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(54) **Improved washing machine for domestic use**

(57) A washing machine for domestic use, in particular a laundry washing machine, is described which comprises:

- a wash tub adapted to contain a certain quantity of laundry;
- means for containing and dispensing washing agents, comprising at least one compartment;
- means for supplying water from the main to the wash tub, comprising valves for selectively conveying the supply water into said at least one compartment;
- means for managing and controlling the washing machine, adapted to store and select at least one wash programme, said wash programme comprising one or more phases (prewash, wash, bleaching, softener, etc.) for washing laundry.

The invention is characterized in that said washing machine is provided with at least one programme being specifically dedicated to the dyeing of laundry inside said washing machine and comprising phases which optimize the dyeing and fixing process according to the type of laundry loaded in said machine.

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**Description**

**[0001]** The present invention relates to a washing machine for domestic use, in particular a laundry washing machine, according to the preamble of claim 1.

**[0002]** The known washing machines for domestic use, hereafter simply called laundry washing machines, have means for managing and controlling the operation of the washing machine which generally comprise an electronic board and substantially are used for implementing wash programmes, or cycles.

**[0003]** Current laundry washing machines for domestic use are designed for executing a plurality of wash programmes, which typically vary depending on the load, the type of the fabric, and of the degree of dirtiness or rinsing performance required for the laundry to be washed; said laundry washing machines may also be fitted with a programme for drying the laundry when the wash is finished.

**[0004]** An example of a wash programme (or cycle), which may be defined as a generic or standard wash programme at a certain temperature  $T$ , e.g. 40 - 90°C, is briefly described below. It comprises the following phases:

- an initial supply of water into the wash tub, typically a quantity being proportional to the loaded laundry (approx. between 7 and 20 litres for household washing machines having drums carrying 5-6 Kg of laundry), wherein detergents and wash additives are also supplied (usually by supplying water into the respective compartments before they are released into the tub);
- heating the water to a first temperature  $T_1$ , generally approx. 40°C;
- rotation of the drum of the washing machine without the water in the wash tub being heated, for a relatively short time interval  $\Delta t_1$  of approx. 5 minutes;
- heating the water to a second temperature  $T_2$ , generally approx. 50°C, higher than  $T_1$ ;
- rotation of the drum for a short time  $\Delta t_2$  of approx. 2 minutes;
- heating the water up to a temperature  $T_3$ , higher than  $T_2$ , being appropriate for the wash programme (e.g. 60 - 90°C), and rotation of the drum for a time interval  $\Delta t_3$ , typically approx. 30 minutes;
- end of wash spinning;
- implementation of a multiplicity of rinse cycles, generally 3 or 4, with supply of new water from the main;
- final spinning.

**[0005]** The chemical industry has for some time now put on the market kits for dyeing laundry items; such kits are made up of a dyestuff in a liquid or powder form, a salt and a fixing agent, which allow the dyestuff to be fixed to the fabrics of the items to be dyed.

**[0006]** The dyestuffs currently available on the market are reactive dyestuffs, adapted to act in water solution, and are compounds of azoic, carbonylic or similar types.

**[0007]** To ensure an effective and long-lasting result, every fabric requires the use of a particular dyestuff. Moreover, for each dyestuff-fabric combination the process is characterized by a specific dyeing kinetics and a specific dyeing balance, which are affected by chemical-physical parameters such as: temperature of the dyeing solution, presence of chemical additives, time of contact between fabric and dyeing solution, bath ratio, i.e. the ratio between quantity of water and quantity of dyestuff in the solution.

**[0008]** Therefore, in order to allow the combination of dyestuff, salt and fixing agents adapted to dye a certain type of fabric to reach the utmost effectiveness (i.e. for the dyestuff to give the fabric the desired color shade and for the mixture of salt and fixing agents to complete the process of fixing the dyestuff permanently), it is necessary that the dyestuff, salt and fixing agents act within a certain time interval, at a certain temperature and in the presence of certain conditions of bath ratio and water stirring.

**[0009]** A user can use the currently available dyestuffs either by carrying out the dyeing manually or by putting such products into the wash tub of a washing machine and subsequently selecting a generic wash programme.

**[0010]** In the first case, i.e. if the user decides to carry out the dyeing of the laundry manually, the user will be first of all compelled to pay some and constant attention to the progress of the recommended dyeing process, as regards the temperature of the water to be used and the time intervals during which the laundry must be soaked in the dyestuff, and for deciding when and how to add the salts and the fixing agent.

**[0011]** Furthermore, the current chemical components of dyeing kits must act, to be effective, for a relatively long time (at least 30-60 minutes) and at a high temperature (i.e. at least 60-90°C). This is not easily feasible manually by using traditional methods, for instance inside a washing trough with hot water supplied by normal household boilers or water heaters, so appropriate solutions for supplying heat constantly to the dyeing water should be adopted.

**[0012]** In the second case, i.e. if the user decides to put the dyeing products into the wash tub of a laundry washing machine, it is necessary to highlight the fact that the wash programmes implemented by the current washing machines for domestic use, such as the previously described standard programme, only allow for a modest utilization of the potentialities of existing dyestuffs; as a matter of fact, to dye an item effectively, said dyestuffs need to be used in large

quantities compared to the effective optimal dosage which would be required if all due conditions were respected during the execution of the dyeing process as regards times, temperatures, bath ratio and stirring of the laundry in the tub.

**[0013]** In short, the wash programmes implemented by the laundry washing machines known in the art are mostly aimed at performing well during the wash cycles and possibly during a post-wash drying cycle, but they are not suitable for dyeing laundry in an effective way and without wasting chemical substances, which on top of everything else they are also strong pollutants.

**[0014]** The present invention aims at solving the above-described drawbacks of the prior art and, in particular, at providing a washing machine for domestic use, in particular a laundry washing machine, adapted to perform an effective laundry dyeing process in a household environment. Said dyeing process is carried out in a specific and optimal manner based on the type of fabrics to be dyed.

**[0015]** A further object is to extend the actual versatility of washing machines for domestic use, in particular of laundry washing machines, and to manufacture said washing machines in such a way as to allow for new and various utilizations; in particular, to be able to carry out a laundry dyeing process with an effectiveness being unknown to the prior art, by means of washing machines which up till now have been used just for washing and possibly for drying laundry, i.e. operations being antithetical to dyeing.

**[0016]** A further object is then to provide new operating programmes allowing the washing machine to operate fully automatically, i.e. without a user having to carry out any checks during the execution of the programme, and ensuring good results.

**[0017]** Another object is to provide a proper dyeing of the laundry appropriate to the different types of fabrics, by adapting the operation of the laundry washing machine to a specific fabric type.

**[0018]** A further object is to provide an efficient dyeing of the laundry by appropriately using the chemical and physical characteristics of the dyestuff, salts and fixing agents known in the art.

**[0019]** A further object consists in providing an efficient dyeing system which avoids any waste of chemical pollutants.

**[0020]** In order to achieve these objects, the present invention provides a washing machine for domestic use, in particular a laundry washing machine, incorporating the features of the annexed claims, which are to be considered as an integral part of the present description.

**[0021]** Further objects, features and advantages of the present invention will become apparent from the following detailed description.

**[0022]** Let us consider a washing machine for domestic use, in particular a laundry washing machine, which is briefly described below. It comprises the following means, having the corresponding features:

- a wash tub, inside which a rotating drum or an agitator may be housed, adapted to contain a certain quantity of laundry, e.g. approx. 5-6 Kg;
- means for containing and dispensing washing agents, generally comprising one or more compartments, in particular a compartment for prewash detergent, a compartment for a wash detergent, and a compartment for a softening additive;
- means for supplying water from the main to the wash tub, comprising valves for conveying the supply water selectively into said plurality of compartments of said containing means;
- means for managing and controlling the washing machine, adapted to store and select the wash programmes of said washing machine. Said management and control means generally comprise an electronic board for controlling actuators and means for selecting said wash programmes, e.g. graduated knobs or dedicated push-buttons, which allow the user to choose the desired wash programme.

**[0023]** In general, the wash programmes used in modern laundry washing machines for domestic use may comprise one or more distinct treatment phases, such as prewash, wash, rinse, spin and drying, which involve different laundry treatment processes.

**[0024]** In accordance with the present invention, the washing machine for domestic use has at least one programme being specifically dedicated to the dyeing of laundry inside said washing machine, wherein the single operating phases are adapted to optimize a dyeing and fixing process according to the type of laundry loaded in the washing machine.

**[0025]** Said dyeing programme can be selected through said management and control means; in particular, said management and control means comprise means for selecting dyeing programmes, in particular comprising graduated knobs or dedicated push-buttons.

**[0026]** More sophisticated machines may be provided with a keyboard and a luminous display as user interface; this solution is particularly advantageous if the machine has more than one dyeing programme.

**[0027]** Besides, said dyeing programme provides for the automatic execution of at least one wash cycle.

**[0028]** The dyestuff, salt and fixing agent may advantageously be loaded into a compartment of said means for containing and dispensing washing agents of the washing machine, in order to be subsequently discharged into the wash tub together with the water from the main, so as to perform a fully automatic dyeing process. As an alternative,

the dyestuff and the salt may be loaded into one compartment and the fixing agent into an additional compartment, or there may be three specific compartments for said dyestuff, salt and fixing agent, respectively.

**[0029]** As said, for the dyestuff to give the desired colour shade to a certain type of fabric, and for the mixture of salt and fixing agents to provide a permanent colour fixing, they must act under different conditions of time, temperature, bath ratio and water stirring depending on the fabric to be dyed.

**[0030]** Experiments carried out have shown that fabrics like cotton, linen, denim and other similar fabrics can be subjected to the same dyeing programme, hereafter simply referred to as dyeing programme for cotton.

**[0031]** The washing machine according to the present invention comprises at least one specific dyeing programme for cotton, in particular comprising the following sequential phases:

- initial supply of water, dyestuff, salt and fixing agent into the wash tub;
- heating the water and keeping the same at a first temperature  $T_{c1}$  of approx. 50°C; fixing agent, salt and dyestuff are already present in the wash tub;
- rotation of the drum of the washing machine, heating the water and keeping the same at a second temperature  $T_{c2}$  higher than  $T_{c1}$ , set for the dyeing programme for cotton, of approx. 60°C;
- rotation of the drum for a time interval  $\Delta t_{c1}$  of approx. 50-60 minutes;
- implementation of a plurality of rinse cycles, in particular three.

**[0032]** The dyeing programme for cotton also provides for the implementation of a specific wash cycle for said type of fabrics, being subsequent to the dyeing process and carried out automatically.

**[0033]** The detergents for the wash cycle implemented during the dyeing programme for cotton may also be loaded in the means for containing and dispensing washing agents of the washing machine.

**[0034]** Tests carried out have also shown that the above-described dyeing programme for cotton might suffer the drawback of causing some damage to certain articles of laundry of particular types or made of fabrics being delicate and/or subject to dimensional variations, such as knitwear and/or articles made of fabrics subject to felting (e.g. articles made of wool, mohair, cashmere, alpaca, camel-hair, etc.) and/or articles made of fabrics prone to stretching.

**[0035]** The washing machine for domestic use according to the present invention has at least one specific dyeing programme for the above listed delicate laundry articles, which for simplicity's sake will hereafter be referred to as dyeing programme for delicate fabrics.

**[0036]** Also for the dyeing programme for delicate fabrics, the dyestuff, salt and fixing agent may be loaded into a compartment of the means for containing and dispensing washing agents of the washing machine, in order to be subsequently discharged into the wash tub together with the water from the supply. As an alternative, the dyestuff and the salt may be loaded into one compartment and the fixing agent into an additional compartment, or there may be three specific compartments for said dyestuff, salt and fixing agent, respectively.

**[0037]** Said dyeing programme for delicate fabrics comprises the following phases:

- initial supply of water, dyestuff, salt and fixing agent into the wash tub;
- heating and keeping the water at a first temperature  $T_{d1}$  of approx. 80 - 90°C, preferably with the drum being stationary or rotating slowly;
- rotation of the drum for a time interval  $\Delta t_{d1}$  of approx. 50-60 minutes;
- implementation of a plurality of rinse cycles, in particular three, at least one of which being a hot rinse cycle, i.e. at a temperature of approx. 40 - 50°C;
- second supply of water into the wash tub;
- heating the water and keeping the same at said first temperature  $T_{d1}$ , preferably with the drum being stationary or rotating slowly;
- rotation of the drum for said time interval  $\Delta t_{d1}$ ;
- implementation of a plurality of rinse cycles, in particular three, at least one of which being a hot rinse cycle.

**[0038]** The dyeing programme for delicate fabrics also comprises, following the dyeing process, the automatic implementation of a wash cycle for delicate items, e.g. for laundry articles made of particular fabrics being delicate and/or subject to dimensional variations, knitwear and/or laundry articles subject to felting and/or stretching.

**[0039]** The features of the present invention, as well as its advantages, are apparent from the above description.

**[0040]** In particular, the fact that the washing machine for domestic use, in particular a laundry washing machine, has at least one programme specifically designed for dyeing laundry allows to have a washing machine for domestic use which is adapted to perform an efficient dyeing of laundry in a household environment, said dyeing being carried out in a specific and optimal manner based on the type of fabrics to be dyed and without wasting chemical substances.

**[0041]** A further advantage of the washing machine for domestic use according to the present invention is the fact that the actual versatility of said washing machines for domestic use is widened, so that new and various utilizations are

allowed, even being antithetical to the traditional ones, and that it is possible to carry out, with an effectiveness unknown to the prior art, the dyeing of laundry by means of washing machines which have been normally used so far just for washing and possibly drying laundry.

[0042] A further advantage of the washing machine for domestic use according to the present invention is the fact that the dyeing programmes may be executed fully automatically, i.e. without the user having to carry out any checks during the execution of the programme, while ensuring good results. In particular, the dyeing programmes may be executed automatically also thanks to the fact that the dyestuff, salt and fixing agent can be loaded into the various compartments of the means for containing and dispensing washing agents.

[0043] A further advantage of the washing machine for domestic use according to the present invention is the fact that it is possible to provide a proper colouring of the laundry according to the different types of fabrics, by modifying the operation of the washing machine depending on the type of fabric.

[0044] The washing machine for domestic use described herein by way of example may be subject to many further possible variations without departing from the novelty spirit of the inventive idea; it is also clear that in the practical realization of the invention the illustrated details may have different shapes or be replaced with other technically equivalent elements.

[0045] It can therefore be easily understood that the present invention is not limited to the above described washing machine, but may be subject to many modifications, improvements or replacements of equivalent parts and elements without departing from the inventive idea, as clearly specified in the following claims.

## Claims

1. Washing machine for domestic use, in particular a laundry washing machine, comprising:

- a wash tub adapted to contain a certain quantity of laundry;
- means for containing and dispensing washing agents, comprising at least one compartment;
- means for supplying water from the supply to the wash tub, comprising valves for selectively conveying the supply water into said at least one compartment;
- means for managing and controlling the washing machine, adapted to store and select at least one wash programme, said wash programme comprising one or more phases (prewash, wash, bleaching, softener, etc.) for washing laundry,

said washing machine being **characterized in that** it is provided with at least one programme being specifically dedicated to the dyeing of laundry inside said washing machine and comprising phases which optimize the dyeing and fixing process according to the type of laundry loaded in said machine.

2. Washing machine for domestic use according to claim 1, **characterized in that** said dyeing programme can be selected through said management and control means of the machine.

3. Washing machine for domestic use according to one or more previous claims, **characterized in that** said management and control means comprise means for selecting at least one dyeing programme, in particular comprising graduated knobs or dedicated push-buttons.

4. Washing machine for domestic use according to one or more previous claims, **characterized in that** it comprises a keyboard and a luminous display as a user interface, specifically adapted to the case wherein said washing machine has more than one dyeing programme.

5. Washing machine for domestic use according to one or more previous claims, **characterized in that** said dyeing programme provides for the implementation of at least one wash cycle for said laundry, which is executed automatically once the dyeing process is over.

6. Washing machine for domestic use according to claim 1, **characterized in that** a dyestuff, a salt and a fixing agent are loaded into said at least one compartment, in order to be subsequently discharged into the wash tub together with the water from the supply.

7. Washing machine for domestic use according to claim 1, **characterized in that** it comprises at least one additional specific compartment, preferably three additional specific compartments, for a dyestuff, a salt and a fixing agent.

8. Washing machine for domestic use according to one or more previous claims 1 to 5, **characterized in that** said dyeing programme is a dyeing programme adapted to dye cotton fabrics.

9. Washing machine for domestic use according to claims 6 and 8 or 7 and 8, **characterized in that** said dyeing programme for cotton comprises the following phases:

- initial supply of water, dyestuff, salt and fixing agent into the wash tub;
- heating the water and keeping the same at a first temperature  $T_{C1}$  of approx. 50°C;
- rotation of the drum of the washing machine, heating the water and keeping the same at a second temperature  $T_{C2}$  higher than  $T_{C1}$ , set for the dyeing programme for cotton, of approx. 60°C;
- rotation of the drum for a time interval  $\Delta t_{C1}$  of approx. 50-60 minutes;
- implementation of a plurality of rinse cycles, in particular three.

10. Washing machine for domestic use according to claim 8 or 9, **characterized in that** said dyeing programme for cotton comprises a wash cycle carried out automatically after the dyeing process.

11. Washing machine for domestic use according to one or more previous claims 1 to 5, **characterized in that** said dyeing programme is a dyeing programme for delicate fabrics.

12. Washing machine for domestic use according to claims 6 and 11 or 7 and 11, **characterized in that** said dyeing programme for delicate fabrics comprises the following phases:

- initial supply of water, of said dyestuff, of said salt and of said fixing agent into the wash tub;
- heating the water and keeping the same at a first temperature  $T_{d1}$  of approx. 80 - 90°C, preferably with the drum being stationary or rotating slowly;
- rotation of the drum for a time interval  $\Delta t_{d1}$  of approx. 50-60 minutes;
- implementation of a plurality of rinse cycles, generally three, at least one of which being a hot rinse cycle, i.e. at a temperature of approx. 40 - 50°C;
- second supply of water into the wash tub;
- heating the water and keeping the same at said first temperature  $T_{d1}$ , preferably with the drum being stationary or rotating slowly;
- rotation of the drum for said time interval  $\Delta t_{d1}$ ;
- implementation of a plurality of rinse cycles, in particular three, at least one of which being a hot rinse cycle.

13. Washing machine for domestic use according to the previous claim, **characterized in that** said dyeing programme for delicate fabrics also comprises a wash cycle for delicate fabrics carried out automatically after the dyeing process.

14. Method for controlling the operation of a washing machine for domestic use, in particular a laundry washing machine, comprising:

- a wash tub adapted to contain a certain quantity of laundry;
- means for containing and dispensing washing agents, comprising at least one compartment;
- means for supplying water from the supply to the wash tub, comprising valves for selectively conveying the supply water into said at least one compartment;
- means for managing and controlling the washing machine, adapted to store and select at least one wash programme, said wash programme comprising one or more phases (prewash, wash, bleaching, softener, etc.) for washing laundry,

said method being **characterized in that** it provides for the implementation of a programme being specifically dedicated to the dyeing of laundry inside said washing machine and comprising phases which optimize the dyeing and fixing process according to the type of laundry loaded in the machine.

15. Method according to the previous claim, **characterized in that** said dyeing programme is a dyeing programme adapted to dye cotton fabrics, said programme comprising the following phases:

- initial supply of water, dyestuff, salt and fixing agent into the wash tub;
- heating the water and keeping the same at a first temperature  $T_{C1}$  of approx. 50°C;
- rotation of the drum of the washing machine, heating the water and keeping the same at a second temperature

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$T_{c2}$  higher than  $T_{c1}$ , set for the dyeing programme for cotton, of approx. 60°C;

- rotation of the drum for a time interval  $\Delta t_{c1}$  of approx. 50-60 minutes;

- implementation of a plurality of rinse cycles, in particular three.

5    **16.** Method according to claim 14, **characterized in that** said dyeing programme is a dyeing programme adapted to dye delicate fabrics, said programme comprising the following phases:

- initial supply of water, of said dyestuff, of said salt and of said fixing agent into the wash tub;

10    - heating the water and keeping the same at a first temperature  $T_{d1}$  of approx. 80 - 90°C, preferably with the drum being stationary or rotating slowly;

- rotation of the drum for a time interval  $\Delta t_{d1}$  of approx. 50-60 minutes;

- implementation of a plurality of rinse cycles, generally three, at least one of which being a hot rinse cycle, i.e. at a temperature of approx. 40 - 50°C;

15    - second supply of water into the wash tub;

- heating the water and keeping the same at said first temperature  $T_{d1}$ , preferably with the drum being stationary or rotating slowly;

- rotation of the drum for said time interval  $\Delta t_{d1}$ ;

- implementation of a plurality of rinse cycles, in particular three, at least one of which being a hot rinse cycle.

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                 |                                                         |                                                     |
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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