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(54) SYSTEM FOR DISPENSING SUBSTANCES FOR THE TREATMENT OF LAUNDRY IN A WASHING MACHINE EQUIPPED WITH AN AUTOMATIC DOSAGE DEVICE

(57) A system (1) for dispensing a liquid treatment substance (2) in a laundry washing machine (3) comprises: one or more multi-dose tanks (4) adapted to contain each an initial volume (V_init) of a liquid treatment substance (2), one or more volumetric dosing pumps (5) which can be activated to selectively extract said liquid treatment substance (2) from said one or more multi-dose tanks (4) and to dispense it, as well as an electronic control unit (6) which:
- activates said one or more dosing pumps (5),
- determines a total dispensable quantity (Q_tot_init) value according to the initial volume (V_init) for each of the one or more multi-dose tanks (4),
- counts a pumping quantity (t_p) of the respective dosing pump (5) during the activation of the one or more dosing pumps (5), for each of the one or more multi-dose tanks (4),
- determines a total dispensed quantity (Q_tot_disp) value according to the counted pumping quantity (t_p) for each of the one or more multi-dose tanks (4),
- selectively generates a warning of liquid treatment substance exhaustion or residual quantity for each of the one or more multi-dose tanks (4), according to the total dispensable quantity (Q_tot_init) value and on the total dispensed quantity (Q_tot_disp) value.

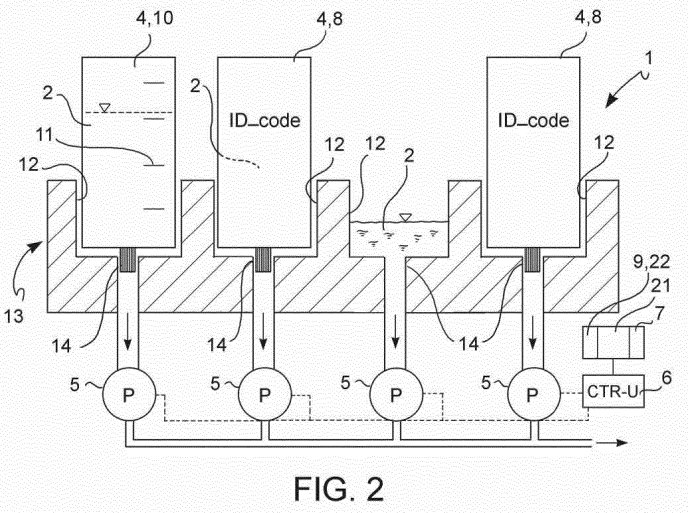

FIG. 2

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Description

[0001] The present invention relates to a system and method for dispensing and controlling the residual amount of treatment substances in a domestic laundry washing machine with automatic dosage or multi-dosage of detergent.

[0002] Domestic laundry washing machines usually comprise a supporting and housing structure, inside which a washing tub is housed provided with a front opening which can be closed by a porthole door frontally hinged to the housing. A basket to accommodate the laundry to be washed is arranged inside the washing tub in rotatable manner about a horizontal or inclined axis. The basket also defines a front opening positioned at the opening of the washing tub, in order to be able to load and unload the laundry.

[0003] The washing tub is adapted to contain the washing liquid during the steps of the laundry washing.

[0004] A water loading system connectable to the water mains is provided in order to allow loading water from the mains, detergents and additive agents into the tank. On the bottom of the washing tub, there is a draining duct with associated draining pump which removes the washing liquid from the tank and which controls, together with the loading system, the liquid level inside the tank.

[0005] In order to add detergent or treatment additive to the washing liquid it is known to arrange a detergent tray in flow communication with the water loading system.

[0006] The detergent tray may be configured as a drawer which can be extracted from and inserted in the housing structure and which can be filled manually for each wash with an amount of detergent and/or treatment additive sufficient for a single washing cycle.

[0007] Are also known laundry washing machines with multi-dosing tanks to contain a sufficient quantity of treatment substance for a plurality of washing cycles and with an automatic dispensing and dosing system, known as laundry washing machines with multi-dosing.

[0008] It is further known to position the detergent multi-dose tanks, e.g. in the front door and, more precisely, in the porthole of the front door of the laundry washing machine.

[0009] In order to determine the residual quantity of detergent in multi-dose tanks, it is possible to equip the laundry washing machine with a system for determining the level of treatment substance, based on the use of optical sensors associated with the multi-dose tanks.

[0010] The use of optical sensors or sensors in general, while being satisfactory from many points of view, implies additional costs and requires electrical wiring of the zone in which the multi-dose tanks are located. This undesirably restricts the freedom of positioning of multi-dose tanks or requires complex electrical wiring systems which are expensive and subject to unwanted mechanical stress, e.g. when electrical cables need to be extended from the laundry washing machine housing in the movable door.

[0011] Furthermore, optical sensor-based detergent residual quantity determination systems are not adapted for use with disposable cartridges of detergent, additives or other processing substances, which are usually opaque to protect the processing substances from light.

[0012] It is thus the object of the present invention to provide a new and improved system and method for dosing and controlling the residual amount of treatment substances (e.g. detergents, additives, enzymes, softeners, etc.) in a multi-dose laundry washing machine.

[0013] It is a specific object to provide a new and improved system and method for dosing and controlling the residual quantity of treatment substances, which is easy to manage, versatile in the positioning of multi-dose tanks and which does not require electrical wiring at multi-dose tanks.

[0014] It is a further specific object to provide a new and improved system and method for dosing and controlling the residual quantity of treatment substances, having features such as to determine a residual quantity of treatment substance of multi-dose tanks and, at the same time, to allow the use of mutually different multi-dose tanks, possibly containing treatment substances having different concentrations, as well as the possibility of alternating washings with automatic dosing from multi-dose tanks with washings with detergent dosing predetermined by the user for a single wash.

[0015] At least one of the objects is achieved by a system according to claim 1 and by a method according to claim 17. The dependent claims relate to advantageous and preferred embodiments.

[0016] According to an aspect of the invention, a system for dispensing liquid treatment substance in a multi-dose laundry washing machine comprises:

- one or more multi-dose tanks adapted to contain each an initial volume of a liquid treatment substance,
- one or more volumetric dosing pumps connected in flow communication with said one or more multi-dose tanks and which can be activated to selectively extract said liquid treatment substance from said one or more multi-dose tanks and to dispense it,
- an electronic control unit, which:
  - activates said one or more dosing pumps 5,
  - determines a total dispensable quantity value according to said initial volume for each of said one or more multi-dose tanks,
  - counts a pumping quantity of the respective dosing pump during the activation of said one or more dosing pumps, for each of said one or more multi-dose tanks,
  - determines a total dispensed quantity value according to the counted pumping quantity for each of said one or more multi-dose tanks,
  - generates a warning of liquid treatment substance exhaustion or residual quantity, accord-

ing to said total dispensable quantity value and to said total dispensed quantity value.

[0017] According to a further aspect of the invention, a method for dispensing liquid treatment substance in a multi-dose laundry washing machine comprises:

- providing one or more multi-dose tanks adapted to contain each an initial volume of a liquid treatment substance,
- activating one or more volumetric dosing pumps in flow communication with said one or more multi-dose tanks to selectively extract said liquid treatment substance from said one or more multi-dose tanks and to dispense it,
- determining a total dispensable quantity value according to said initial volume for each of said one or more multi-dose tanks,
- counting a pumping quantity of the respective dosing pump, during the activation of said one or more dosing pumps, for each of said one or more multi-dose tanks,
- determining a total dispensed quantity value according to the counted pumping quantity for each of said one or more multi-dose tanks,
- generating a warning of liquid treatment substance exhaustion or residual quantity according to said total dispensable quantity value and to said total dispensed quantity value.

[0018] The determination of the total dispensed quantity according to the count of the pumping quantities referred to the single multi-dose tanks allows the determination of the residual quantities of treatment substance in the multi-dose tanks without using sensors at the multi-dose tanks themselves.

[0019] This avoids the need to electrify or wire the zones of the multi-dose tanks and thus allows a free positioning of the multi-dose tanks in or at the laundry washing machine, e.g. inside a porthole door that otherwise would create electrical wiring problems.

[0020] In order to better understand the invention and appreciate its advantages, some non-limiting embodiments will be described below by way of example with reference to the accompanying figures, in which:

- figure 1 is a diagrammatic view of a laundry washing machine containing a dosing system according to an embodiment of the invention;
- figure 2 is a diagrammatic view of the dosing system according to an embodiment;
- figures 3 and 4 show examples of multi-dose tanks of the dispensing system according to embodiments.

[0021] With reference to the figure, a system 1 for dispensing a liquid treatment substance 2 in a laundry washing machine 3, comprises:

- one or more multi-dose tanks 4 adapted to contain each an initial volume V_init of a liquid treatment substance,
- one or more volumetric dosing pumps 5 connected in flow communication with said one or more multi-dose tanks 4 and which can be activated to selectively extract said liquid treatment substance 2 from said one or more multi-dose tanks 4 and to dispense it,
- an electronic control unit 6, which:
  - activates said one or more dosing pumps 5,
  - determines a total dispensable quantity Q_tot_init value according to said initial volume V_init for each of said one or more multi-dose tanks 4,
  - counts a pumping quantity t_p of the respective dosing pump 5, during the activation of said one or more dosing pumps 5, for each of said one or more multi-dose tanks 4,
  - determines a total dispensed quantity Q_tot_disp value according to the counted pumping quantity t_p for each of said one or more multi-dose tanks 4,
  - generates a warning of exhaustion or residual quantity of the liquid treatment substance 2, according to said total dispensable quantity value Q_tot_init and to said total dispensed quantity value Q_tot_disp.

[0022] According to a further aspect of the invention, a method for dispensing a liquid treatment substance 2 in a multi-dose laundry washing machine 3 comprises:

- providing one or more multi-dose tanks 4 adapted to contain each an initial volume V_init of a liquid treatment substance,
- activating one or more volumetric dosing pumps 5 in flow communication with said one or more multi-dose tanks 4 to selectively extract said liquid treatment substance from said one or more multi-dose tanks 4 and to dispense it,
- determining a total dispensable quantity Q_tot_init value according to said initial volume V_init for each of said one or more multi-dose tanks 4,
- counting a pumping quantity t_p of the respective dosing pump 5, during the activation of said one or more dosing pumps 5, for each of said one or more multi-dose tanks 4,
- determining a total dispensed quantity Q_tot_disp value according to the counted pumping quantity t_p for each of said one or more multi-dose tanks 4,
- generating a warning of exhaustion or residual quantity of the liquid treatment substance 2 according to said total dispensable quantity value Q_tot_init and to said total dispensed quantity value Q_tot_disp.

[0023] According to an aspect of the invention, the val-

ue of the total dispensable quantity value Q_tot_init may comprise:

a volume value expressed in terms of volume (e.g. ml) or
a volume value expressed in terms of filling level (e.g. cm), with a known, e.g. constant, functional dependency or ratio between the filling level and the corresponding filling volume of the multi-dose container 4, e.g. volume = constant area x filling level height, or
preferably a volume value expressed in terms of operating time of the volumetric dosing pump 5 (e.g. seconds), with a known, e.g. constant, functional dependency or ratio between the pump operating time and the corresponding volume pumped by the dosing pump 5, e.g. volume = (pumped volume / time unit) constant x pumping time, or
alternatively, a volume value expressed in terms of the number of pumping cycles of the volumetric dosing pump 5, with a known e.g. constant, functional dependency or ratio between the number of pumping cycles and the corresponding volume pumped by the dosing pump 5, e.g. volume = (pumped volume / number of pumping cycles) constant x number of pumping cycles, or
another equivalent value.

[0024] Similarly, the total dispensed quantity value Q_tot_disp may also comprise a volume value expressed in terms of volume (e.g. ml), or expressed in terms of filling level (e.g. cm), or preferably expressed in terms of operating time of the volumetric dosing pump 5 (e.g. seconds), or alternatively expressed in terms of number of pumping cycles of the volumetric dosing pump 5, or another equivalent value.

[0025] Similarly, the pumping quantity t_p of the dosing pump 5 may also be counted as volume expressed in terms of volume (e.g. ml), or in terms of filling level (e.g. cm) of the multi-dose tank 4, or preferably expressed in terms of operating time of the volumetric dosing pump 5 (e.g. seconds), or alternatively in terms of number of pumping cycles of the volumetric dosing pump 5, or expressed in equivalent manner.

[0026] The determination of the total dispensed quantity value Q_tot_disp according to the counted pumping quantities t_p may comprise a cumulative sum of the counted pumping quantity t_p, or a cumulative subtraction of the counted pumping quantity t_p, e.g. starting from an initial quantity value, e.g. a sum from zero or a subtraction starting from the total dispensable quantity value Q_tot_init.

[0027] The determination of the total dispensed quantity Q_tot_disp according to the count of the pumping quantities t_p referred to the single multi-dose tanks 4 allows the determination of the residual quantities of treatment substance 2 in the multi-dose tanks 4 without using level sensors at the multi-dose tanks 4.

[0028] This avoids the need to electrify or wire the zones of the multi-dose tanks 4 and thus allows a free positioning of the multi-dose tanks 4 in or at the laundry washing machine 3, e.g. inside a porthole door which otherwise would create electrical wiring problems.

[0029] According to a preferred embodiment, the one or more dosing pumps 5 are activated so as to pump at a constant flow rate (expressed in terms of ml/s), and the counting of the pumping quantity t_p comprises a counting of the activation time of the dosing pump 5.

[0030] The monitoring of the quantity of treatment substance 2 dispensed by one or more dosing pumps 5, in terms of pumping time t_p, greatly facilitates the determination of the residual quantity of treatment substance 2, because the pump activation times are usually already available in the control software of the dosing system 1 and in any case can be very easily detected and recorded.

[0031] According to an embodiment, the dispensing system 1 comprises a user interface 7 in signal connection with the control unit 6 and which allows the user to enter a treatment substance 2 reloading confirmation and, possibly, an indicative value of the initial volume V_init of treatment substance 2, selectively for each of the multi-dose tanks 4.

[0032] In response to the insertion of the reloading confirmation of the treatment substance 2, the control unit 6 automatically determines the respective total dispensable quantity value Q_tot_init according to the indicative value of the initial volume V_init of treatment substance 2 and starts (in other words, resets or initializes) the counting the pumping quantity t_p for the respective multi-dose tank 4 again from the beginning. Initializing the pumping quantity count t_p may, for example, comprise resetting the total dispensed quantity Q_tot_disp to zero.

[0033] According to an embodiment of the invention, the electronic control unit 6 and one or more dosing pumps 5 are configured so that during operation, the dosing pump 5 extracts the treatment substance 2 from the multi-dose tank 4 at a constant flow rate, e.g. in the range from 0.5 ml/s to 1.0 ml/s, preferably at a constant flow rate of about 0.75 ml/s.

[0034] The control unit 6 may be configured to generate the warning of exhaustion or residual quantity Q_res of the liquid treatment substance 2, in dependency of a difference between said total dispensable quantity value Q_tot_init and said total dispensed quantity value Q_tot_disp.

[0035] For example, the control unit 6 generates a display of a residual quantity value Q_res calculated according to the formula Q_res = Q_tot_init - Q_tot_disp, and expressed in terms of volume or in terms of number of residual washing cycles or in terms of percentage or fraction referring to the total dispensable quantity value Q_tot_init, e.g. "75%", "10%" or "1/2", "1/4".

[0036] The control unit 6 may be configured to generate the warning of exhaustion of the treatment substance 2, according to a comparison between a predetermined

exhaustion threshold value Q_limit_1 and a difference between said total dispensable quantity Q_tot_init value and said total dispensed quantity Q_tot_disp value.

[0037] For example, the control unit 6 generates the exhaustion warning if Q_res = Q_tot_init - Q_tot_disp < Q_limit_1.

[0038] Possibly, the predetermined exhaustion threshold value Q_limit_1 corresponds to a quantity of treatment substance 2 which is lower than a quantity of treatment substance required for a single washing cycle.

[0039] The control unit 6 may be configured to generate a treatment substance reserve warning, according to a comparison between a predetermined exhaustion threshold value Q_limit_2 and a difference between said total dispensable quantity Q_tot_init value and said total dispensed quantity Q_tot_disp value.

[0040] For example, the control unit 6 generates the reserve warning if Q_res = Q_tot_init - Q_tot_disp < Q_limit_2.

[0041] Possibly, the predetermined reserve threshold value Q_limit_2 corresponds to a residual quantity of treatment substance Q_res which is greater than a quantity of treatment substance 2 required for a single washing cycle, but lower than a quantity of treatment substance 2 required for "n" washing cycles, e.g. ten washing cycles, wherein "n" is a value which can be predetermined and/or set by the user.

[0042] Advantageously, this allows the reserve warning to be adapted to the user's needs (e.g. users who go less frequently to shopping centers and need to know when the detergent is about to run out with greater advance).

[0043] Preferably, the predetermined reserve threshold value Q_limit_2 corresponds to a residual quantity Q_res of treatment substance 2 which is lower than a quantity of treatment substance 2 required for a fifth, preferably a tenth, of the number of washing cycles which can be performed with the multi-dose tank 4 full.

[0044] According to an embodiment, the "residual treatment substance" and/or "reserve" and/or "treatment substance exhaustion" warnings comprise acoustic and/or optical warnings, e.g. by means of a display and/or by means of the illumination of an LED warning light, or the flashing of said LED warning light at different intervals, or a change in the color of the light emitted by said LED warning light.

[0045] According to an embodiment, the control unit 6 comprises a transceiver system 21 adapted to connect the control unit 6 wirelessly to electronic devices 23 external to the laundry washing machine 3, such as mobile phones. According to this embodiment, the control unit 6 may be configured or set up by the user so as to send "residual processing substance" and/or "reserve" and/or "processing substance exhaustion" warnings to said external electronic devices 23, e.g. in the form of text message.

[0046] According to an embodiment, the control unit 6 is configured to perform or not prevent the performance of the washing cycles selected by the user even if the treatment substance 2 in at least one of the multi-dose tanks 4 is exhausted.

[0047] This allows a washing cycle to be performed also if the user does not intend to or cannot reload the treatment substance 2, but still needs to wash the laundry.

Dispensing system and method using multi-dose cartridges with fixed initial volume V init

[0048] According to an embodiment, the one or more multi-dose tanks 4 comprise one or more replaceable 8 cartridges in which the initial volume V_init of treatment substance 2 is fixed (i.e. the replaceable cartridges 8 are marketed or supplied with a fixed initial volume V_init of treatment substance 2). The replaceable cartridges 8 may comprise several different replaceable cartridges 8, containing the same or different treatment substance 2 and having equal or different initial volumes V_init.

[0049] In case of a plurality of different replaceable cartridges 8 with a fixed initial volume V_init of treatment substance 2, the replaceable cartridges 8 can be identified by an identification code or name ID_code, e.g. by a brand and/or a product and/or processing substance name.

[0050] The control unit 6 may comprise a memory 9 containing a cartridge list 22 with one or more initial volume V_init values, pre-stored for the one or more replaceable cartridges 8 with a fixed initial volume (V_init) of treatment substance 2.

[0051] Additionally, the cartridge list 22 can contain the pre-stored identification codes or names and association links between the pre-stored initial volume values V_init and the respective pre-stored identification codes or names ID_code.

[0052] The user interface 7 may be configured to allow the user to enter or select the identification code ID_code of the replaceable cartridge 8 as said indicative value of the initial volume V_init of treatment substance, selectively for each of the multi-dose tanks 4.

[0053] The control unit 6 may be configured to determine, for each of said one or more replaceable cartridges 8, the total dispensable quantity Q_tot_init value according to said one or more initial volume V_init values pre-stored in the cartridge list 22. For example, the control unit 6 can use the corresponding pre-stored initial volume V_init value as the total dispensable quantity value Q_tot_init.

[0054] In particular, the control unit 6 may be configured to determine, for each of said one or more replaceable cartridges 8, the total dispensable quantity Q_tot_init value on the basis of the cartridge list 22 according to the identification code or name ID_code selected by the user by means of the user interface 7. The identification code ID_code could, for example, simply be a brand of detergent for laundry washing machines.

[0055] This avoids the need for the user to insert initial

volumes of treatment substance 2 for each individual multi-dose tank 4. This also allows the use of replaceable cartridges 8 from different detergent suppliers and, at the same time, facilitates the identification of the replaceable cartridges 8 used.

Dispensing system and method using multi-dose tanks fillable with variable initial volume V init

[0056] According to an embodiment, said one or more multi-dose 4 tanks comprise one or more fillable tanks 10 refillable, e.g. by the user, if the initial volume V_init of treatment substance 2 is not fixed but may vary. The fillable tanks 10 may comprise a plurality of different fillable tanks 10, containing the same or different treatment substances 2 and having equal or different initial volumes V_init.

[0057] Advantageously, the refillable tank 10 includes a graduated scale 11 which allows the user to choose and/or read the initial filling amount of filled treatment substance 2.

[0058] The user interface 7 can be configured to allow the user to enter an initial filling quantity for the fillable tank 10 as said indicative value of the initial volume V_init of treatment substance 2, selectively for each of the multi-dose tanks 4.

[0059] The control unit 6 may be configured to determine for each of the fillable tanks 10, the total dispensable quantity value Q_tot_init according to the initially filling quantity or the initial volume V_init entered by the user by means of the user interface 7.

[0060] According to an embodiment, the treatment substances 2 may be supplied by the detergent manufacturer, accompanied by recommendations on the quantities of treatment substances which may be useful for a single wash cycle. These recommendations usually depend on the concentration of the treatment substance 2 and can be generalized and also concretized, for the purposes of the present description, as "unit dosage value" or "concentration value".

[0061] Similarly, the user interface 7 may be configured to allow the user to enter a concentration value indicative for a concentration of the processing substance 2 or for a unit quantity of processing substance 2 recommended for a single wash cycle, selectively for each of the multi-dose 4 containers.

[0062] The control unit 6 may be configured to determine the duration of the steps of activating of the one or more dosing pumps 5, selectively for each of the multi-dose tanks 10, according to the concentration value entered by the user by means of the user interface 7.

[0063] This allows the use of treatment substances 2 with different concentrations and optimizes the use of treatment substances 2 according to the instructions of the detergent manufacturers and, in this manner, reconciles the requirements of washing efficiency, resource saving and environmental compatibility.

Dispensing system and method with use of single-dosage containers filllable with a quantity of treatment substance pre-dosed by the user

[0064] According to an embodiment of the invention, the dispensing system 1 comprises one or more single-dose compartments 12 which can be filled with treatment substance pre-dosed by the user for a single washing, wherein the one or more dosing pumps 5 are connectable in flow communication to said one or more single-dose compartments 12 and activatable to extract said pre-dosed treatment substance selectively from said one or more single-dose compartments 12.

[0065] According to an embodiment, each of the one or more single-dosage compartments 12 may be provided instead of one of the multi-dose tanks 4, respectively.

[0066] This allows the use of the dispensing system 1 both for an automatic dispensing of detergent for a plurality of washing cycles (multi-dosage) and for a dispensing of detergent pre-dosed by the user for a single washing cycle (single-dosage).

[0067] According to an embodiment, the user interface 7 allows the user to confirm a selection of a multi-dose delivery from one or more multi-dose tanks 4 and a single-dose delivery from one or more single-dose compartments 12.

[0068] According to an embodiment, such confirmation of selection between a multi-dose and single-dose delivery can be inserted selectively for one or more single-dose compartments 12 and/or multi-dose tanks 4.

[0069] According to an embodiment, a confirmation of selection of single-dose delivery from one of the single-dose compartments 12 excludes and replaces a corresponding multi-dose delivery from one of the multi-dose 4 tanks.

[0070] In response to the entered single-dose dispensing selection, the control unit 6 automatically suspends the counting of the pumping quantity t_p for the respective multi-dose tank 4, keeping the total dispensable quantity value Q_tot_init and the total dispensed quantity value Q_tot_disp for the respective multi-dose tank 4 unchanged.

[0071] According to an embodiment, in the case of a previous suspension of the calculation of the pumping quantity t_p for at least one of the multi-dose tanks 4 and of a subsequent selection confirmation of a multi-dose dispensing from this multi-dose tank 4, the control unit 6 automatically resumes the counting of the pumping quantity t_p for the respective multi-dose tank 4.

[0072] The user interface 7 can be configured and/or controlled by the control unit 6 so as to request from the user, at the beginning of a washing program:

- first, the aforesaid confirmation of selection between single dose and multi-dose delivery, and
- then, in the case of multi-dose delivery selection, a confirmation of selection between reloading at least one of the multi-dose tanks 4 and continuing the pro-

gram without reloading one of the multi-dose tanks 4, and

- in case of confirmation of selection of reloading of at least one of the multi-dose 4 tanks, a confirmation of selection between reloading of at least one refillable tank 10 with a variable initial volume V_init and reloading by connecting at least one new replaceable cartridge 8 with a fixed initial volume V_init.

[0073] This makes it possible to avoid errors of determination of the total dispensable quantity value Q_tot_init and of determination of the residual quantities of treatment substances in multi-dose tanks 4.

Tank interface 13

[0074] According to an embodiment, the dispensing system 1 comprises a tanks interface 13 having one or more attachment portions 14 in flow connection with the one or more dosing pumps 5 and adapted to be reversibly coupled to one or more multi-dose tanks 4.

[0075] The shape of the attachment portions 14 and/or the shape of the tank interface 13 and the shape of the multi-dose tanks 4 are preferably such as to allow a coupling of each of the multi-dose tanks 4 to only one of the attachment portions 14, respectively.

[0076] This allows a univocal association of each multi-dose tank 4 and, therefore, of each treatment substance 2 with only one of the connection portions 14 and, therefore, with a given dosing pump 5.

[0077] Advantageously, the one or more single-dose compartments 12 are each formed around one of the attachment portions 14, respectively, so that, with the multi-dose tank 4 detached from the attachment portion 14, the free attachment portion 14 creates a flow connection between the respective single-dose compartment 12 and one or more dosing pumps 5 possibly without further switching operations of the flow connection.

[0078] Additionally, it is particularly intuitive for the user to attach a multi-dose tank 4 and/or to pour a single dose of single-dosed detergent in exactly the same position of the dispensing system 1.

Laundry washing machine 3

[0079] The invention further relates to a laundry washing machine 3 comprising the dosing system 1.

[0080] According to an embodiment, the laundry washing machine 3 comprises a housing 15, a washing tank 16 arranged inside the housing 15 and having an opening 19, e.g. front or top, which can be closed by means of a front or upper door 17, e.g. a porthole door, connected, e.g. hinged, frontally or on top, to the housing 15.

[0081] The laundry washing machine 3 further comprises a basket 18 arranged inside the washing tub 16 and possibly rotatable about a horizontal or inclined axis, wherein the basket 18 delimits a loading opening 24 which is or can be positioned at the front opening 19 of the washing tub 16 for loading and unloading the laundry to be washed.

[0082] The laundry washing machine 3 further comprises a water loading system 20 connectable to the water mains and in communication with the washing tub 16 to load water in the washing tub 16.

[0083] Furthermore, the laundry washing machine 3 comprises a control system with a user interface which can implement or communicate with the aforesaid control unit 6 with the user interface 7 of the dispensing system 1 for the dispensing of treatment substances 2.

[0084] The treatment substance 2 extracted from one or more multi-dose tanks 4 is then conveyed into the washing tank 16 and/or laundry basket 18, e.g. directly by one or more dosing pumps 5 and/or by the water loading system 20.

[0085] In an advantageous embodiment, the tanks interface 13 and/or the multi-dose tanks 4 and/or the single-dose compartments 12 are positioned in the door 17 of the laundry washing machine 3, which door 17 is not electrically wired, while the control unit 6 and the one or more dosing pumps 5 are positioned in the housing 15 outside the door 17 and are electrically powered.

[0086] The system 1 and method of dispensing treatment substance 2 allows to provide the tank interface 13 and/or multi-dose tanks 4 and/or single-dose compartments 12 in non-wired regions of the laundry washing machine 1 without having to forgo a control of the residual level of treatment substance 2 in multi-dose tanks 4.

[0087] By way of non-limiting example, the treatment substances 2 may comprise one or more detergents, fabric softeners, enzymes, perfumes, disinfectants, descalers or additives.

[0088] The steps of the method described for the sake of brevity in connection with the description of the dispensing system 1 and/or the laundry washing machine 3, may be further performed by equivalent, alternative or different means than the electronic control unit 6, or manually and mentally by an operator.

[0089] Obviously, a skilled person may make further changes and variants to the treatment substance dispensing system 1, to the laundry washing machine 3 and to the treatment substance dispensing method without departing from the scope of protection of the invention as defined in the following claims.

Claims

1. A system (1) for dispensing a liquid treatment substance (2) in a laundry washing machine (3), the system (1) comprising:

   - one or more multi-dose tanks (4) adapted to contain each an initial volume (V_init) of a liquid treatment substance (2),
   - one or more volumetric dosing pumps (5) connected in flow communication to said one or

more multi-dose tanks (4) and which can be activated to selectively extract said liquid treatment substance (2) from said one or more multi-dose tanks (4) and dispense it,
- an electronic control unit (6) which:

  - actuates said one or more dosing pumps (5),
  - determines for each of said one or more multi-dose tanks (4) a total dispensable quantity (Q_tot_init) value depending on said initial volume (V_init),
  - counts, during the actuation of said one or more dosing pumps (5), for each of said one or more multi-dose tanks (4), a pumping quantity (t_p) of the respective dosing pump (5),
  - determines for each of said one or more multi-dose tanks (4) a total dispensed quantity (Q_tot_disp) value depending on the counted pumping quantity (t_p),
  - selectively generates, for each of said one or more multi-dose tanks (4), a warning of liquid treatment substance exhaustion or residual quantity, depending on said total dispensable quantity (Q_tot_init) value and on said total dispensed quantity (Q_tot_disp) value.

2. A system (1) according to claim 1, wherein the one or more dosing pumps (5) are activated so as to pump at a constant flow rate, and the counting of the pumping quantity (t_p) comprises a counting of the activation time of the pump (5).

3. A system (1) according to claim 1 or 2, wherein the dispensing system (1) comprises a user interface (7) in signal connection with the control unit (6) and which allows the user to enter a treatment substance reloading confirmation and, optionally, an indicative value of the initial volume (V_init) of treatment substance (2), selectively for each of the multi-dose tanks (4),
wherein, in response to the entering of the treatment substance (2) reloading confirmation, the control unit (6):

  - automatically determines the respective total dispensable quantity (Q_tot_init) value depending on said indicative value of the initial volume (V_init) of treatment substance, and
  - resets to zero the total dispensed quantity (Q_tot_disp) value.

4. A system (1) according to any one of the preceding claims, wherein said one or more multi-dose tanks (4) comprise one or more replaceable cartridges (8) wherein the initial volume (V_init) of treatment substance (2) is fixed and which are identifiable by means of an identification code,
wherein the control unit (6) comprises a memory (9) containing a cartridge list (22) with one or more initial volume (V_init) values, pre-stored for the one or more replaceable cartridges (8) with a fixed initial volume (V_init),
wherein the control unit (6) is configured to determine, for each of said one or more replaceable cartridges (8), the total dispensable quantity (Q_tot_init) value depending on said one or more initial volume (V_init) values pre-stored in the cartridge list (22),
wherein the user interface (7) is configured to allow the user to enter or select the identification code (ID_code) of the replaceable cartridge (8) as said indicative value of the initial volume (V_init) of treatment substance, selectively for each of the multi-dose tanks (4), and
wherein the cartridge list (22) also contains links associating the pre-stored initial volume (V_init) values with the respective ID_code identification codes selectable by means of the user interface (7),
wherein the control unit (6) determines, for each of said one or more replaceable cartridges (8), the total dispensable quantity (Q_tot_init) value on the basis of the cartridge list (22) depending on the ID_code identification code selected by the user by means of the user interface (7).

5. A system (1) according to any one of the preceding claims, wherein said one or more multi-dose tanks (4) comprise one or more fillable tanks (10) fillable by the user, wherein the initial volume (V_init) of treatment substance (2) is not fixed, wherein the fillable tank (10) may comprise a graduated scale (11) indicating the initial filling quantity of treatment substance (2),
wherein the user interface (7) allows the user to enter an initial filling quantity for the fillable tank (10) as said indicative value of the initial volume (V_init) of treatment substance, selectively for each of the multi-dose tanks (4),
wherein the control unit (6) determines for each of the fillable tanks (10) the value of total dispensable quantity (Q_tot_init) depending on the initial filling quantity entered by the user.

6. A system (1) according to any one of the preceding claims, wherein the user interface (7) allows the user to enter or select an indicative concentration value of the treatment substance concentration, selectively for each of the multi-dose tanks (4), wherein the control unit (6) determines the duration of the steps for activating the one or more dosing pumps (5), selectively for each of the multi-dose tanks (4), depending on the concentration value received by means of the user interface (7).

7. A system (1) according to any one of the preceding claims, wherein the control unit (6) generates a warning of treatment substance residual quantity, depending on a difference between said total dispensable quantity (Q_tot_init) value and said total dispensed quantity (Q_tot_disp) value.

8. A system (1) according to any one of the preceding claims, wherein the control unit (6) generates a treatment substance exhaustion warning, depending on a comparison between a predetermined exhaustion threshold value (Q_limit_1) and a difference between said total dispensable quantity (Q_tot_init) value and said total dispensed quantity (Q_tot_disp) value,
wherein the predetermined exhaustion threshold value (Q_limit_1) corresponds to a residual quantity (Q_res) of treatment substance (2) which is lower than a quantity of treatment substance (2) required for a single washing cycle.

9. A system (1) according to any one of the preceding claims, wherein the control unit (6) generates a treatment substance reserve warning, depending on a comparison between a predetermined reserve threshold value and a difference between said total dispensable quantity (Q_tot_init) value and said total dispensed quantity (Q_tot_disp) value,
wherein the predetermined reserve threshold value corresponds to a quantity of treatment substance which is greater than a quantity of treatment substance required for a single washing cycle selected by the user or set, but lower than a quantity of treatment substance required for "n" washing cycles, wherein "n" is a predetermined value and/or a value set by the user.

10. A system (1) according to any one of the preceding claims, comprising one or more single-dose compartments (12) which can be filled with treatment substance pre-dosed by the user for a single washing, wherein the one or more dosing pumps (5) are connectable in flow communication to said one or more single-dose compartments (12) and activatable to extract said pre-dosed treatment substance selectively from said one or more single-dose compartments (12).

11. A system (1) according to claim 10, wherein the user interface (7) allows the user to confirm a selection between a multi-dose dispensing from the one or more multi-dose tanks (4) and a single-dose dispensing from the one or more single-dose compartments (12), wherein a confirmation of the single-dose dispensing selection from one of the single-dose compartments (12) excludes and replaces a corresponding multi-dose dispensing from one of the multi-dose tanks (4),
wherein, in response to the entered single-dose dispensing selection, the control unit (6) automatically suspends the counting of the pumping quantity (t_p) for the respective multi-dose tank (4), keeping the total dispensable quantity (Q_tot_init) and total dispensed quantity values for the respective multi-dose tank (4) unchanged, wherein, in the case of a previous suspension of the calculation of the pumping quantity (t_p) for at least one of the multi-dose tanks (4) and of a subsequent selection confirmation of a multi-dose dispensing from this multi-dose tank (4), the control unit (6) automatically resumes the counting of the pumping quantity (t_p) for the respective multi-dose tank (4).

12. A system (1) according to claim 10 or 11, comprising a tanks interface (13) having one or more attachment portions (14) in flow connection with the one or more dosing pumps (5) and adapted to be reversibly coupled to the one or more multi-dose tanks (4),
wherein the one or more single-dose compartments (12) are each formed around one of the attachment portions (14), respectively, so that, with the multi-dose tank (4) detached from the attachment portion (14), the attachment portion (14) frees outlets in the respective single-dose compartment (12) and makes the flow connection of the single-dose compartment (12) with the one or more dosing pumps (5).

13. A system (1) according to claim 12, wherein the shape of the tanks interface (13) and the shape of the multi-dose tanks (4) are such as to allow a coupling of each of the multi-dose tanks (4) to only one of the attachment portions (14), respectively.

14. A laundry washing machine (3) comprising a housing (15), a washing tub (16) arranged in the housing (15) and having an opening (19) which may be closed by means of a movable door (17), a basket (18) arranged inside the washing tub (16) and adapted to receive the laundry to be washed, a water loading system (20) which can be connected to the water mains and in communication with the washing tub (16) to load water into the washing tub (16),
characterized in that it comprises the dispensing system (1) according to any one of the preceding claims, wherein the treatment substance (2) extracted from the one or more multi-dose tanks (4) is conveyed into the washing tub (16),
wherein the multi-dose tanks (4) are positioned in the door (17), the door (17) is not electrically wired, while the control unit (6) and the one or more dosing pumps (5) are positioned in the housing (15) outside the door (17) and are electrically powered.

15. A method for dispensing and controlling a quantity of liquid treatment substance (2) in a multi-dosing laundry washing machine (3), said method compris-

ing:

- providing one or more multi-dose tanks (4) adapted to contain each an initial volume (V_init) of a liquid treatment substance,
- actuating one or more volumetric dosing pumps (5) in flow communication with said one or more multi-dose tanks (4) to selectively extract from said one or more multi-dose tanks (4) said liquid treatment substance and dispense it,
- determining for each of said one or more multi-dose tanks (4) a total dispensable quantity (Q_tot_init) value depending on said initial volume (V_init),
- counting, during the actuation of said one or more dosing pumps (5), for each of said one or more multi-dose tanks (4), a pumping quantity (t_p) of the respective dosing pump (5),
- determining for each of said one or more multi-dose tanks (4) a total dispensed quantity (Q_tot_disp) value depending on the counted pumping quantity (t_p),
- selectively generating, for each of said one or more multi-dose tanks (4), a warning of liquid treatment substance exhaustion or residual quantity, depending on said total dispensable quantity (Q_tot_init) value and on said total dispensed quantity (Q_tot_disp) value.

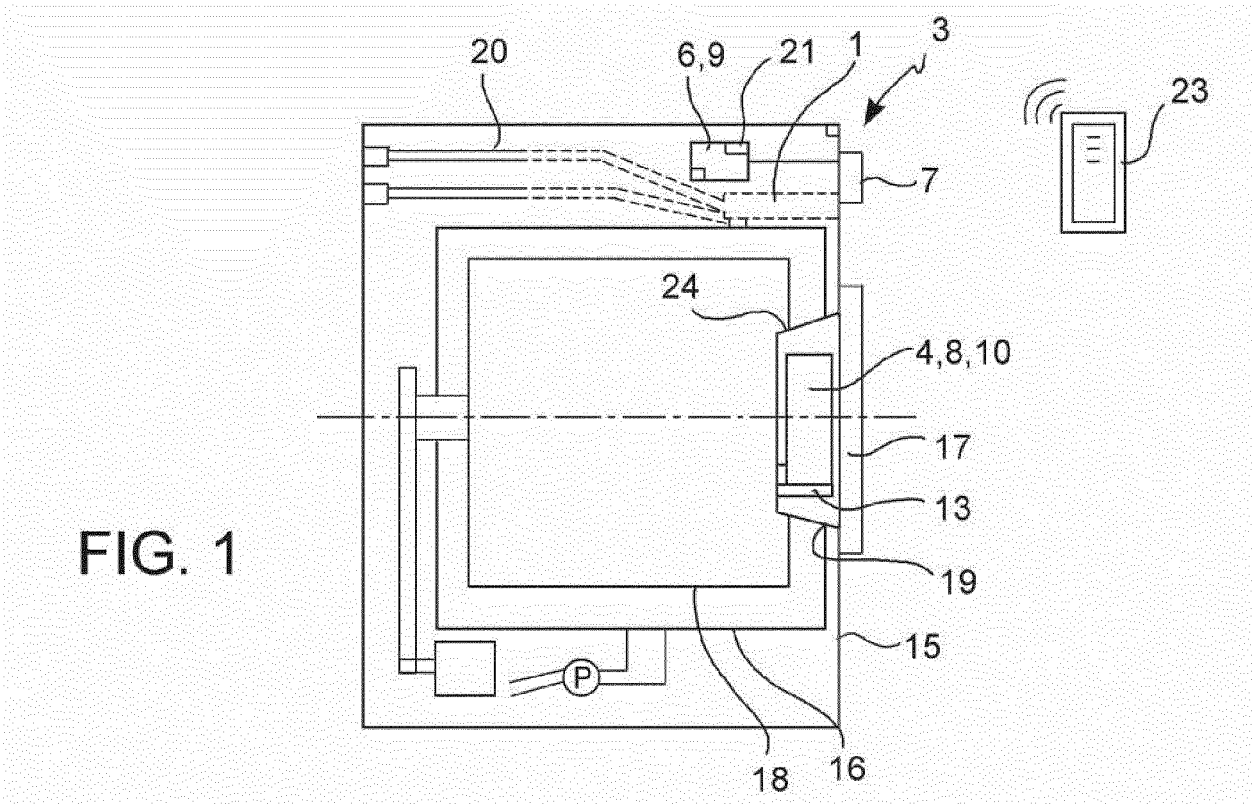
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FIG. 1

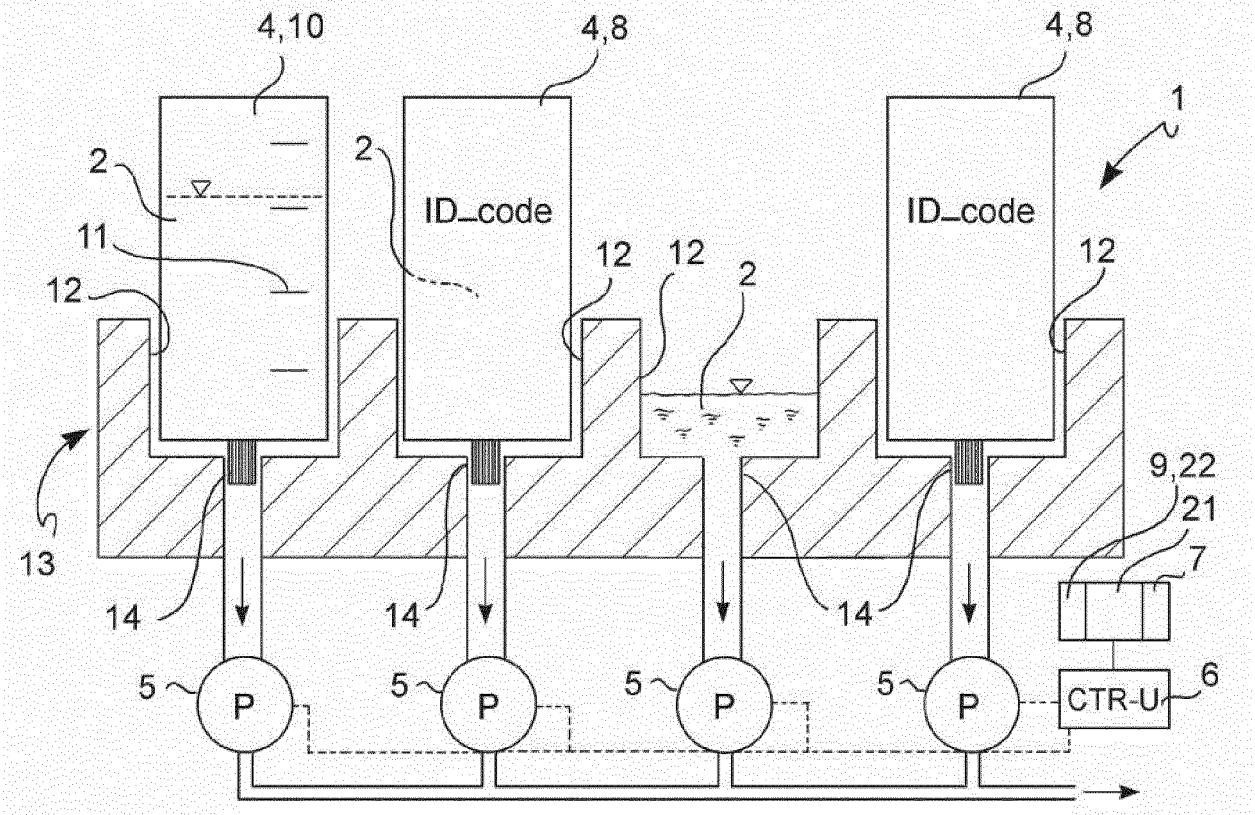
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FIG. 2

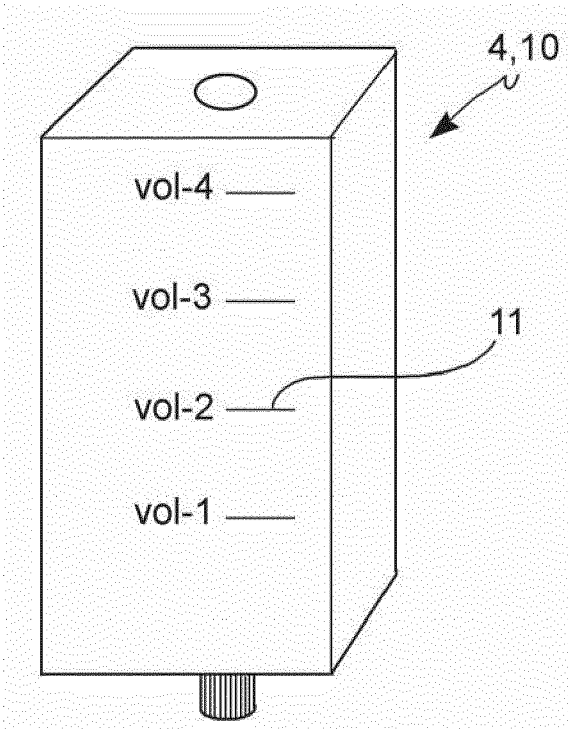

FIG. 3

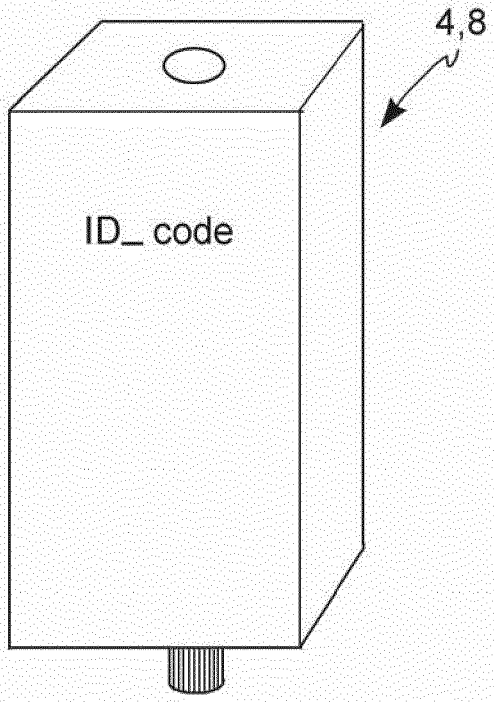

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 19 18 8665

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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	12 September 2019	Clivio, Eugenio

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