hydraulic circuit of the washing machine 1, in this specific case the pit 3 of a dishwasher.

[0055] This gives the evident advantage of simplifying the operations needed for assembling the apparatus A into the washing machine 1, being such operations carried out during the co-molding process. The assembler's only task is to connect a specific connector, being connected to the control and management system of the machine 1, to the terminals 23 of the heating apparatus A. It follows that the washing machine assembly process is faster and simpler, with the possibility of increasing the units manufactured along the same production line and of decreasing the risk of assembly errors.

[0056] The characteristics of the apparatus for heating a working fluid circulating within a washing machine, of the method for manufacturing and assembling said apparatus, and of the washing machine incorporating said apparatus and implementing said method, as well as their advantages, are apparent from the above description.

[0057] An advantage is represented by an appreciable simplification of the supply and management activities related to the parts making up the washing machine, the latter being less complex than the known solutions, thereby improving the management of the industrial processes.

[0058] A further advantage is the reduction of the time needed to assembly the heating apparatus into the washing machine, said operation being simpler, with a consequent reduction of the risk of assembly errors by the operator.

[0059] A further advantage lies in the fact that the above improvements are implemented by obtaining an excellent ability of heating the mass of water circulating within the hydraulic circuit, as well as by using a known and reliable technology which however has found no applications so far in this field and for the purposes of the present invention.

[0060] In conclusion, the inventive idea of the present Patent substantially consists in applying the co-molding technique to working fluid heating apparatuses inserted within the plastic material being a part of a hydraulic circuit of a washing machine, in particular a household dishwasher. The heating devices substantially consist of resistive elements being electrically insulated in respect to a plane of a thermally conductive element suitable for transmitting heat to the working fluid being present in the hydraulic circuit.

[0061] Advantageously, the resistive elements may be silk-screened, after having been appropriately insulated electrically, onto a side of said thermally conductive and electrically insulated element, which side clearly must not be in contact with the working fluid.

[0062] Furthermore, in order to avoid heat dispersions outside the working fluid and to let the heat propagate quickly and effectively within the same fluid, preferably the heating devices are co-molded within particular components located in specific points of the hydraulic circuit of the machine. For example, the heating apparatus is applied where a big water mass is constantly present and in continuous contact with the heat transmitting surface, being said water mass preferably subjected to a slightly whirling motion. Thus the caloric power applied may be very high, thereby promoting a reduction of the water heating times.

[0063] Advantageously, therefore, the propagation of heat takes place not only by conduction among the layers of the working fluid, i.e. natural convection, but also by forced convection, thereby improving the transmission and distribution of caloric power within the working fluid. It follows that efficient washings can be performed in less time.

[0064] It is clear that many changes are possible for the man skilled in the art to the method and the apparatus for heating a working fluid circulating within a hydraulic circuit of a washing machine described herein by way of example, without departing from the novelty spirit of the innovative idea; likewise, it is also clear that in the final implementation the details illustrated may have different shapes or be replaced with other technically equivalent elements.

[0065] For example, the heating apparatus with silk-screened resistances may be applied by co-molding to the scroll of the wash pump of the hydraulic circuit of a washing machine, in particular a dishwasher or a laundry washing machine.

[0066] Such a solution is cheaper to produce compared to the previously described one, as well as easier to implement for wash pump manufacturers, in that it offers superior versatility as regards product customization and component assembly.

[0067] The silk-screened resistance typology and the process for co-molding the heating device within the scroll of the wash pump are quite similar to what previously described regarding the application on the bottom of the pit of the dishwasher; the details are therefore omitted for simplicity's sake.

[0068] The inventive principle applied to a dishwasher in the example shown in Fig. 1-3 may also be applied to a laundry washing machine. In a substantially similar way, the co-molding of electric resistances, in particular of silk-screened ones, may be accomplished within any part being made of a plastic material and pertaining to the hydraulic circuit of the laundry washing machine, if the latter is made of a plastic material.

[0069] Advantageously, this operation may for instance be carried out in those areas where a large quantity of wash water is collected, such as the bottom of the

wash tub of a laundry washing machine. Moreover, the silk-screened resistances may be located inside the scroll of the wash pump, or within any container where there is a large quantity of still water.

Claims

1. Apparatus for heating a working fluid circulating within a hydraulic circuit of a washing machine (1), of a type comprising a first element (20) having a thermal exchange surface (20S) operationally in contact with said working fluid during at least one heating phase of said working fluid of said machine (1),
characterized in that it is associated by co-molding with a component (3) of the hydraulic circuit of said washing machine (1).

2. Apparatus, according to claim 1, **characterized in that** said heating apparatus (A) of said washing machine (1) comprises a silk-screened resistance (22), associated with said first element (20), for heating the same element (20).

3. Apparatus, according the previous claim, **characterized in that** said silk-screened resistance (22) is associated with a first side (20A) of said first element (20) of said heating apparatus (A), being different from a second side (20B) housing said thermal exchange surface (20S) operationally in contact with said working fluid.

4. Apparatus, according to the previous claim, **characterized in that** said silk-screened resistance (22) is substantially buried in the material forming said component (3) of said washing machine (1) when said heating apparatus (A) is co-molded to said component (3) of said washing machine (1).

5. Apparatus, according to claim 3 or 4, **characterized in that** said heating apparatus (A) comprises an insulating element (21) associated with said first element (20), on which the resistive material forming said silk-screened resistance (22) is applied, said insulating element (21) being electrically but not thermally insulated from said first element (20).

6. Apparatus, according to the previous claim, **characterized in that** said insulating element (21) is made of an electrically insulating material and is associated with a number of electrically conductive ducts being suitable for transmitting a potential difference exclusively to the ends of said silk-screened resistance (22) in order to heat it.

7. Apparatus, according to one or more of the previous claims, **characterized in that** said washing machine is a dishwasher (1) or a laundry washing machine, in particular for household use.

8. Apparatus, according to the previous claim, **characterized in that** said component (3) of said hydraulic circuit is the pit (3) of said dishwasher (1).

9. Apparatus, according to the previous claim, **characterized in that** said heating apparatus (A) is housed in a portion (3I, 3S) of said pit (3) of said dishwasher (1), with said thermal exchange surface (20S) facing the pit (3).

10. Apparatus, according to the previous claim, **characterized in that** said portion of said pit (3) of said dishwasher (1) comprises the lower portion (3I) of said pit (3).

11. Apparatus, according to the previous claim, **characterized in that** said first element (20) of said apparatus (A) has such a shape as to occupy substantially the whole bottom of said pit (3) of said dishwasher (1).

12. Apparatus, according to the previous claim, **characterized in that** said element of said heating apparatus (A) comprises a disk-shaped element (20), which is located at the bottom of said lower portion (3I) of said pit (3).

13. Apparatus, according to claim 11 or 12, **characterized in that** said disk-shaped element 20 is made of a metal material.

14. Apparatus, according to claim 11 or 12, **characterized in that** said disk-shaped element (20) is made of quartz glass and/or ceramic materials.

15. Apparatus, according to one or more of claims 1 to 7, **characterized in that** said component (3) of said hydraulic circuit of said washing machine (1) is a scroll of a wash pump (5) of the hydraulic circuit.

16. Method for manufacturing and assembling an apparatus (A) for heating a working fluid circulating within a hydraulic circuit of a washing machine (1), comprising the operation for associating said heating apparatus (A) with a component (3) of said hydraulic circuit of said washing machine (1), so that at least a first element (20) of said heating apparatus (A) is operationally in contact with said working fluid through its thermal exchange surface (20S) at least during the implementation of one heating phase of said washing machine (1),
characterized in that it comprises a process for co-molding said heating apparatus (A) into said component (3) of said hydraulic circuit of said washing machine (1).

17. Method, according to the previous claim, **characterized in that** said co-molding process comprises the insertion of said heating apparatus (A) in association with a plastic matrix characterizing at least part of said component (3).

18. Method, according to claim 16 or 17, **characterized in that** said process for co-molding said heating apparatus (A) into said component (3) of said washing machine (1) is carried out in such a way that said heating apparatus (A) forms one unit together with said component (3), i.e. said heating apparatus (A) is fitted in the washing machine (1) simultaneously with said component (3).

19. Method, according to claim 16 or 17 or 18, **characterized in that** it comprises an operation for pre-assembling said heating apparatus (A) before it is positioned into the molds for the actuation of said co-molding process.

20. Method, according to the previous claim, **characterized in that**, before said pre-assembly process, said heating apparatus (A) is manufactured by using a silk-screening process for applying a resistive material onto at least one portion (21) of said heating apparatus (A), in particular said silk-screened resistive material forming a resistance (22) suitable for generating heat to be transmitted to said element (20) being operationally in contact with said working fluid through one of its surfaces (20S).

21. Method, according to the previous claim, **characterized in that** said silk-screening process comprises the application of the resistive material onto an insulating element (21) being electrically but not thermally insulated with respect to said first element (20) of said heating apparatus (A).

22. Method, according to the previous claim, **characterized in that** said silk-screening process comprises the association of said insulating element (21) with a first side (20A) of said first element (20), different from a second side (20B) where said thermal exchange surface (20S) is obtained.

23. Method, according to one or more of the previous claims from 16 to 22, **characterized in that** said process for co-molding said heating apparatus (A) into said washing machine (1) is implemented when said component (3) being a part of the hydraulic circuit of said washing machine (1) is manufactured, in particular so that said component (3) is substantially ready for being fitted along a production line of said washing machine (1).

24. Method, according to one or more of the previous claims from 16 to 23, **characterized in that** said process for co-molding said heating apparatus (A) is carried out within said component (3) of the hydraulic circuit of said washing machine (1), said component (3) being located at a point of said hydraulic circuit where said working fluid is operationally present in a large quantity and/or subjected to a whirling motion.

25. Method, according to one or more of the previous claims from 16 to 24, **characterized in that** it is applied to a dishwasher (1), and said component (3) of said hydraulic circuit of said washing machine (1) is the pit (3) of said dishwasher (1).

26. Method, according to the previous claim, **characterized in that** during said co-molding process, said heating apparatus (A) is associated with a lower area (3l) of said pit (3) of said dishwasher (1).

27. Method, according to the previous claim, **characterized in that** during said co-molding process, said heating apparatus (A) is associated with the bottom of said lower area (3l) of said pit (3).

28. Method, according to one or more of claims 16 to 24, **characterized in that**, during said co-molding process, said heating apparatus (A) is associated with a scroll of a wash pump (5) of said hydraulic circuit of said washing machine (1).

29. Washing machine comprising an apparatus (A) for heating a working fluid circulating within a hydraulic circuit of a washing machine (1), according to one or more of claims 1 to 15.

30. Washing machine implementing a method for manufacturing and assembling an apparatus (A) for heating a working fluid circulating within a hydraulic circuit of said washing machine (1), according to one or more of claims 16 to 28.

31. Washing machine, apparatus for heating a working fluid circulating within a hydraulic circuit of said washing machine (1), method for manufacturing and assembling said apparatus (A) for heating a working fluid circulating within a hydraulic circuit of said washing machine (1), according to the teachings of the present description and of the annexed drawings.

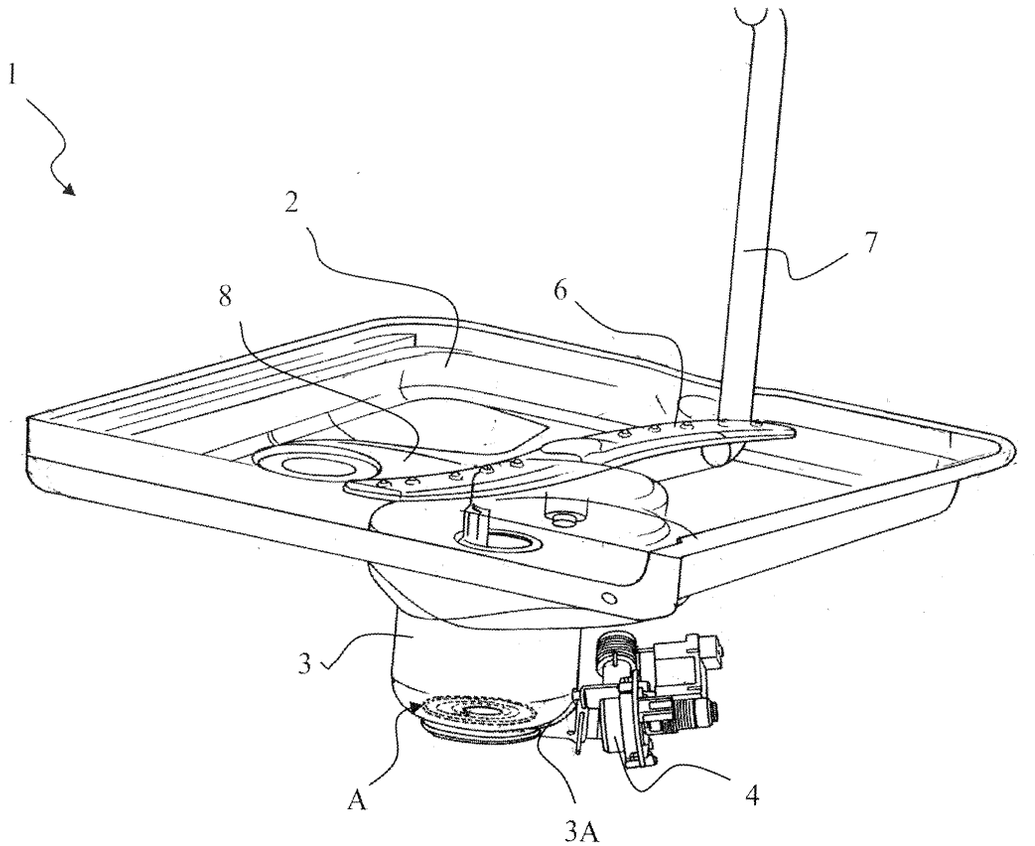

Fig. 1

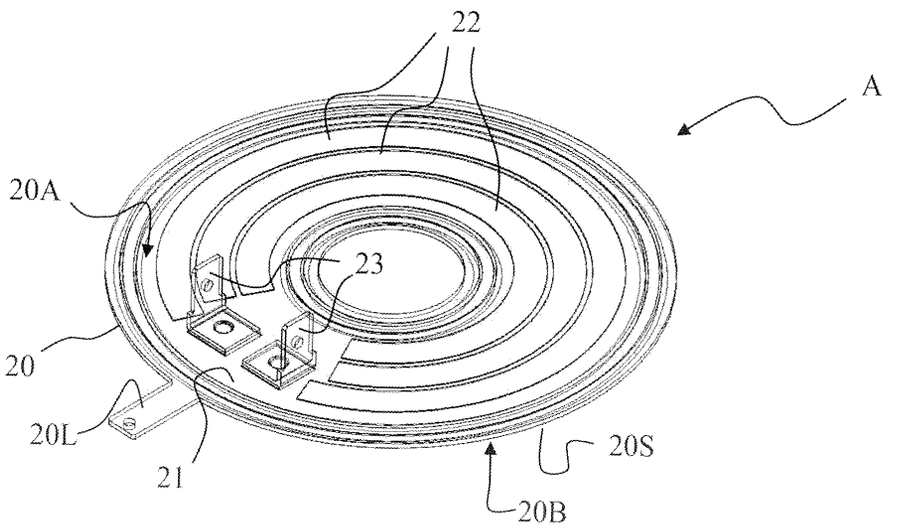

Fig. 3

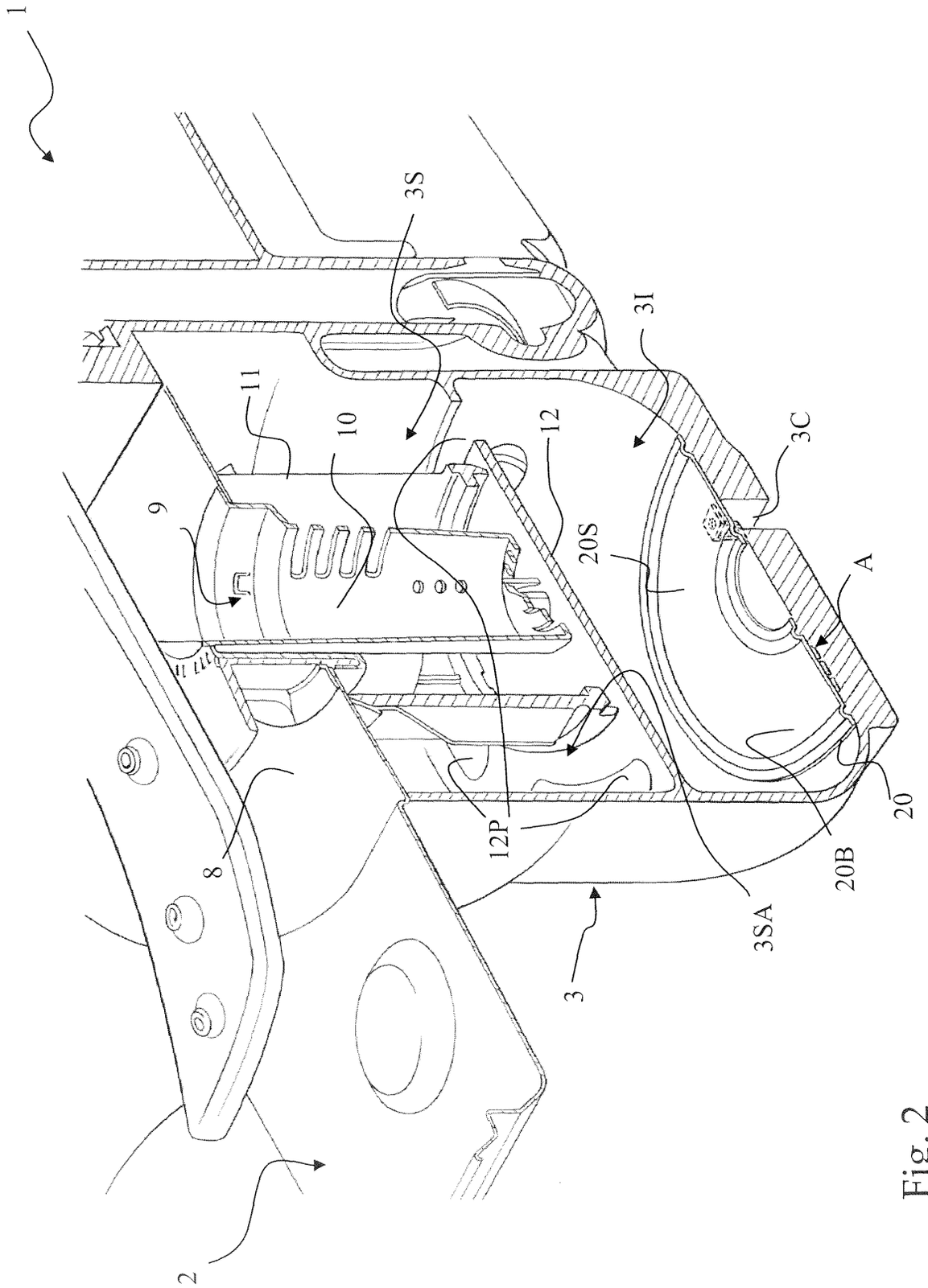

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 10 5999

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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Y		2-6, 8-14, 20-22, 25-27	
X	DE 202 08 545 U1 (AWECO APPLIANCE SYSTEMS GMBH & CO. KG) 19 December 2002 (2002-12-19) * page 4, line 1 - page 5, line 6 * * page 6, line 21 - page 9, line 20 * * figure 4 *	1,7, 15-19, 23,24, 28-30	
Y	EP 0 352 499 A (INDUSTRIE ZANUSSI S.P.A) 31 January 1990 (1990-01-31) * the whole document *	2-6, 20-22	TECHNICAL FIELDS SEARCHED (Int.Cl.7) A47L D06F
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~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
Munich	2 March 2005	Weinberg, E

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

EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 04 10 5999

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

[X] Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

11-30

[ ] No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

[ ] All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

[ ] As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

[ ] Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

[ ] None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 10 5999

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82