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(54) LAUNDRY WASHING MACHINE AND CORRESPONDING OPERATING METHOD

WASCHMASCHINE UND ZUGEHÖRIGES BETRIEBSVERFAHREN

MACHINE À LAVER LE LINGE ET PROCÉDÉ DE FONCTIONNEMENT S'Y RAPPORTANT

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Description

[0001] The present invention relates to a laundry washing machine and to its operating method.

[0002] More in details, the present invention relates to a front-loading home laundry washing machine provided with an internal water softening device and to its operating method, to which the following description refers purely by way of example without this implying any loss of generality.

[0003] As is known, currently marketed front-loading home laundry washing machines generally comprise: a substantially parallelepiped-shaped outer boxlike casing structured for resting on the floor; a substantially bell-shaped washing tub which is suspended in floating manner inside the casing, directly facing a laundry loading/unloading through opening realized in the front wall of the casing; a substantially cylindrical elastically-deformable bellows, which connects the front opening of the washing tub to the laundry loading/unloading opening formed in the front wall of the casing; a porthole door which is hinged to the front wall of the casing to rotate to and from a closing position in which the door closes the laundry loading/unloading opening in the front wall of the casing for watertight sealing the washing tub; a substantially cylindrical, bell-shaped revolving drum structured for housing the laundry to be washed, and which is arranged inside the washing tub with its concavity facing the laundry loading/unloading opening and is supported in axially rotating manner so as to be able to freely rotate about its substantially horizontally-oriented longitudinal axis; and finally an electrically-powered motor assembly which is structured for driving into rotation the revolving drum about its longitudinal axis inside the washing tub.

[0004] Alike any other home laundry washing machine, this type of laundry washing machine is furthermore provided with a detergent dispensing assembly which is generally located inside the boxlike casing, immediately above the washing tub, and is structured for selectively feeding into the washing tub, according to the washing cycle manually-selected by the user via a control panel generally located on the front wall of the boxlike casing, a given amount of detergent, softener and/or other washing agent suitably mixed with fresh water arriving from the water mains; and with a fresh-water supply circuit which is structured for selectively drawing fresh water from the water mains according to the washing cycle manually-selected by the user, and channelling said water into the detergent dispensing assembly or directly into the washing tub.

[0005] The detergent dispensing assembly, in turn, generally comprises: a detergent drawer which is usually divided into a number of detergent compartments each structured for being manually fillable with a corresponding detergent product, and which is fitted/inserted in manually extractable manner into a completely recessed drawer housing whose entrance is usually located on front wall of the boxlike casing, above the porthole door,

and whose bottom directly communicates with the inside of the washing tub via a connecting duct; and a drawer flush circuit which receives the fresh water from the fresh-water supply circuit, and is structured to selectively and alternatively channel said fresh water into any one of the detergent compartments of the detergent drawer, so as to selectively flush the detergent, softener or other washing agent out of the corresponding detergent compartment and down on the bottom of the drawer housing which, in turn, communicates with the inside of the washing tub.

[0006] As is known the hardness of the fresh water channelled into the washing tub deeply negatively influences the cleaning efficiency of the detergents and softeners used in the washing cycle, thus the user is usually requested to considerably increase, when the hardness degree of the fresh water is too high, the amount of detergent and softener used in the washing cycle and/or to mix the detergent with a given amount of very expensive, generally polycarboxylates-based, water-softening chemical product.

[0007] The European patent application No. 1085118 discloses a front-loading home laundry washing machine provided with an internal water softening device capable of reducing, during each washing cycle, the hardness degree of the fresh water used in the washing cycle. This internal water softening device uses ion-exchange resins to restrain calcium and magnesium ions (Ca^{++} and Mg^{++}) dissolved in the fresh water channelled to the washing tub, and uses brine (i.e. salt water) to periodically regenerate these ion-exchange resins. Salt water, in fact, is able to remove from the ion-exchange resins the calcium and magnesium ions previously combined/fixed to said resins.

[0008] Unluckily integration of the salt reservoir on the back of the detergent drawer has brought to a very complicated detergent drawer structure with a consequent significant increase in the detergent dispensing assembly overall production costs.

[0009] Moreover the brine accidentally coming out of the salt reservoir during the drawer movement accumulates on the bottom of the drawer housing which is in direct communication with the upper portion of the washing tub, thus the brine can reach quite easily the outer surface of the revolving drum with all problems concerned. The revolving drum, in fact, is generally made of metal material and gets rusty very quickly in presence of brine.

[0010] Last but not less important, the capacity of the salt reservoir on the back of the detergent drawer is too limited for the everyday-use typical of a traditional home laundry washing machine. It is unacceptable for a normal user to refill the salt reservoir every 3-4 washing cycles.

[0011] Aim of the present invention is therefore to realize an internal water softening device designed to eliminate the drawbacks referred above.

[0012] In compliance with the above aims, according to the present invention there is provided a laundry wash-

ing machine comprising an outer casing and, inside said outer casing, a washing tub, a rotatable drum housed in axially rotatable manner inside the washing tub and structured for housing the laundry to be washed, a detergent dispensing assembly which is structured for supplying detergent into the washing tub, a fresh-water supply circuit which is structured for selectively channeling a flow of fresh water from the water mains towards the detergent dispensing assembly and/or the washing tub, and a water softening device which is arranged/located along the fresh-water supply circuit and is structured for reducing the hardness degree of the fresh water channelled to the detergent dispensing assembly and/or the washing tub; the water softening device in turn comprising a water-softening agent container which is arranged/located along the fresh-water supply circuit and is filled with a water softening agent able to reduce the hardness degree of the fresh water flowing through the same water-softening agent container; a regeneration-agent reservoir which is fluidically connected to the water-softening agent container and is structured to receive a consumable regeneration agent for performing a regeneration of the water softening function of the water softening agent stored into the water-softening agent container; and a water supply circuit which is structured for channelling fresh water into the regeneration-agent reservoir so to at least partly dissolve the regeneration agents stored therein to form some brine; the laundry washing machine being characterized in that the regeneration-agent reservoir comprises a hermetically-closable container which is structured for receiving a given amount of consumable regeneration agent; and in that the water softening device furthermore comprises electrically-controlled pressurizing means which are structured to form, into said hermetically-closable container, an air volume or bubble of pressurized air which pressurizes the brine contained into the hermetically-closable container.

[0013] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the hermetically-closable container is provided with an exposed or exposable and hermetically-sealable loading inlet or mouth which is structured for allowing the user to load the consumable regeneration agent into the same hermetically-closable container.

[0014] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the pressurizing means comprise the water supply circuit of the water softening device.

[0015] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the water supply circuit of the water softening device is able to control the level of the liquid contained into the hermetically-closable container, so as to regulate the pressure of the air forming said air volume or bubble.

[0016] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the water supply circuit of the water softening device comprises a valve assembly which is interposed between the

water mains and the hermetically-closable container, and is able to control/regulate the flow of fresh water towards the hermetically-closable container.

[0017] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the pressurizing means comprise an electrically-controlled, source of pressurized-air which is able to selectively pump/channel a flow of pressurized air or other gas inside the hermetically-closable container.

[0018] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the electrically-controlled, source of pressurized-air comprises an electrically-powered, air-pumping device which has the outlet or delivery in direct communication with the inside of the hermetically-closable container, so as to be able to selectively pump a flow of pressurized air into said hermetically-closable container.

[0019] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the water softening device additionally comprises an electrically-controlled on-off valve which is interposed between the hermetically-closable container and the water-softening agent container, and is structured to selectively and alternatively put the hermetically-closable container in direct communication with the inside of the water-softening agent container, or to completely watertight seal/isolate the hermetically-closable container from the water-softening agent container.

[0020] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the water softening device furthermore comprises a water-level sensor which is structured for measuring the level of the fresh water and/or brine contained inside the hermetically-closable container, and/or a salinity-level sensor which is structured for measuring the salinity degree of the brine contained inside the hermetically-closable container, and/or a pressure sensor which is structured for measuring the value of the pressure of the air remained entrapped inside the hermetically-closable container.

[0021] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the hermetically-closable container is housed/recessed into the outer casing in manually detachable manner.

[0022] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the hermetically-closable container comprises a storage tank which is structured for being manually fillable with a given quantity of said consumable regeneration agent, and a manually-removable sealing cap which is structured to hermetically closed the storage tank.

[0023] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the storage tank is provided with a number self-closing hydraulic connectors which are structured to couple in detachable manner with corresponding complementary self-closing hydraulic connectors arranged inside the casing, so as to selectively put the storage tank in com-

munication with the water supply circuit of the water softening device and with the on-off valve of the water softening device.

[0024] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the storage tank is provided with a self-closing pneumatic connector which is structured to couple in detachable manner with corresponding complementary self-closing pneumatic connector arranged inside the casing, so as to selectively put the storage tank in communication with said pressurizing means.

[0025] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the hermetically-closable container is located/ incorporated into a drawer-like supporting structure which is fitted/inserted in manually extractable manner into a corresponding, substantially completely recessed, drawer housing which extends inside the casing starting from the front wall of the casing, so as to be movable between a retracted position in which the drawer-like supporting structure is completely recessed/inserted into the drawer housing to place the hermetically-closable container completely inside the casing; and an extracted position in which the drawer-like supporting structure partly juts out from the front wall of the casing so to arrange the hermetically-closable container outside of the casing.

[0026] Preferably, though not necessarily, the laundry washing machine is furthermore characterized by also comprising an appliance control panel which is located on a front side of said drawer-like supporting structure, so to be arranged substantially coplanar to the front wall of the casing when the drawer-like supporting structure is in the retracted position, and so to be arranged forward spaced apart from the front wall of the casing when the drawer-like supporting structure is in the extracted position.

[0027] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the detergent dispensing assembly is provided with an exposed or exposable loading inlet or mouth which is structured for allowing the user to load the requested detergent, softener and/or other washing agent inside the same detergent dispensing assembly 9, and in that the drawer-like supporting structure is located beside the exposed or exposable loading inlet or mouth of said detergent dispensing assembly.

[0028] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the hermetically-closable container is recessed/ incorporated on the worktop of the casing.

[0029] Preferably, though not necessarily, the laundry washing machine is furthermore characterized in that the hermetically-closable container is recessed/ located immediately underneath the worktop of the casing, and is freely accessible by the user through a manual-operated trapdoor realized on said worktop.

[0030] In addition to the above, according to the present invention there is provided an operating method

of a laundry washing machine having an internal water softening device that comprises: a water-softening agent container which is crossed by the fresh water flowing along the fresh-water supply circuit, and is filled with a water softening agent able to reduce the hardness degree of the fresh water flowing through the same water-softening agent container, and a regeneration-agent reservoir consisting in a hermetically-closable container which is fluidically connected to the water-softening agent container and is structured to receive a consumable regeneration agent for performing a regeneration of the water softening function of the water softening agent stored into the water-softening agent container; the operating method of the laundry washing machine being characterized by comprising the step of channelling a given amount of fresh water into the regeneration-agent reservoir so as to at least partly dissolve the regeneration agents stored therein to form some brine; and the step of creating inside the regeneration-agent reservoir an air volume or bubble of pressurized air which pressurizes the brine contained into the hermetically-closable container.

[0031] Preferably, though not necessarily, the operating method is furthermore characterized in that the step of creating said air volume or bubble inside the regeneration-agent reservoir comprises the step of pumping/channelling a flow of pressurized air or other gas inside the hermetically-closable container after having channelled the fresh water into the same regeneration-agent reservoir.

[0032] Preferably, though not necessarily, the operating method is furthermore characterized in that the step of creating said air volume or bubble inside the regeneration-agent reservoir comprises the step of channelling fresh water into the regeneration-agent reservoir so to control the level of the liquid contained into the hermetically-closable container.

[0033] Preferably, though not necessarily, the operating method is furthermore characterized in that a valve assembly is interposed between the hermetically-closable container and the water-softening agent container; said valve assembly being structured to selectively watertight seal/isolate the hermetically-closable container from the water-softening agent container, and the operating method comprises the step of opening said valve assembly for allowing the brine to flow from the hermetically-closable container to the water-softening agent container after the creation of the air volume or bubble into the hermetically-closable container.

[0034] Preferably, though not necessarily, the operating method is furthermore characterized by comprising also the step of channelling additional fresh water into the regeneration-agent reservoir when the valve assembly is opened to allow the brine to flow from the hermetically-closable container to the water-softening agent container.

[0035] A non-limiting embodiment of the present invention will now be described, by way of example, with ref-

reference to the accompanying drawings, in which:

- Figures 1 and 2 are two perspective views of a front-loading, home laundry washing machine realized in accordance with the teachings of the present invention, in two different working configurations;
- Figure 3 is a schematic view of the internal water softening device of the Figure 1 laundry washing machine;
- Figure 4 is a schematic perspective view of a portion of the Figure 3 internal water softening device of the laundry washing machine;
- Figure 5 is a schematic view of an alternative embodiment of the internal water softening device of the Figure 1 laundry washing machine;
- Figures 6, 7 and 8 are three perspective views of further three alternative embodiments of the Figure 1 laundry washing machine; whereas
- Figures 9a to 9e show schematically corresponding steps of the operating method of the Figure 1 laundry washing machine.

[0036] With reference to Figures 1, 2 and 3, reference number 1 indicates as a whole a home laundry washing machine which comprises: a preferably, though not necessarily, substantially parallelepiped-shaped, rigid outer boxlike casing 2 which is structured for resting on the floor; a preferably substantially cylindrical, bell-shaped hollow washing tub (not shown) which is arranged inside the casing 2 with its opening or mouth directly facing a laundry loading/unloading through opening realized in the front wall 2a of boxlike casing 2; a preferably substantially cylindrical, elastically-deformable bellows (not shown) which watertight connects the front opening or mouth of the washing tub to the laundry loading/unloading opening realized in front wall 2a of casing 2; and a substantially cylindrical, bell-shaped revolving drum (not shown) structured for housing the laundry to be washed, and which is housed in axially rotatable manner inside the washing tub (not shown), so as to be able to freely rotate about its longitudinal reference axis.

[0037] In the example shown, in particular, the laundry loading/unloading opening is preferably realized on front wall 2a of casing 2 substantially astride of the vertical center-plane of the casing 2, and the washing tub (not shown) is preferably arranged inside the boxlike casing 2 with its longitudinal reference axis substantially horizontally-oriented, i.e. substantially perpendicular to front wall 2a. The revolving drum (not shown), in turn, is housed in axially rotating manner inside the washing tub (not shown) with its front opening directly faced/aligned to the laundry loading/ unloading opening on front wall 2a, and the drum rotation axis is preferably arranged locally substantially coincident with the substantially horizontally-oriented longitudinal reference axis of the washing tub.

[0038] Furthermore in the example shown the hollow washing tub (not shown) is preferably suspended in float-

ing manner inside the casing 2 via a suspension system preferably, though not necessarily, comprising a couple of upper coil springs (not shown) connecting the upper portion of the washing tub to the top of the boxlike casing 2, and a number of lower vibration dampers (not shown) connecting the bottom portion of the washing tub to the bottom of casing 2.

[0039] With reference to Figures 1, 2 and 3, the laundry washing machine 1 furthermore comprises:

- a porthole door 7 which is hinged to the front wall 2a of casing 2 to rotate about a preferably, though not necessarily, vertically-oriented reference axis to and from a closing position in which the peripheral border of the porthole door 7 rests completely on front wall 2a for closing the laundry loading/unloading opening and watertight sealing the washing tub (not shown);
- an electrically-powered motor assembly (not shown) which is structured for driving into rotation the revolving drum about its longitudinal reference axis inside the washing tub;
- a detergent dispensing assembly 9 which is housed inside the casing 2 in easily reachable manner by the user, and is structured for selectively feeding into the washing tub (not shown), according to the selected washing cycle, a given amount of detergent, softener and/or other washing agent preferably suitably mixed with the fresh water arriving from the water mains, or even simply a given amount of fresh water arriving from the water mains; and
- a fresh-water supply circuit 10 which is connectable to the water mains and is structured for selectively channelling the fresh water from the water mains to the detergent dispensing assembly 9 and/or to the washing tub (not shown), preferably while controlling/regulating the flow of fresh water towards the detergent dispensing assembly 9 and/or the washing tub (not shown).

[0040] In addition to the above, the laundry washing machine 1 furthermore comprises an appliance control panel 11 which is structured for allowing the user to manually select the desired washing-cycle, and is preferably located on front wall 2a of casing 2, above the laundry loading/unloading opening and preferably also immediately underneath a preferably substantially horizontally oriented, worktop or top wall 2b of the casing 2; and an internal water softening device 12 which is located inside the casing 2, and is structured for selectively reducing, during each washing cycle, the hardness degree of the fresh water flowing from the water mains to the detergent dispensing assembly 9 and/or to the washing tub (not shown).

[0041] In the examples shown, in particular, the appliance control panel 11 is preferably located immediately underneath the top wall 2b of casing 2, substantially on the upper left corner of front wall 2a.

[0042] The internal water softening device 12, in turn, is arranged/located along the fresh-water supply circuit 10, so as to be crossed by the fresh water flowing from the water mains to the detergent dispensing assembly 9 and/or the washing tub (not shown), and is internally provided with a given amount of water softening agent which is able to reduce the hardens degree of the fresh water flowing through the same water softening device 12, and with a given amount of consumable salt or other regeneration agent which is able to regenerate the water softening function of the water softening agent.

[0043] More in particular, with reference to Figures 2 and 3, the internal water softening device 12 basically comprises a water-softening agent container 13 and a regeneration-agent reservoir 14, both housed inside the boxlike casing 2.

[0044] The water-softening agent container 13 is arranged/located along the fresh-water supply circuit 10 so as to be crossed by the fresh water flowing along the fresh-water supply circuit 10, and is filled with a water softening agent able to reduce the hardness degree of the fresh water flowing through the same water-softening agent container 13. The regeneration-agent reservoir 14, instead, is structured for receiving a given quantity of consumable salt or other regeneration agent which is able to regenerate the water softening function of the water softening agents stored inside the water-softening agent container 13, and is fluidically connected to the water-softening agent container 13 for selectively transferring a mixture of water and salt, or other regeneration agent, to the water-softening agent container 13.

[0045] With reference to Figure 3, in the example shown, in particular, the fresh-water supply circuit 10 preferably comprises an electrically-controlled on-off valve 15 which is arranged/interposed between the water mains and the water softening device 12, namely the water-softening agent container 13 of the water softening device 12, and is able to control/regulate the flow of fresh water from the water mains towards the water softening device 12; a first pipeline 16 connecting the on-off valve 15 directly to the water inlet of the internal water softening device 12, i.e. the water inlet of the water-softening agent container 13; and a second pipeline 17 connecting the water outlet of the internal water softening device 12, i.e. the water outlet of the water-softening agent container 13, to the detergent dispensing assembly 9 and/or to the washing tub (not shown).

[0046] Furthermore the fresh-water supply circuit 10 is preferably also provided with a one-way valve 18 which is located along pipeline 16 immediately downstream of the on-off valve 15, i.e. between the on-off valve 15 and the water inlet of the water-softening agent container 13 of the water softening device 12, and is arranged to allow the fresh water to only flow along the pipeline 16 from the water mains to the water softening device 12 and not vice versa. The internal water softening device 12 is therefore located downstream of the electrically-controlled on-off valve 15, and also downstream of the one-way

valve 18 if present.

[0047] With reference to Figures 1, 2 and 3, the detergent dispensing assembly 9, in turn, is preferably provided with an exposed or exposable loading inlet or mouth which is structured for allowing the user to timely load the requested detergent, softener and/or other washing agent inside the same detergent dispensing assembly 9. Furthermore the detergent dispensing assembly 9 is preferably arranged/located inside the boxlike casing 2 so that the loading inlet or mouth of the same detergent dispensing assembly 9 is exposed or exposable to the outside on front wall 2a of casing 2, preferably above the laundry loading/unloading opening and beneath the top wall 2b of the casing 2.

[0048] More specifically, the detergent dispensing assembly 9 is preferably arranged/located inside the casing 2 so that the loading inlet or mouth of the same detergent dispensing assembly 9 is preferably exposed or exposable to the outside on front wall 2a, substantially horizontally beside the appliance control panel 11.

[0049] In the example shown, in particular, the detergent dispensing assembly 9 is preferably arranged inside the casing 2 so as to locate its loading inlet or mouth immediately underneath the top wall 2b of casing 2, close to the upper right corner of front wall 2a. Thus the detergent dispensing assembly 9 and the appliance control panel 11 are preferably arranged inside the boxlike casing 2 substantially horizontally aligned to one another, immediately underneath the top wall 2b of the same casing 2.

[0050] More in details, with reference to Figures 1, 2 and 3, in the example shown the detergent dispensing assembly 9 preferably comprises a detergent container 20 which is manually fillable with a given quantity of detergent, softener and/or other washing agent, and is housed inside the casing 2 into a corresponding container housing 21; and the front wall 2a of casing 2 is preferably provided with a corresponding pass-through opening 21a through which the detergent container 20 is accessible by the user.

[0051] In other words, the detergent container 20 is provided with an exposed or exposable loading inlet or mouth which is structured for allowing the user to load the requested detergent, softener and/or other washing agent inside the same detergent container 20, and this loading inlet or mouth is accessible by the user through the pass-through opening 21a on front wall 2a.

[0052] The quantity of detergent, softener and/or other washing agent stored into the detergent container 20 may be sufficient either for a single washing cycle or for several consecutive washing cycles.

[0053] In the example shown, in particular, the container housing 21 is preferably located inside casing 2, above the washing tub (not shown) and beneath the top wall 2b, and the pass-through opening 21a is preferably arranged/located on front wall 2a of casing 2, immediately beneath the top wall 2b.

[0054] With reference to Figure 3, preferably, though

not necessarily, the detergent dispensing assembly 9 furthermore comprises a water supply circuit 22 which is connected to the fresh-water supply circuit 10 downstream of the water softening device 12, and is structured for selectively channelling a given amount of fresh water arriving from the water mains towards the detergent container 20, so as to selectively flush/push a given quantity of the detergent, softener or other washing agent into the washing tub (not shown).

[0055] More specifically, the inlet of water supply circuit 22 is fluidically connected to the fresh-water supply circuit 10, that is to say to the pipeline 17 of the fresh-water supply circuit 10, so as to receive the fresh water coming out from the internal water softening device 12.

[0056] With reference to Figures 1, 2 and 3, in the example shown, in particular, the detergent dispensing assembly 9 preferably comprises a detergent drawer 20 which is manually fillable with a given quantity of detergent, softener and/or other washing agent, and which is fitted/inserted in manually extractable manner into a corresponding, completely recessed drawer housing 21 which, starting from front wall 2a of casing 2, extends preferably substantially horizontally inside the boxlike casing 2 while remaining above the washing tub (not shown), and moreover communicates with the outside of casing 2 via a front entrance or opening 21a realized on front wall 2a of casing 2 substantially immediately above the laundry loading/unloading opening and substantially horizontally beside the appliance control panel 11.

[0057] Preferably the bottom of drawer housing 21 is furthermore structured so to directly communicate with the inside of the beneath-located washing tub (not shown) via a corresponding connecting duct (not shown).

[0058] The detergent drawer 20 is therefore manually movable inside the drawer housing 21 in a preferably substantially horizontally-oriented, displacement direction between a working position (see Figure 2) in which the detergent drawer 20 is completely recessed inside the corresponding drawer housing 21 preferably while at same time closing the front entrance or opening 21a of the same drawer housing 21, and a completely extracted position (see Figure 1) in which the detergent drawer 20 partly juts out from front wall 2a of casing 2 through the front entrance or opening 21a of the drawer housing 21.

[0059] In the example shown, in particular, the drawer housing 21 of detergent drawer 20 is preferably arranged inside casing 2 so as to locate its front entrance or opening 21a immediately beneath the top wall 2b of casing 2, close to the upper right corner of front wall 2a of casing 2; whereas the detergent drawer 20 is preferably movable inside the same drawer housing 21 along a substantially horizontally-oriented, displacement direction which is also locally substantially perpendicular to front wall 2a of casing 2.

[0060] With reference to Figure 3, the water supply circuit 22, in turn, is structured for selectively spilling/pouring into the detergent drawer 20 a given amount of fresh

water arriving from the fresh-water supply circuit 10 preferably in form of a dense shower of water droplets, so as to selectively flush a given quantity of the detergent, softener or other washing agent into the washing tub (not shown).

[0061] In the example shown, in particular, the detergent drawer 20 is preferably, though not necessarily, divided into a plurality of detergent compartments 20a (three detergent compartments in the example shown) each of which is manually fillable with a respective washing agent; and the water supply circuit 22 is preferably structured for spilling/pouring the fresh water arriving from the fresh-water supply circuit 10 selectively and alternatively into any one of the detergent compartments 20a of detergent drawer 20, so as to selectively flush the detergent, softener or other washing agent out of the same compartment 20a and down onto the substantially funnel-shaped bottom of the drawer housing 21. This mixture of water and detergent, softener or other washing agent afterwards flows into the washing tub (not shown) via the connecting duct branching off from the bottom of drawer housing 21.

[0062] More in particular, in the example shown the water supply circuit 22 is preferably structured for selectively spilling/pouring a dense shower of water droplets by gravity directly into any one of the detergent compartments 20a of detergent drawer 20, so as to flush the detergent, softener or other washing agent out of the detergent drawer 20 and down onto the bottom of drawer housing 21.

[0063] With reference to Figure 3, in the example shown the water supply circuit 22 of detergent dispensing assembly 9 preferably comprises an electrically-controlled hydraulic distributor 24 or similar valve assembly, which is arranged/interposed between the fresh-water supply circuit 10 and the various detergent compartments 20a of the detergent drawer 20, i.e. between the outlet of the pipeline 17 and the various detergent compartments 20a of detergent drawer 20, and is structured for selectively and alternatively channelling the fresh water arriving from the fresh-water supply circuit 10 towards the various detergent compartments 20a of detergent drawer 20.

[0064] Furthermore, the water supply circuit 22 preferably also comprises a sprinkler head 25 which is associated to the drawer housing 21 of detergent drawer 20 so as to be located immediately above the detergent drawer 20 when the latter is completely inserted/recessed into the drawer housing 21. This sprinkler head 25 is provided with a number (three in the example shown) of shower-making portions/sections 25a each of which is preferably substantially vertically aligned to one or more detergent compartments 20a of detergent drawer 20, and is structured for feeding a dense shower of water droplets by gravity into said detergent compartment/s 20a.

[0065] In the example shown, in particular, each shower-making section/portion 25a of sprinkler head 25 is

preferably locally vertically aligned to a respective detergent compartment 20a of detergent drawer 20, and is preferably structured for feeding a dense shower of water droplets exclusively into the detergent compartment 20a located immediately beneath.

[0066] The hydraulic distributor 24 is located upstream of the sprinkler head 25, i.e. between the sprinkler head 25 and the fresh-water supply circuit 10, and is structured for channelling the fresh water arriving from the fresh-water supply circuit 10 selectively and alternatively towards the various shower-making sections/portions 25a of the sprinkler head 25.

[0067] In other words, the electrically-controlled hydraulic distributor 24 is provided with a water inlet fluidically connected to the fresh-water supply circuit 10, i.e. to pipeline 17, and a number (three in the example shown) of water outlets each fluidically connected to a respective shower-making section/portion 25a of the sprinkler head 25, and it is structured for selectively and alternatively channelling the fresh water arriving from the fresh-water supply circuit 10 to the various shower-making sections/portions 25a of the sprinkler head 25.

[0068] Turning now to the internal water softening device 12, with reference to Figures 2 and 3, the water-softening agent container 13 is preferably filled with a given amount of ion-exchange resins (not shown) capable to restrain the calcium and/or magnesium ions (Ca^{++} and Mg^{++}) dissolved in the fresh water flowing across the same water-softening agent container 13, and is located along the fresh-water supply circuit 10 so as to be crossed by the fresh water directed towards the detergent dispensing assembly 9 and/or towards the washing tub (not shown). The ion-exchange resins (not shown) stored into the water-softening agent container 13 form the water softening agents of the water softening device 12.

[0069] In the example shown the water-softening agent container 13, hereinafter also referred to as the resin container 13, is preferably arranged upstream of the hydraulic distributor 24, so as to be crossed by the fresh water flowing from the water mains to the inlet of the water supply circuit 22 of detergent dispensing assembly 9.

[0070] The regeneration-agent reservoir 14 of water softening device 12, instead, consists in a hermetically-closable container 14, i.e. a container closable in a substantially airtight and watertight manner, which is structured for receiving a given amount (for example half a Kilo or one Kilo) of salt (Sodium Chloride) grains or similar regeneration chemical agent, and is provided with an exposed or exposable and hermetically-sealable loading inlet or mouth which is structured for allowing the user to timely load said given amount of consumable salt or other regeneration agent into the same hermetically-closable container 14.

[0071] With reference to Figure 3, in addition to the resin container 13 and to the outside-accessible, hermetically-closable container 14, the internal water softening device 12 furthermore comprises:

- a water supply circuit 28 which is structured for channelling, on command, a given amount of fresh water into the hermetically-closable container 14 so as to at least partly dissolve the salt or other regeneration agents stored therein and form a given amount of brine (i.e. of salt water); and
- an electrically-controlled on-off valve 29 which is interposed between the hermetically-closable container 14 and the water-softening agent container 13, and is structured to selectively and alternatively put the hermetically-closable container 14 in direct communication with the inside of the water-softening agent container 13 for allowing the brine (i.e. the salt water) to freely flow from the hermetically-closable container 14 to the water-softening agent container 13, or to completely watertight seal/isolate the hermetically-closable container 14 from the water-softening agent container 13 so as to prevent the brine (i.e. the salt water) contained into the hermetically-closable container 14 from flowing towards the water-softening agent container 13.

[0072] In addition to the above, the internal water softening device 12 moreover comprises an electrically-controlled, source of pressurized-air 30 which is able to selectively pump/channel a flow of pressurized air or other gas inside the hermetically-closable container 14 so as to form/create, inside the hermetically-closable container 14, a big air volume or bubble which pressurizes the brine contained into the same hermetically-closable container 14.

[0073] With reference to Figure 3, the water softening device 12 is preferably also provided with a first water drain line 31 which fluidically connects the resin container 13, i.e. the water-softening agent container 13, to the washing tub (not shown) of the laundry washing machine 1 and is structured for selectively draining the brine or fresh water out of the resin container 13 and channelling said brine or fresh water directly into the washing tub.

[0074] As an alternative, the water drain line 31 is structured for channelling the brine or fresh water stored into the resin container 13 preferably into the drain sump (not shown) that extends downwards from the bottom of the washing tub (not shown), or into the water filtering assembly (not shown) that is interposed between the drain sump (not shown) of the washing tub and the suction of either the water circulating pump (not shown) or the water exhaust pump (not shown), or substantially directly into the water exhaust pump (not shown) which drains the waste water or washing liquor outside of the laundry washing machine 1, or in any case into the waste-water drain line that channels the waste water or washing liquor outside the laundry washing machine 1.

[0075] With reference to Figure 3, in the example shown, in particular, the water supply circuit 28 of water softening device 12 is preferably structured for being connected to the water mains independently from the fresh-water supply circuit 10, so as to be able to selectively

draw a given amount of fresh water from the water mains and channel said fresh water directly into the outside-accessible, hermetically-closable container 14.

[0076] Moreover the water supply circuit 28 preferably comprises: a pipeline 32 or the like which connects the hermetically-closable container 14 to the water mains independently from the fresh-water supply circuit 10; and an electrically-controlled on-off valve 33 which is located along pipeline 32, so as to be interposed between the water mains and the hermetically-closable container 14, and is able to control/ regulate the flow of fresh water from the water mains towards the hermetically-closable container 14.

[0077] In the example shown, in particular, the electrically-controlled on-off valve 33 is preferably, though not necessarily, attached to the rear wall of casing 2 close to on-off valve 15, and it is directly connected to the hermetically-closable container 14 via the pipeline 32.

[0078] With reference to Figure 3, preferably, though not necessarily, the water supply circuit 28 of water softening device 12 furthermore comprises an auxiliary one-way valve 34 which is located along pipeline 32 preferably immediately downstream of the on-off valve 33, i.e. between the on-off valve 33 and the hermetically-closable container 14, and which is arranged to allow the fresh water to only flow along pipeline 32 from the water mains to the hermetically-closable container 14.

[0079] Still with reference to Figure 3, the electrically-controlled source of pressurized-air 30, in turn, preferably, though not necessarily, comprises an electrically-powered air compressor 35 or similar air-pumping device which has the outlet or delivery in direct communication with the inside of the hermetically-closable container 14 preferably via an air duct 36, so as to be able to selectively pump a flow of pressurized air into the hermetically-closable container 14. The pressure of the air channelled into the hermetically-closable container 14 is greater than the ambient pressure.

[0080] The water drain line 31, instead, preferably comprises a pipeline 37 or the like which directly connects the bottom of the resin container 13 to the washing tub (not shown), or to the drain sump (not shown), or to the water filtering assembly (not shown), or to the water exhaust pump (not shown); and an electrically-controlled on-off valve 38 which is located along the pipeline 37 for controlling the outflow of the brine or fresh water from the resin container 13.

[0081] In addition to the above, the internal water softening device 12 preferably furthermore comprises a water-level sensor (not shown) which is structured for measuring the level of the fresh water and/or brine contained inside the hermetically-closable container 14, and/or a salinity-level sensor (not shown) which is structured for measuring the salinity degree of the brine contained inside the hermetically-closable container 14.

[0082] Optionally, the internal water softening device 12 may furthermore comprise a pressure sensor (not shown) which is structured for measuring the value of

the pressure of the air remained entrapped inside the hermetically-closable container 14.

[0083] Furthermore the internal water softening device 12 is preferably also provided with a water-hardness sensor (not shown) which is structured for measuring the hardness degree of the fresh water coming out from the resin container 13, i.e. the water-softening agent container 13, directed towards the detergent dispensing assembly 9.

[0084] In the example shown, in particular, the water-level sensor and/or the salinity-level sensor and/or the air-pressure sensor and/or the water-hardness sensor is/are able to communicate with an internal electronic central control unit (not shown) which is housed inside the boxlike casing 2 and controls all electrically-operated component parts of the laundry washing machine 1.

[0085] With reference to Figure 3, the laundry washing machine 1 is preferably, though not necessarily, also provided with a second water drain line 43 which is structured for selectively rerouting the brine or fresh water coming out from the resin container 13 directed towards the detergent dispensing assembly 9, into the washing tub (not shown) so as to bypass the detergent dispensing assembly 9, or rather at least the detergent container 20, i.e. the detergent drawer 20, of the detergent dispensing assembly 9.

[0086] As an alternative, the water drain line 43 is structured for channeling the brine or fresh water coming out from the resin container 13 directed towards the detergent dispensing assembly 9, preferably into the drain sump (not shown) that extends downwards from the bottom of washing tub (not shown) of the laundry washing machine 1, or into the water filtering assembly (not shown) that is interposed between the drain sump (not shown) of the washing tub and the suction of the water circulating pump (not shown) and/or of the water exhaust pump (not shown) of the laundry washing machine 1, or in any case into the waste-water drain line that channels the waste water or washing liquor outside the laundry washing machine 1.

[0087] In the example shown, in particular, the second water drain line 43 is structured to selectively reroute the brine or fresh water that enters into the detergent dispensing assembly 9 through pipeline 17, directly towards the washing tub (not shown), or towards the drain sump (not shown) that extends downwards from the bottom of the washing tub, or towards the water filtering assembly (not shown) that is interposed between the drain sump (not shown) of the washing tub and the suction of the water circulating pump (not shown) and/or of the water exhaust pump (not shown) of the laundry washing machine 1, so as to bypass solely the detergent container 20, i.e. the detergent drawer 20, of detergent dispensing assembly 9.

[0088] More in particular, with reference to Figure 3, the second water drain line 43 preferably comprises a pipeline 44 or the like which is connected to a specific additional water outlet of the electrically-controlled hy-

draulic distributor 24 or similar valve assembly of the detergent dispensing assembly 9, and ends directly into the washing tub (not shown), or into the drain sump, or into the water filtering assembly, or into the water exhaust pump; and the electrically-controlled hydraulic distributor 24 is structured to selectively direct/channel directly into pipeline 44 the brine of softened fresh water arriving from resin container 13 via pipeline 17, so as to channel the brine or fresh water arriving from resin container 13 directly into the washing tub (not shown) or into the drain sump (not shown) or into the water filtering assembly (not shown) or into the water exhaust pump (not shown).

[0089] According to a non-shown alternative embodiment, the second water drain line 43 may comprise, immediately upstream of the water supply circuit 22 of detergent dispensing assembly 9, an electrically-controlled three-way valve which has a first outlet connected to the inlet of the water supply circuit 22, i.e. to the hydraulic distributor 24, and a second outlet connected to pipeline 44 of water drain line 43. This electrically-controlled three-way valve is structured for selectively and alternatively channelling the fresh water coming out of the resin container 13 either to pipeline 44, or to the inlet of the water supply circuit 22 of detergent dispensing assembly 9, i.e. to the hydraulic distributor 24.

[0090] In this alternative embodiment, therefore, the second water drain line 43 is structured so as to bypass the whole detergent dispensing assembly 9, and therefore the water supply circuit 22 of detergent dispensing assembly 9 may lack the hydraulic distributor 24.

[0091] With reference to Figures 2, 3 and 4, the hermetically-closable container 14 of water softening device 12, in turn, is preferably dimensioned to contain an amount of brine sufficient for performing several resin regeneration processes. Furthermore the hermetically-closable container 14 is preferably, though not necessarily, located/ incorporated, either in unmovable or in manually detachable manner, into a drawer-like supporting structure 50 which is fitted/inserted in manually extractable manner into a corresponding, substantially completely recessed, drawer housing 51 which, starting from the front wall 2a, extends preferably substantially horizontally inside the casing 2 and communicates with the outside via a front entrance or opening 51a realized on the same front wall 2a of casing 2, so as to be movable in a preferably substantially horizontally-oriented, displacement direction between

- a retracted position (see Figure 1) in which the drawer-like supporting structure 50 carrying the hermetically-closable container 14 is completely recessed/inserted into the drawer housing 51, so as to place the hermetically-closable container 14 completely inside the casing 2 and hide, i.e. make inaccessible to the user, the loading inlet or mouth of the same hermetically-closable container 14; and
- a completely extracted position (see Figure 2) in which the drawer-like supporting structure 50 partly

juts out from the front wall 2a of casing 2 through the front entrance or opening 51a of drawer housing 51, so as to place the hermetically-closable container 14 at least partially outside of the casing 2 and make freely accessible to the user at least the loading inlet or mouth of the hermetically-closable container 14.

[0092] In the example shown, in particular, the drawer housing 51 preferably extends substantially horizontally inside the casing 2 while remaining above the washing tub (not shown) and preferably also beside the detergent container 20 of the detergent dispensing assembly 9, and furthermore communicates with the outside via a front entrance or opening 51a which is realized on front wall 2a of casing 2, immediately above the laundry loading/unloading opening on front wall 2a and preferably also beside the exposed or exposable loading inlet of the detergent dispensing assembly 9.

[0093] More in details, in the example shown the drawer housing 51 preferably extends substantially horizontally inside the casing 2 while remaining above the washing tub (not shown) and between the drawer housing 21 of the detergent dispensing assembly 9 and the right side-wall of the casing 2. Furthermore the drawer housing 51 communicates with the outside via a front entrance or opening 51a which is realized on front wall 2a of casing 2 immediately above the laundry loading/ unloading opening and immediately beside the front entrance or opening 21a of the drawer housing 21, opposite to the appliance control panel 11.

[0094] In other words, the front entrance or opening 51a of drawer housing 51, the front entrance or opening 21a of drawer housing 21 and the appliance control panel 11 are preferably substantially horizontally aligned on front wall 2a of casing 2, one beside the other substantially immediately underneath the top wall 2b of the same casing 2.

[0095] With reference to Figures 2, 3 and 4, preferably the hermetically-closable container 14 moreover comprises:

- a preferably substantially parallelepiped-shaped, storage tank 53 which is structured for being manually fillable with a given quantity of consumable salt or other regeneration agent, and is housed/located into the drawer-like supporting structure 50 so to be freely accessible by the user when the drawer-like supporting structure 50 is in the extracted position, and to be hidden and inaccessible by the user when the drawer-like supporting structure 50 is arranged in the retracted position; and
- a manually-removable sealing cap 54 which is structured to hermetically closed the storage tank 53, and is preferably also located on top of storage tank 53 so as to be freely accessible by the user when the drawer-like supporting structure 50 is in the completely extracted position.

[0096] The water supply circuit 28 is therefore structured to directly communicate with the inside of the storage tank 53 for channelling, on command, a given amount of fresh water from the water mains directly into the storage tank 53, so as to preferably completely dissolve at once the whole salt or other regeneration agents contained into storage tank 53 and form a great amount of brine (i.e. of salt water).

[0097] The air duct 35, in turn, is structured to directly communicate with the inside of storage tank 53 for channelling, on command and to the storage tank 53, the pressurized air coming out from the delivery of the air compressor 35.

[0098] The electrically-controlled on-off valve 29, instead, is interposed between the storage tank 53 and the water-softening agent container 13 and is structured to selectively and alternatively put the storage tank 53 in direct communication with the inside of the water-softening agent container 13 for allowing the brine to freely flow from the storage tank 53 to the water-softening agent container 13, or completely watertight seal/isolate the storage tank 53 from the water-softening agent container 13, i.e. from the resin container 13.

[0099] In addition to the above, the storage tank 53 is preferably housed/ incorporated into the drawer-like supporting structure 50 so as to be placed almost completely outside of the casing 2 when the drawer-like supporting structure 50 is in the completely extracted position, and is preferably also housed/incorporated into the drawer-like supporting structure 50 in a manually removable manner, so as to be selectively detachable from the drawer-like supporting structure 50 when the drawer-like supporting structure 50 is arranged in the completely extracted position.

[0100] In other words, the hermetically-closable container 14 is preferably housed/ incorporated into the drawer-like supporting structure 50 in a manually removable manner, so as to be selectively detachable from the drawer-like supporting structure 50 when the drawer-like supporting structure 50 is arranged in the completely extracted position.

[0101] Thus, the hermetically-closable container 14 is housed/recessed into the outer casing 2 in a manually detachable manner.

[0102] With reference to Figures 2 and 4, in the example shown, in particular, the drawer housing 51 of drawer-like supporting structure 50 is preferably provided with a substantially basin-shaped, tank seat 53a which is specifically structured for receiving the storage tank 53 when the drawer-like supporting structure 50 is arranged in the retracted position; and the storage tank 53 is provided with a number self-closing hydraulic and pneumatic connectors 55, 56, 57 which are structured to connect in easily detachable manner the storage tank 53 to, respectively, the water supply circuit 28, the on-off valve 29 and the source of pressurized air 30, preferably during the movement of the drawer-like supporting structure 50 from the extracted to the retracted position.

[0103] In other words, the regeneration-agent reservoir 14 is housed into the drawer-like supporting structure 50 in manually removable manner.

[0104] More in particular, the storage tank 53 is preferably provided with two self-closing hydraulic connectors 55 and 56, and one self-closing pneumatic connector 57. Each self-closing hydraulic connector 55, 56 of storage tank 53 is specifically structured to watertight couple in easily detachable manner with a corresponding complementary self-closing hydraulic connector 58, 59 preferably arranged on the drawer-like supporting structure 50; whereas the self-closing pneumatic connector 57 of storage tank 53 is specifically structured to airtight couple in easily detachable manner with a corresponding complementary self-closing pneumatic connector 60 preferably arranged on the drawer-like supporting structure 50.

[0105] The self-closing hydraulic connector 58 of tank seat 53a directly communicates with the water supply circuit 28 of water softening device 12, namely with pipeline 32, and allows, when suitably coupled to the complementary self-closing hydraulic connector 55 of storage tank 53, the fresh water arriving from the water supply circuit 28 to freely flow into storage tank 53, so as to dissolve the salt and produce the brine.

[0106] The self-closing hydraulic connector 59 of tank seat 53a, instead, directly communicates with the inlet of the electrically-controlled on-off valve 29 of water softening device 12, and allows, when suitably coupled to the complementary self-closing hydraulic connector 56 of storage tank 53, the brine stored into the storage tank 53 to freely flow out of the storage tank 53 towards the electrically-controlled on-off valve 29 which, in turn, directly communicates with the resin container 13, i.e. with the water-softening agent container 13.

[0107] Lastly, the self-closing pneumatic connector 60 of tank seat 53a directly communicates with the electrically-controlled source of pressurized air 30 of water softening device 12, namely the air duct 36, and allows, when suitably coupled to the complementary self-closing pneumatic connector 57 of storage tank 53, the pressurized air arriving from the source of pressurized air 30 to freely flow into storage tank 53, so as to form/create the big air volume or bubble which pressurizes the brine contained into the storage tank 53.

[0108] In addition to the above, each self-closing hydraulic connector 55, 56 of storage tank 53 is furthermore structured so as to remain closed in watertight manner when uncoupled from the corresponding complementary self-closing hydraulic connector 58, 59 on the drawer-like supporting structure 50; whereas each self-closing hydraulic connector 58, 59 of the drawer-like supporting structure 50 is preferably structured so as to remain closed in watertight manner when uncoupled from the corresponding complementary self-closing hydraulic connector 55, 56 of storage tank 53.

[0109] Similarly, the self-closing pneumatic connector 57 of storage tank 53 is preferably, though not necessarily, structured so as to remain closed in airtight manner

when uncoupled from the corresponding complementary self-closing pneumatic connector 60 of the drawer-like supporting structure 50. The self-closing pneumatic connector 60 of the drawer-like supporting structure 50, in turn, is preferably, though not necessarily, structured so as to remain closed in airtight manner when uncoupled from the corresponding complementary self-closing pneumatic connector 57 of storage tank 53.

[0110] With reference to Figure 4, in the example shown, in particular, the self-closing hydraulic and pneumatic connectors 58, 59, 60 are preferably arranged on the back wall of tank seat 53a, so as to couple with the corresponding, complementary self-closing hydraulic and pneumatic connectors 55, 56, 57 of storage tank 53 when the drawer-like supporting structure 50 moves substantially horizontally from the extracted to the retracted position.

[0111] Furthermore the bottom of tank seat 53a is preferably, though not necessarily, shaped/structured so as to form a catchment basin wherein the fresh water or brine leaking out of the storage tank 53 may accumulate. This catchment basin, in turn, is preferably connected to the bottom of the washing tub (not shown) of the laundry washing machine 1 via a specific water drain line 61 which is structurally similar to the water drain line 31.

[0112] As an alternative, the water drain line 61 may be structured for channelling the brine or fresh water accumulating on the bottom of tank seat 53a preferably into the drain sump (not shown) that extends downwards from the bottom of the washing tub (not shown), or into the water filtering assembly (not shown) that is interposed between the drain sump (not shown) of the washing tub and the suction of the water circulating pump (not shown) and/or of the water exhaust pump (not shown) of the laundry washing machine 1, or in any case into the wastewater drain line that channels the waste water or washing liquor outside the laundry washing machine 1.

[0113] With reference to figure 4, the regeneration-agent reservoir 29 is preferably also provided with a second water-level sensor 62 which is located on the bottom of tank seat 53a and is structured is able to measure the level of the fresh water and/or brine accumulated on the catchment basin formed on the bottom of tank seat 53a, and the electronic central control unit (not shown) of the laundry washing machine 1 activates the water drain line 61 when the level of brine and/or fresh water on the bottom of tank seat 53a exceeds a given threshold value.

[0114] According to an alternative embodiment of the water softening device 12, the laundry washing machine 1 may lack the drawer-like supporting structure 50 and the corresponding drawer housing 51; and the storage tank 53, i.e. the hermetically-closable container 14, may be structured so as to form a completely stand-alone modular cartridge, which is structured so as to be easily insertable in manually extractable manner into a corresponding, completely recessed tank seat 53a which is preferably realized either on the front wall 2a or on the top wall 2b the casing 2.

[0115] With reference to Figure 3, the resin container 13 of water softening device 12, in turn, is preferably, though not necessarily, located inside the casing 2 immediately beneath the outside-accessible, hermetically-closable container 14.

[0116] In the example shown, in particular, the resin container 13 is preferably attached to the bottom of the drawer housing 51 of the drawer-like supporting structure 50, immediately beside the upper portion of the washing tub (not shown), so as to internally face the front wall 2a of casing 2.

[0117] In other words, the resin container 13 is preferably located below the drawer housing 51, within an approximately triangular pocket seat or compartment delimited by the bottom of the drawer housing 51, the front wall 2a of casing 2, the vertical right sidewall of the same casing 2, and the upper portion of the washing tub.

[0118] Moreover, the resin container 13 preferably, though not necessarily, consists in a completely stand-alone modular cartridge 13 which is provided with mechanical coupling members (not shown) structured for allowing a rigid and stable, though easily releasable, fastening of the stand-alone modular component-part or cartridge 13 directly to the bottom of the drawer housing 51 of drawer-like supporting structure 50, and with hydraulic connectors (not shown) structured for allowing the stable, though easily removable, hydraulic connection of the stand-alone modular cartridge 13 to the fresh water supply circuit 10 and to the outlet of the electrically-controlled on-off valve 29.

[0119] In other words, a first hydraulic connector (not shown) of the stand-alone modular cartridge 13 is connected to pipeline 16, so as to allow the inflow of the fresh water into the resin container 13; a second hydraulic connector (not shown) of the stand-alone modular cartridge 13 is connected to pipeline 17 so as to allow the outflow of the fresh water from the resin container 13 towards the detergent dispensing assembly 9; and a third hydraulic connector (not shown) of the stand-alone modular cartridge 13 is structured to directly communicate with the outlet of the on-off valve 29 so as to allow the controlled inflow of the brine (i.e. the salt water) into the resin container 13.

[0120] With reference to Figure 3, preferably the laundry washing machine 1 is finally provided with a second fresh-water supply circuit 66 which is structured for being connected to the water mains independently from the fresh-water supply circuit 10, and for selectively channelling the fresh water from the water mains to the detergent dispensing assembly 9 and/or directly to the washing tub (not shown), bypassing the water softening device 12.

[0121] In other words, the second fresh-water supply circuit 66 connects the water mains directly to the inlet of the water supply circuit 22 of detergent dispensing assembly 9 bypassing the water softening device 12, and is structured so as to selectively channel to the inlet of the water supply circuit 22 a second flow of non-softened

fresh water of the water mains. The second fresh-water supply circuit 66 is therefore able to channel the fresh water of the water mains directly towards the inlet of water supply circuit 22 independently from the fresh-water supply circuit 10.

[0122] Furthermore, if the second water drain line 43 is present, the second fresh-water supply circuit 66 is preferably, though not necessarily, also able to channel the non-softened fresh water of the water mains directly into the washing tub (not shown) via the water drain line 43, thus bypassing all detergent compartments 20a of the detergent drawer 20.

[0123] With reference to Figure 4, similarly to the fresh-water supply circuit 10, the second fresh-water supply circuit 66 preferably comprises:

- a pipeline 68 or the like directly connecting the water mains to the inlet of water supply circuit 22 of detergent dispensing assembly 9 while bypassing the resin container 13; and
- a electrically-controlled on-off valve 67 which is located along pipeline 68, between the water mains and the inlet of water supply circuit 22, and is able to control/regulate the flow of fresh water from the water mains towards the inlet of the water supply circuit 22.

[0124] Furthermore the second fresh-water supply circuit 66 preferably also comprises a one-way valve 69 which is located downstream of the on-off valve 67, and is arranged so as to allow the fresh water to only flow along the pipeline 68, from the water mains to the inlet of the water supply circuit 22 of detergent dispensing assembly 9, and not vice versa.

[0125] Preferably, though not necessarily, the appliance control panel 11 is furthermore structured so as to allow the user to manually select the desired washing cycle between washing cycles that use softened fresh water, washing cycles that use normal, i.e. non-softened, fresh water, and finally washing cycles that use a mixture of softened and normal, i.e. non-softened, fresh water.

[0126] General operation of home laundry washing machine 1 is clearly inferable from the above description. When the on-off valve 15 of fresh-water supply circuit 10 is opened the fresh water flows from the water mains to the resin container 13 of internal water softening device 12, wherein the ion-exchange resins reduce the hardness degree of the fresh water directed to the detergent dispensing assembly 9. The water-hardness sensor monitors the hardness degree of the fresh water directed to the detergent dispensing assembly 9.

[0127] After having crossed the resin container 13, the softened fresh water of the water mains reaches the detergent dispensing assembly 9 and enters into the electrically-controlled hydraulic distributor 24 of water supply circuit 22. According to phase of the washing cycle, the hydraulic distributor 24 then channels the softened fresh water to one or more of the shower-making portions/sec-

tions 25a of the sprinkler head 25 for flushing the detergent, softener or other washing agent out of the corresponding detergent compartment 20a of the detergent drawer 20 and sweeping away said detergent, softener or other washing agent down into the washing tub (not shown) via the connecting duct present on the bottom of the drawer housing 21 of detergent drawer 20.

[0128] When determines that the ion-exchange resins inside the resin container 13 are no more able to reduce the hardness degree of the fresh water directed to the washing tub (not shown), the electronic central control unit (not shown) of laundry washing machine 1 performs, preferably immediately before the starting of the rinsing phase of the washing cycle, a regeneration process of the ion-exchange resins stored inside the resin container 13.

[0129] Obviously the regeneration process may also take place during the washing phase of the washing cycle, or can take place even when no washing cycle at all is running, preferably on specific request of the user.

[0130] Assuming now that the currently airtight-sealed, hermetically-closable container 14 was previously refilled with a sufficient quantity of consumable salt or other regeneration agent and that there is currently no brine inside the same hermetically-closable container 14, the central control unit of laundry washing machine 1, at any time before the beginning of the regeneration process, opens the on-off valve 33 of water supply circuit 28 for a predetermined time interval, so as to fill up with fresh water the hermetically-closable container 14, i.e. the storage tank 53, preferably while also forming/creating/generating at same time an air volume or bubble inside the hermetically-closable container 14.

[0131] Since the on-off valve 29 is still configured so as to completely watertight seal/isolate the hermetically-closable container 14, i.e. the storage tank 53, from the water-softening agent container 13, the entry of fresh water into the hermetically-closable container 14 naturally stops when the hermetically-closable container 14 is completely full of water and/or the pressure of the air forming the air bubble inside the hermetically-closable container 14, i.e. the storage tank 53, is greater than the ambient pressure and almost equal to the pressure of the fresh water arriving from the water mains.

[0132] The central control unit of laundry washing machine 1 can close the on-off valve 33 of water supply circuit 28 either in advance to the natural stop of the water flow towards the hermetically-closable container 14, so to directly control the level of water/brine contained inside the hermetically-closable container 14, or after the natural stop of the water flow towards the hermetically-closable container 14.

[0133] In the first case, when the on-off valve 33 is closed, the brine contained inside the hermetically-closable container 14 will be at a pressure higher than the ambient pressure and lower than that of the fresh water arriving from the water mains. In the second case, when the on-off valve 33 is closed, the brine contained inside

the hermetically-closable container 14 will be at a pressure higher than the ambient pressure and almost equal to that of the fresh water arriving from the water mains.

[0134] The fresh water channelled into the hermetically-closable container 14, i.e. the storage tank 53, dissolves substantially the whole salt contained into the airtight-closed hermetically-closable container 14 and forms a great amount of brine (i.e. of salt water) sufficient for performing several resin regeneration processes.

[0135] This great amount of brine remains inside the hermetically-closable container 14 at a pressure greater than the ambient pressure until a resin regeneration process is requested to take place.

[0136] If necessary, after having closed the on-off valve 33 of the water supply circuit 28, the central control unit of laundry washing machine 1 activates the source of pressurized-air 30, i.e. the air compressor 35, so as to pump further pressurized air into the hermetically-closable container 14, i.e. the storage tank 53, so as to further increase the pressure and or volume of the air inside the hermetically-closable container 14, i.e. the pressure or volume of the air forming the air bubble inside the hermetically-closable container 14. This pressurized air, in turn, pressurizes the brine contained inside the hermetically-closable container 14 at a pressure value greater than the ambient pressure and preferably, though not necessarily, also greater than that of the fresh water arriving from the water mains.

[0137] Obviously, if the no air remains entrapped into the hermetically-closable container 14 when the water supply circuit 28 channeled the fresh water of the water mains into the hermetically-closable container 14, the central control unit of laundry washing machine 1 may activate the source of pressurized-air 30, i.e. the air compressor 35, so to create from zero the air volume or bubble of pressurized air into the hermetically-closable container 14.

[0138] Since the hermetically-closable container 14 is substantially airtight and watertight, the brine contained into the hermetically-closable container 14 remains pressurized at a pressure greater than the ambient pressure, until a resin regeneration process is requested to take place and the central control unit of the laundry washing machine 1 opens the on-off valve 29.

[0139] At beginning of the regeneration process, assuming that the hermetically-closable container 14, i.e. the storage tank 53, already contains a given amount of brine sufficient for performing one or more resin regeneration processes and that the on-off valves 33 and 29 are both closed, the central control unit of laundry washing machine 1 closes the on-off valve 15 of the fresh-water supply circuit 10 to stop the flow of fresh water across the resin container 13, and preferably also arranges the hydraulic distributor 24 of detergent dispensing assembly 9 so as to channel the fresh water arriving from the resin container 13 directly into the water drain line 43.

[0140] Afterwards, the central control unit of laundry washing machine 1 opens the on-off valve 29 to allow

the brine to flow from the regeneration-agent reservoir 14, i.e. the hermetically-closable container 14, to the resin container 13. The movement of the brine from the regeneration-agent reservoir 14, i.e. the hermetically-closable container 14, to the resin container 13 is supported by the pressurized air forming the air volume or bubble inside the hermetically-closable container 14, thus the resin container 13 may be located above the regeneration-agent reservoir 14, i.e. the hermetically-closable container 14.

[0141] Since the resin container 13 is completely filled with the fresh water of the water mains, the brine entering into the resin container 13 pushes out of the resin container 13 the fresh water previously stored therein. This fresh water flows along pipeline 17 towards the hydraulic distributor 24 which, in turn, directs/channels said fresh water directly into the second water drain line 43.

[0142] Obviously, the outflow of the brine from the hermetically-closable container 14 causes a progressive drop of the pressure of the air entrapped into the hermetically-closable container 14, i.e. the storage tank 53.

[0143] If detects that pressure of the brine contained into the hermetically-closable container 14 is too low to push the brine through the on-off valve 29 into the resin container 13, the central control unit of laundry washing machine 1 activates the again the source of pressurized-air 30, i.e. the air compressor 35, so as to pump further pressurized air into the hermetically-closable container 14, i.e. the storage tank 53, thus increasing again the pressure of the air entrapped into the hermetically-closable container 14.

[0144] Similarly, if detects that level of the brine contained into the hermetically-closable container 14 is too low, the central control unit of the laundry washing machine 1 temporarily opens again the on-off valve 33 of water supply circuit 28 to channel some more fresh water into the hermetically-closable container 14 and increase the quantity of brine contained into the hermetically-closable container 14, i.e. the storage tank 53.

[0145] When the resin container 13 is completely filled with a sufficient amount of brine, the central control unit of laundry washing machine 1 closes the on-off valve 29, so as to watertight isolate the resin container 13 from the regeneration-agent reservoir 14, and then keeps the brine inside the resin container 13 for a predetermined time interval generally sufficient to allow the brine to remove from the ion-exchange resins the calcium and magnesium ions previously combined/fixed to said resins.

[0146] When the regeneration process of the ion-exchange resins is completed, the central control unit of laundry washing machine 1 opens again the on-off valve 15 of fresh-water supply circuit 10, so that the pressurized fresh water of the water mains pushes the brine out of the resin container 13 and into the pipeline 17 which channels the brine towards the hydraulic distributor 24 which, in turn, directs/channels said fresh water directly into the second water drain line 43.

[0147] Alternatively, the central control unit of laundry

washing machine 1 may open the on-off valve 38 of the water drain line 31 so to drain the brine out of the resin container 13 through the water drain line 31.

[0148] Therefore the brine stored in the resin container 13 flows directly into the washing tub, or into the drain sump, or into the water filtering assembly, or into the water exhaust pump, via the water drain line 31 and/or via the water drain line 43.

[0149] Finally, preferably after having closed again the on-off valves 15, the central control unit of the laundry washing machine 1 activates the water exhaust pump so to discharge the brine out of the laundry washing machine 1 preferably together with the washing or rinsing water already stored on the bottom of the washing tub (not shown), and continues the washing cycle.

[0150] The second fresh-water supply circuit 66, in turn, can channel the fresh water of the water mains towards the inlet of water supply circuit 22 bypassing the water softening device 12, so to channel the non-softened fresh water of the water mains directly towards the inlet of the water supply circuit 22 of detergent dispensing assembly 9. The water supply circuit 22 of detergent dispensing assembly 9 therefore can channel towards any one of the detergent compartments 20a of detergent drawer 20, or towards the second water drain line 43 if connected to the hydraulic distributor 24, either softened, non-softened (i.e. normal) fresh water of the water mains or a mixture thereof.

[0151] The laundry washing machine 1 is therefore able to use, during each stage of the washing cycle, either softened or non-softened fresh water of the water mains or a mixture thereof. The second fresh-water supply circuit 66, in fact, can channel non-softened fresh water to the inlet of the water supply circuit 22 of detergent dispensing assembly 9 independently from the fresh-water supply circuit 10, thus also at the same time of the fresh-water supply circuit 10.

[0152] According to a less sophisticated embodiment, the internal water softening device 12 may lack the electrically-controlled source of pressurized-air 30, i.e. the air compressor 35, and use the water supply circuit 28 to control the level of the liquid contained into the hermetically-closable container 14, so as to regulate the pressure of the air forming the air volume or bubble.

[0153] In this case, with reference to Figures 9a and 9b, assuming that the airtight-sealed, hermetically-closable container 14 was previously refilled with a sufficient quantity of consumable salt or other regeneration agent and that there is currently no brine inside the same hermetically-closable container 14 (Figure 9a), the central control unit of laundry washing machine 1, at any time before the beginning of the regeneration process, opens the on-off valve 33 of water supply circuit 28 for a predetermined time interval, so as to fill with fresh water the hermetically-closable container 14, i.e. the storage tank 53, and also form/create/generate at same time a relatively big air volume or bubble inside the hermetically-closable container 14 (Figure 9b).

[0154] Since the on-off valve 29 is still configured so as to completely watertight seal/isolate the hermetically-closable container 14, i.e. the storage tank 53, from the water-softening agent container 13, the entry of fresh water into the hermetically-closable container 14 naturally stops when the pressure of the air forming the air bubble inside the hermetically-closable container 14, i.e. inside the storage tank 53, is greater than the ambient pressure and preferably almost equal to the pressure of the fresh water arriving from the water mains.

[0155] The central control unit of laundry washing machine 1 can close the on-off valve 33 of water supply circuit 28 either in advance to the natural stop of the water flow towards the hermetically-closable container 14, so to directly control the level of water/brine contained inside the hermetically-closable container 14, or after the natural stop of the water flow towards the hermetically-closable container 14.

[0156] In the first case, when the on-off valve 33 is closed, the brine contained inside the hermetically-closable container 14 will be at a pressure higher than the ambient pressure and lower than that of the fresh water arriving from the water mains. In the second case, when the on-off valve 33 is closed, the brine contained inside the hermetically-closable container 14 will be at a pressure higher than the ambient pressure and almost equal to that of the fresh water arriving from the water mains.

[0157] With reference to Figure 9b, the fresh water channelled into the hermetically-closable container 14, i.e. the storage tank 53, dissolves substantially the whole salt contained into the airtight-closed hermetically-closable container 14 and forms a great amount of brine (i.e. of salt water) sufficient for performing several resin regeneration processes. This great amount of brine remains inside the hermetically-closable container 14 at a pressure higher than the ambient pressure until a resin regeneration process is requested to take place.

[0158] With reference to Figure 9c, when the central control unit of laundry washing machine 1 opens the on-off valve 29, the brine is pushed out of the hermetically-closable container 14, i.e. of storage tank 53, by the pressure of the air volume or bubble remained entrapped into the hermetically-closable container 14 during preparation of the brine, and quickly flows from the hermetically-closable container 14 to the water-softening agent container 13.

[0159] In fact, during preparation of the brine, the air remained entrapped into the hermetically-closable container 14, i.e. the storage tank 53, is compressed up to water-mains pressure by the pressurized fresh water that the water supply circuit 28 channels into the hermetically-closable container 14.

[0160] Obviously, with reference to Figure 9c, when the central control unit of laundry washing machine 1 opens the on-off valve 29, the outflow of the brine from the hermetically-closable container 14 causes an expansion of the air volume or bubble and, as a consequence, a progressive drop of the pressure of the air entrapped

into the hermetically-closable container 14, i.e. the storage tank 53.

[0161] With reference to Figure 9d, if detects that level of the brine contained into the hermetically-closable container 14 is too low, the central control unit of the laundry washing machine 1 temporarily closes the on-off valve 29 and opens the on-off valve 33 of water supply circuit 28 so to channel some more fresh water into the hermetically-closable container 14 and increase the level of water/brine contained into the hermetically-closable container 14, i.e. the storage tank 53.

[0162] Furthermore, still with reference to Figure 9d, if detects that pressure of the brine contained into the hermetically-closable container 14 is too low to push the brine through the on-off valve 29 towards the resin container 13, the central control unit of laundry washing machine 1 temporarily closes the on-off valve 29 and opens the on-off valve 33 of water supply circuit 28 so as to channel some more fresh water into the hermetically-closable container 14, i.e. the storage tank 53, thus increasing again the volume/level of water/brine into the hermetically-closable container 14 and consequently recompress the air entrapped into the hermetically-closable container 14, i.e. the storage tank 53.

[0163] Subsequently, the central control unit of laundry washing machine 1 closes the on-off valve 33 of water supply circuit 28 and opens again the on-off valve 29 to continue transferring the brine from the hermetically-closable container 14, i.e. from the storage tank 53, to the water-softening agent container 13.

[0164] As an alternative, with reference to Figure 9e the central control unit of laundry washing machine 1 may open the on-off valve 33 of water supply circuit 28 and the on-off valve 29 at same time, so as to keep substantially constant the volume of liquid into the hermetically-closable container 14. In this case, the movement of the brine from the hermetically-closable container 14 to the resin container 13 is supported by a substantially equivalent amount of fresh water arriving into the hermetically-closable container 14 via the water supply circuit 28.

[0165] In other words, the fresh water that enters into the hermetically-closable container 14, i.e. into storage tank 53, pushes out an equivalent amount of brine that in turn flows into the resin container 13.

[0166] In addition to the above, with reference to Figure 5, rather than being directly connected to the water mains, according to an alternative embodiment of the water softening device 12, the water supply circuit 28 preferably branches off from the fresh-water supply circuit 10 downstream of resin container 13, so as to selectively channel into the regeneration-agent reservoir 29 the softened fresh water coming out of resin container 13.

[0167] In this embodiment, the water supply circuit 28 lacks the on-off valve 33 and instead comprises an electrically-controlled three-way valve 70 which is arranged along the fresh-water supply circuit 10, downstream of resin container 13, i.e. along the pipeline 17 connecting the outlet of resin container 13 to the inlet of the water

supply circuit 22 of detergent dispensing assembly 9.

[0168] The pipeline 32 of water supply circuit 28 is now connected to the three-way valve 70, and the electrically-controlled three-way valve 70 is structured for selectively and alternatively channelling the fresh water coming out of the resin container 13, into the hermetically-closable container 14, i.e. into the storage tank 53, for producing the brine, or to the inlet of the water supply circuit 22 of detergent dispensing assembly 9 for performing the washing cycle.

[0169] In the Figure 5 embodiment, to form the brine into the hermetically-closable container 14, the electronic central control unit of laundry washing machine 1 sets the three-way valve 70 of water supply circuit 28 so as to put the outlet of resin container 13 in direct communication with the inside of the hermetically-closable container 14, i.e. of the storage tank 53, and afterwards opens the on-off valve 15 of the fresh-water supply circuit 10 for enough time to channel into the hermetically-closable container 14 the fresh water necessary to dissolve the salt contained therein, and form an amount of brine sufficient to perform several resin regeneration processes. This fresh water obviously flows across the resin container 13 before reaching the hermetically-closable container 14.

[0170] Then, after having closed again the on-off valve 15 of the fresh-water supply circuit 10, the central control unit of laundry washing machine 1 sets the three-way valve 70 so as to put again the outlet of resin container 13 in direct communication with the detergent dispensing assembly 9.

[0171] Similarly to the Figure 3 embodiment, the brine contained into the hermetically-closable container 14 remains pressurized at a pressure greater than the ambient pressure, until a resin regeneration process is requested to take place and the central control unit of the laundry washing machine 1 opens the on-off valve 29.

[0172] In addition to the above, according to a further less sophisticated embodiment, rather than monitoring the hardness degree of the fresh water coming out from the internal water softening device 12, the electronic central control unit of the laundry washing machine 1 may be programmed to regenerate the ion-exchange resins stored in the resin container 13 after a given number of washing cycles. Thus the water-hardness sensor is no more necessary.

[0173] The number of washing cycles to wait for performing a resin regeneration process may be decided by the user on the basis of an alleged hardness degree of the fresh water coming out from the water mains.

[0174] The advantages resulting from the use of the pressurized air volume or bubble entrapped into the hermetically-closable container 14 to push the brine out of the hermetically-closable container 14, are really remarkable. First of all, thanks to the pressure of the brine the outflow of the brine from of the hermetically-closable container 14 is extremely quick. Furthermore the resin container 13, i.e. the water-softening agent container 13, can

now be located in any place inside the casing 2, thus even spaced far away from the regeneration-agent reservoir 14 and even above the regeneration-agent reservoir 14, with all layout advantages concerned.

[0175] Furthermore, the second fresh-water supply circuit 66 bypassing the internal water softening device 12 allows to improve the working flexibility of the laundry washing machine 1. During pre-wash or rinse phases of the washing cycle, when detergent agents are usually not required, the laundry washing machine 1 can use normal fresh water, thus lengthening the time between the regenerations of the ion-exchange resins. In view of that, the appliance control panel 11 may be structured so as to allow the user to manually select washing cycles that use softened fresh water, washing cycles that use normal, i.e. non-softened, fresh water, and finally washing cycles that use a mixture of softened and normal, i.e. non-softened, fresh water.

[0176] Clearly, changes may be made to the front-loading laundry washing machine 1 and to its operating method without, however, departing from the scope of the present invention.

[0177] For example, with reference to Figure 6, the appliance control panel 11 is arranged substantially immediately underneath the top wall 2b of casing 2, almost astride of the vertical center-plane of the casing 2, so as to be substantially vertically aligned to the laundry loading/unloading opening realized on front wall 2a of casing 2; and the drawer-like supporting structure 50 carrying the hermetically-closable container 14 is fitted/inserted in manually extractable manner into a corresponding, substantially completely recessed, drawer housing 51 which is located immediately beside the appliance control panel 11, substantially at the upper left corner of front wall 2a.

[0178] The appliance control panel 11 is therefore laterally flanked, on opposite sides, by the exposed or exposable loading inlet or mouth of the detergent dispensing assembly 9, i.e. by the detergent drawer 20, and by the drawer-like supporting structure 50 that supports the hermetically-closable container 14.

[0179] Also in this embodiment, the hermetically-closable container 14 preferably comprises a storage tank 53 which is structured for being manually fillable with a given quantity of consumable salt or other regeneration agent, a manually-removable sealing cap 54 which is structured to hermetically closed the storage tank 53.

[0180] Again the storage tank 53 is preferably housed/located, either in unmovable or in manually detachable manner, into the drawer-like supporting structure 50 so as to be freely accessible by the user when the drawer-like supporting structure 50 is in the extracted position, and to be hidden and inaccessible by the user when the drawer-like supporting structure 50 is arranged in the retracted position.

[0181] With reference to Figure 7, according to a second alternative embodiment the appliance control panel 11 is located/arranged on front of a drawer-like support-

ing structure 150 which is fitted/inserted in manually extractable manner into the front wall 2a of casing 2, preferably between the laundry loading/unloading opening on front wall 2a and the top wall of casing 2, so as to be movable in a preferably substantially horizontally-oriented, displacement direction d between

- a retracted position in which the drawer-like supporting structure 150 is completely recessed into the front wall 2a of casing 2, and the appliance control panel 11 is arranged substantially coplanar to the front wall 2a of casing 2; and
- a completely extracted position (see Figure 7) in which the drawer-like supporting structure 13 partly juts out from the front wall 2a of casing 2, and the appliance control panel 11 is forward spaced apart from the front wall 2a of casing 2.

[0182] The hermetically-closable container 14 of water softening device 12, in turn, is located/incorporated into the drawer-like supporting structure 150, so as to be hidden into the casing 2 and inaccessible to the user when the drawer-like supporting structure 150 is arranged in the retracted position, and so as to be freely accessible by the user when the drawer-like supporting structure 150 is arranged in the completely extracted position (see Figures 7).

[0183] Also in this embodiment, the hermetically-closable container 14 preferably comprises: a storage tank 53 which is structured for being manually fillable with a given quantity of consumable salt or other regeneration agent, and is housed/located, into the drawer-like supporting structure 50, either in unmovable or in manually detachable manner; and a manually-removable sealing cap 54 which is structured to hermetically closed the storage tank 53.

[0184] With reference to Figure 8, according to a third alternative embodiment the hermetically-closable container 14 of water softening device 12 is recessed/located immediately underneath the worktop 2b of casing 2, preferably substantially immediately behind the appliance control panel 11, and is moreover preferably freely accessible by the user through a manual-operated trapdoor 100 realized on worktop 2b of casing 2.

[0185] Also in this embodiment, the hermetically-closable container 14 preferably comprises: a storage tank 53 which is structured for being manually fillable with a given quantity of consumable salt or other regeneration agent, and is recessed/ located underneath the top wall 2b of casing 2, either in unmovable or in manually detachable manner; and a manually-removable sealing cap 54 which is structured to hermetically closed the storage tank 53.

Claims

1. Laundry washing machine (1) comprising an outer

casing (2) and, inside said outer casing (2), a washing tub, a rotatable drum housed in axially rotatable manner inside the washing tub and structured for housing the laundry to be washed, a detergent dispensing assembly (9) which is structured for supplying detergent into the washing tub, a fresh-water supply circuit (10) which is structured for selectively channelling a flow of fresh water from the water mains towards the detergent dispensing assembly (9) and/or the washing tub, and a water softening device (12) which is arranged/located along the fresh-water supply circuit (10) and is structured for reducing the hardness degree of the fresh water channelled to the detergent dispensing assembly (9) and/or the washing tub;

the water softening device (12) in turn comprising a water-softening agent container (13) which is arranged/located along the fresh-water supply circuit (10) and is filled with a water softening agent able to reduce the hardness degree of the fresh water flowing through the same water-softening agent container (13); a regeneration-agent reservoir (14) which is fluidically connected to the water-softening agent container (13) and is structured to receive a consumable regeneration agent for performing a regeneration of the water softening function of the water softening agent stored into the water-softening agent container (13); and a water supply circuit (28) which is structured for channelling fresh water into the regeneration-agent reservoir (14) so to at least partly dissolve the regeneration agents stored therein to form some brine;

the laundry washing machine (1) **being characterized in that** the regeneration-agent reservoir (14) comprises a hermetically-closable container (14) which is structured for receiving a given amount of consumable regeneration agent; **and in that** the water softening device (12) furthermore comprises electrically-controlled pressurizing means (28, 30) which are structured to form, into said hermetically-closable container (14), an air volume or bubble of pressurized air which pressurizes the brine contained into the hermetically-closable container (14).

2. Laundry washing machine according to Claim 1, **characterized in that** the hermetically-closable container (14) is provided with an exposed or exposable and hermetically-sealable loading inlet or mouth which is structured for allowing the user to load the consumable regeneration agent into the same hermetically-closable container (14).
3. Laundry washing machine according to Claim 1 or 2, **characterized in that** the pressurizing means (28, 30) comprise the water supply circuit (28) of the water softening device (12).
4. Laundry washing machine according to Claim 3,

characterized in that the water supply circuit (28) of the water softening device (12) is able to control the level of the liquid contained into the hermetically-closable container (14), so as to regulate the pressure of the air forming said air volume or bubble.

5. Laundry washing machine according to according to Claim 3 or 4, **characterized in that** the water supply circuit (28) of the water softening device (12) comprises a valve assembly (33, 70) which is interposed between the water mains and the hermetically-closable container (14), and is able to control/regulate the flow of fresh water towards the hermetically-closable container (14).
6. Laundry washing machine according to Claim 1, 2 or 3, **characterized in that** the pressurizing means (28, 30) comprise an electrically-controlled, source of pressurized-air (30) which is able to selectively pump/channel a flow of pressurized air or other gas inside the hermetically-closable container (14).
7. Laundry washing machine according to Claim 6, **characterized in that** the electrically-controlled, source of pressurized-air (30) comprises an electrically-powered, air-pumping device (35) which has the outlet or delivery in direct communication with the inside of the hermetically-closable container (14), so as to be able to selectively pump a flow of pressurized air into said hermetically-closable container (14).
8. Laundry washing machine according to any one of the preceding claims, **characterized in that** the water softening device (12) additionally comprises an electrically-controlled on-off valve (29) which is interposed between the hermetically-closable container (14) and the water-softening agent container (13), and is structured to selectively and alternatively put the hermetically-closable container (14) in direct communication with the inside of the water-softening agent container (13), or to completely watertight seal/isolate the hermetically-closable container (14) from the water-softening agent container (13).
9. Laundry washing machine according to any one of the preceding claims, **characterized in that** the water softening device (12) furthermore comprises a water-level sensor which is structured for measuring the level of the fresh water and/or brine contained inside the hermetically-closable container (14), and/or a salinity-level sensor which is structured for measuring the salinity degree of the brine contained inside the hermetically-closable container (14), and/or a pressure sensor which is structured for measuring the value of the pressure of the air remained entrapped inside the hermetically-closable container (14).

10. Laundry washing machine according to any one of the preceding claims, **characterized in that** the hermetically-closable container (14) is housed/recessed into the outer casing (2) in manually detachable manner. 5
11. Laundry washing machine according to any one of the preceding claims, **characterized in that** the hermetically-closable container (14) comprises a storage tank (53) which is structured for being manually fillable with a given quantity of said consumable regeneration agent, and a manually-removable sealing cap (54) which is structured to hermetically closed the storage tank (53). 10
12. Laundry washing machine according to Claim 11, **characterized in that** the storage tank (53) is provided with a number self-closing hydraulic connectors (55, 56) which are structured to couple in detachable manner with corresponding complementary self-closing hydraulic connectors (58, 59) arranged inside the casing (2), so as to selectively put the storage tank (53) in communication with the water supply circuit (28) of the water softening device (12) and with the on-off valve (29) of the water softening device (12). 20
13. Laundry washing machine according to Claim 11 or 12, **characterized in that** the storage tank (53) is provided with a self-closing pneumatic connector (57) which is structured to couple in detachable manner with corresponding complementary self-closing pneumatic connector (60) arranged inside the casing (2), so as to selectively put the storage tank (53) in communication with said pressurizing means (28, 30). 30
14. Operating method of a laundry washing machine (1) having an internal water softening device (12) that comprises: a water-softening agent container (13) which is crossed by the fresh water flowing along the fresh-water supply circuit (10), and is filled with a water softening agent able to reduce the hardness degree of the fresh water flowing through the same water-softening agent container (13), and a regeneration-agent reservoir (14) including a hermetically-closable container (14) which is fluidically connected to the water-softening agent container (13) and is structured to receive a consumable regeneration agent for performing a regeneration of the water softening function of the water softening agent stored into the water-softening agent container (13); the operating method of the laundry washing machine (1) **being characterized by** comprising the step of channelling a given amount of fresh water into the regeneration-agent reservoir (14) so as to at least partly dissolve the regeneration agents stored therein to form some brine; and the step of generating inside the regeneration-agent reservoir (14) an air volume or bubble of pressurized air which pressurizes the brine contained into the hermetically-closable container (14). 35
15. Operating method according to Claim 14, **characterized in that** the step of creating said air volume or bubble inside the regeneration-agent reservoir (14) comprises the step of pumping/channelling a flow of pressurized air or other gas inside the hermetically-closable container (14) after having channelled the fresh water into the same regeneration-agent reservoir (14). 40
16. Operating method according to Claim 14, **characterized in that** the step of creating said air volume or bubble inside the regeneration-agent reservoir (14) comprises the step of channelling fresh water into the regeneration-agent reservoir (14) so to control the level of the liquid contained into the hermetically-closable container (14). 45
17. Operating method according to Claim 14, 15 or 16, **characterized in that** a valve assembly (29) is interposed between the hermetically-closable container (14) and the water-softening agent container (13); said valve assembly (29) being structured to selectively watertight seal/isolate the hermetically-closable container (14) from the water-softening agent container (13), and the operating method comprises the step of opening said valve assembly (29) for allowing the brine to flow from the hermetically-closable container (14) to the water-softening agent container (13) after the creation of the air volume or bubble into the hermetically-closable container (14). 50
18. Operating method according to Claim 17, **characterized by** comprising also the step of channelling additional fresh water into the regeneration-agent reservoir (14) when the valve assembly (29) is opened to force the brine to flow from the hermetically-closable container (14) to the water-softening agent container (13). 55

Patentansprüche

1. Waschmaschine (1), umfassend ein äußeres Gehäuse (2) und in dem äußeren Gehäuse (2) einen Laugenbehälter, eine drehbare Trommel, die axial drehbar im Laugenbehälter untergebracht und zur Aufnahme der zu waschenden Wäsche strukturiert ist, eine Waschmittelabgabeordnung (9), die zur Zufuhr von Waschmittel in den Laugenbehälter strukturiert ist, einen Frischwasserzufuhrkreislauf (10), der dazu strukturiert ist, eine Frischwasserströmung vom Wasserleitungsnetz gezielt zu der Waschmittelabgabeordnung (9) und/oder dem

- Laugenbehälter zu leiten, und eine Wasserenthärtungsvorrichtung (12), die entlang dem Frischwasserzufuhrkreislauf (10) angeordnet/lokalisiert und dazu strukturiert ist, den Härtegrad des zu der Waschmittelabgabeordnung (9) und/oder dem Laugenbehälter geleiteten Frischwassers zu reduzieren, wobei die Wasserenthärtungsvorrichtung (12) wiederum einen Wasserenthärtungsmittelbehälter (13), der entlang dem Frischwasserzufuhrkreislauf (10) angeordnet/lokalisiert und mit einem Wasserenthärtungsmittel gefüllt ist, das den Härtegrad des durch denselben Wasserenthärtungsmittelbehälter (13) strömenden Frischwassers reduzieren kann, ein Regenerierungsmittelreservoir (14), das fluidisch mit dem Wasserenthärtungsmittelbehälter (13) verbunden und dazu strukturiert ist, ein verbrauchbares Regenerierungsmittel aufzunehmen, um eine Regenerierung der Wasserenthärtungsfunktion des im Wasserenthärtungsmittelbehälter (13) gelagerten Wasserenthärtungsmittels durchzuführen, und einen Wasserzufuhrkreislauf (28) umfasst, der zum Leiten von Frischwasser in das Regenerierungsmittelreservoir (14) strukturiert ist, um die darin gelagerten Regenerierungsmittel mindestens teilweise zu lösen, um etwas Salzlösung zu bilden, **dadurch gekennzeichnet, dass** das Regenerierungsmittelreservoir (14) einen hermetisch verschließbaren Behälter (14) umfasst, der zur Aufnahme einer gegebenen Menge an verbrauchbarem Regenerierungsmittel strukturiert ist, und dass die Wasserenthärtungsvorrichtung (12) ferner elektrisch gesteuerte Druckbeaufschlagungsmittel (28, 30) umfasst, die dazu strukturiert sind, in dem hermetisch verschließbaren Behälter (14) ein Druckluftvolumen oder eine Druckluftblase zu bilden, das bzw. die die in dem hermetisch verschließbaren Behälter (14) enthaltene Salzlösung mit Druck beaufschlagt.
2. Waschmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** der hermetisch verschließbare Behälter (14) mit einem freiliegenden oder freilegbaren und hermetisch abdichtbaren Ladeeinlass oder einer freiliegenden oder freilegbaren und hermetisch abdichtbaren Öffnung versehen ist, der bzw. die so strukturiert ist, dass der Benutzer das verbrauchbare Regenerierungsmittel in denselben hermetisch verschließbaren Behälter (14) laden kann.
 3. Waschmaschine nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Druckbeaufschlagungsmittel (28, 30) den Wasserzufuhrkreislauf (28) der Wasserenthärtungsvorrichtung (12) umfassen.
 4. Waschmaschine nach Anspruch 3, **dadurch gekennzeichnet, dass** der Wasserzufuhrkreislauf (28) der Wasserenthärtungsvorrichtung (12) den Stand der in dem hermetisch verschließbaren Behälter (14) enthaltenen Flüssigkeit steuern kann, um den Druck der das Luftvolumen oder die Druckluftblase bildenden Luft zu regulieren.
 5. Waschmaschine nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** der Wasserzufuhrkreislauf (28) der Wasserenthärtungsvorrichtung (12) eine Ventilanordnung (33, 70) umfasst, die zwischen dem Wasserleitungsnetz und dem hermetisch verschließbaren Behälter (14) angeordnet ist und die Strömung von Frischwasser zum hermetisch verschließbaren Behälter (14) steuern/regulieren kann.
 6. Waschmaschine nach Anspruch 1, 2 oder 3, **dadurch gekennzeichnet, dass** die Druckbeaufschlagungsmittel (28, 30) eine elektrisch gesteuerte Druckluftquelle (30) umfassen, die einen Strom aus Druckluft oder einem anderen Gas gezielt in den hermetisch verschließbaren Behälter (14) pumpen/leiten kann.
 7. Waschmaschine nach Anspruch 6, **dadurch gekennzeichnet, dass** die elektrisch gesteuerte Druckluftquelle (30) eine elektrisch getriebene Luftpumpvorrichtung (35) umfasst, deren Auslass oder Zufuhröffnung direkt mit dem Inneren des hermetisch verschließbaren Behälters (14) kommuniziert, um einen Druckluftstrom gezielt in den hermetisch verschließbaren Behälter (14) pumpen zu können.
 8. Waschmaschine nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Wasserenthärtungsvorrichtung (12) zusätzlich ein elektrisch gesteuertes auf/zu-Ventil (29) umfasst, das zwischen dem hermetisch verschließbaren Behälter (14) und dem Wasserenthärtungsmittelbehälter (13) angeordnet und so strukturiert ist, dass es gezielt und alternativ eine direkte Verbindung zwischen dem hermetisch verschließbaren Behälter (14) und dem Inneren des Wasserenthärtungsmittelbehälters (13) herstellt oder den hermetisch verschließbaren Behälter (14) völlig wasserdicht gegen den Wasserenthärtungsmittelbehälter (13) abdichtet/ihn von dem Wasserenthärtungsmittelbehälter (13) isoliert.
 9. Waschmaschine nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Wasserenthärtungsvorrichtung (12) ferner einen Wasserstandsensor, der dazu strukturiert ist, den Stand des im hermetisch verschließbaren Behälter (14) enthaltenen Frischwassers und/oder der im hermetisch verschließbaren Behälter (14) enthaltenen Salzlösung zu messen, und/oder einen Salzgehaltssensor, der dazu strukturiert ist, den Salzgehaltgrad der im hermetisch verschließbaren Behälter (14) enthaltenen Salzlösung zu messen, und/oder einen Drucksensor umfasst, der dazu strukturiert ist,

- den Druck der im hermetisch verschließbaren Behälter (14) eingeschlossen verbliebenen Luft zu messen.
10. Waschmaschine nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der hermetisch verschließbare Behälter (14) auf manuell lösbare Weise im äußeren Gehäuse (2) untergebracht/eingelassen ist.
11. Waschmaschine nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der hermetisch verschließbare Behälter (14) einen Vorratstank (53), der so strukturiert ist, dass er manuell mit einer gegebenen Menge des verbrauchbaren Regenerierungsmittels gefüllt werden kann, und eine manuell abnehmbare Dichtkappe (54), die zum hermetischen Verschließen des Vorratstanks (53) strukturiert ist, umfasst.
12. Waschmaschine nach Anspruch 11, **dadurch gekennzeichnet, dass** der Vorratstank (53) mit mehreren selbstschließenden Hydraulikanschlüssen (55, 56) versehen ist, die so strukturiert sind, dass sie lösbar mit entsprechenden komplementären selbstschließenden Hydraulikanschlüssen (58, 59), die im Gehäuse (2) angeordnet sind, koppelbar sind, um gezielt eine Verbindung zwischen dem Vorratstank (53) und dem Wasserzufuhrkreislauf (28) der Wasserenthärtungsvorrichtung (12) und dem auf/zu-Ventil (29) der Wasserenthärtungsvorrichtung (12) herzustellen.
13. Waschmaschine nach Anspruch 11 oder 12, **dadurch gekennzeichnet, dass** der Vorratstank (53) mit einem selbstschließenden pneumatischen Anschluss (57) versehen ist, der so strukturiert ist, dass er lösbar mit einem entsprechenden komplementären selbstschließenden pneumatischen Anschluss (60), der im Gehäuse (2) angeordnet ist, koppelbar ist, um gezielt eine Verbindung zwischen dem Vorratstank (53) und den Druckbeaufschlagungsmitteln (28, 30) herzustellen.
14. Betriebsverfahren einer Waschmaschine (1) mit einer internen Wasserenthärtungsvorrichtung (12), die Folgendes umfasst: einen Wasserenthärtungsmittelbehälter (13), durch den das entlang dem Frischwasserzufuhrkreislauf (10) fließende Frischwasser strömt und der mit einem Wasserenthärtungsmittel gefüllt ist, das den Härtegrad des durch denselben Wasserenthärtungsmittelbehälter (13) strömenden Frischwassers reduzieren kann, und ein Regenerierungsmittelreservoir (14) mit einem hermetisch verschließbaren Behälter (14), der fluidisch mit dem Wasserenthärtungsmittelbehälter (13) verbunden und dazu strukturiert ist, ein verbrauchbares Regenerierungsmittel aufzunehmen, um eine Rege-
- nerierung der Wasserenthärtungsfunktion des im Wasserenthärtungsmittelbehälter (13) gelagerten Wasserenthärtungsmittels durchzuführen, **dadurch gekennzeichnet, dass** es Folgendes umfasst: den Schritt des Leitens einer gegebenen Menge an Frischwasser in das Regenerierungsmittelreservoir (14), um die darin gelagerten Regenerierungsmittel mindestens teilweise zu lösen, um etwas Salzlösung zu bilden, und den Schritt des Erzeugens eines Druckluftvolumens oder einer Druckluftblase in dem Regenerierungsmittelreservoir (14), das bzw. die die in dem hermetisch verschließbaren Behälter (14) enthaltene Salzlösung mit Druck beaufschlagt.
15. Betriebsverfahren nach Anspruch 14, **dadurch gekennzeichnet, dass** der Schritt des Erzeugens des Luftvolumens oder der Luftblase in dem Regenerierungsmittelreservoir (14) den Schritt des Pumpens/Leitens eines Stroms aus Druckluft oder einem anderen Gas in den hermetisch verschließbaren Behälter (14), nachdem das Frischwasser in dasselbe Regenerierungsmittelreservoir (14) geleitet worden ist, umfasst.
16. Betriebsverfahren nach Anspruch 14, **dadurch gekennzeichnet, dass** der Schritt des Erzeugens des Luftvolumens oder der Luftblase in dem Regenerierungsmittelreservoir (14) den Schritt des Leitens von Frischwasser in das Regenerierungsmittelreservoir (14) umfasst, um den Stand der in dem hermetisch verschließbaren Behälter (14) enthaltenen Flüssigkeit zu steuern.
17. Betriebsverfahren nach Anspruch 14, 15 oder 16, **dadurch gekennzeichnet, dass** die Ventilanordnung (29) zwischen dem hermetisch verschließbaren Behälter (14) und dem Wasserenthärtungsmittelbehälter (13) angeordnet wird, wobei die Ventilanordnung (29) dazu strukturiert ist, den hermetisch verschließbaren Behälter (14) gezielt wasserdicht gegen den Wasserenthärtungsmittelbehälter (13) abzudichten/ihn von dem Wasserenthärtungsmittelbehälter (13) zu isolieren, und das Betriebsverfahren den Schritt des Öffnens der Ventilanordnung (29) umfasst, damit die Salzlösung nach dem Herstellen des Luftvolumens oder der Luftblase im hermetisch verschließbaren Behälter (14) aus dem hermetisch verschließbaren Behälter (14) in den Wasserenthärtungsmittelbehälter (13) fließen kann.
18. Betriebsverfahren nach Anspruch 17, **dadurch gekennzeichnet, dass** es auch den Schritt des Leitens von zusätzlichem Frischwasser in das Regenerierungsmittelreservoir (14) umfasst, wenn die Ventilanordnung (29) geöffnet wird, um die Salzlösung dazu zu zwingen, vom hermetisch verschließbaren Behälter (14) in den Wasserenthärtungsmittelbehälter (13) zu fließen.

Revendications

1. Machine à laver le linge (1) comprenant un boîtier extérieur (2) et, à l'intérieur dudit boîtier extérieur (2), un bac de lavage, un tambour rotatif logé de manière axialement rotative à l'intérieur du bac de lavage et structuré de manière à recevoir le linge à laver, un ensemble de distribution de détergent (9) qui est structuré de manière à fournir du détergent dans le bac de lavage, un circuit d'alimentation en eau fraîche (10) qui est structuré de manière à canaliser de manière sélective un flux d'eau fraîche provenant de la canalisation d'eau principale vers l'ensemble de distribution de détergent (9) et/ou vers le bac de lavage, et un dispositif d'adoucissement de l'eau (12) qui est disposé/situé le long du circuit d'alimentation en eau fraîche (10) et qui est structuré de manière à réduire le degré de dureté de l'eau fraîche canalisée vers l'ensemble de distribution de détergent (9) et/ou vers le bac de lavage ;
le dispositif d'adoucissement de l'eau (12) comprenant à son tour un récipient d'agent adoucisseur d'eau (13) qui est disposé/situé le long du circuit d'alimentation en eau fraîche (10) et qui est rempli d'un agent adoucisseur d'eau apte à réduire le degré de dureté de l'eau fraîche s'écoulant à travers ledit récipient d'agent adoucisseur d'eau (13) ; un réservoir d'agent de régénération (14) qui est connectée fluidiquement au récipient d'agent adoucisseur d'eau (13) et qui est structuré de manière à recevoir un agent de régénération consommable pour effectuer une régénération de la fonction d'adoucissement de l'eau de l'agent adoucisseur d'eau stocké dans le récipient d'agent adoucisseur d'eau (13) ; et un circuit d'alimentation en eau (28) qui est structuré de manière à canaliser de l'eau fraîche dans le réservoir d'agent de régénération (14) de manière à au moins en partie dissoudre les agents de régénération stockés dans celui-ci pour former de la saumure ;
la machine à laver le linge (1) **étant caractérisée en ce que** le réservoir d'agent de régénération (14) comprend un récipient pouvant être fermé hermétiquement (14) qui est structuré de manière à recevoir une quantité donnée d'agent de régénération consommable ; **et en ce que** le dispositif d'adoucissement de l'eau (12) comprend en outre des moyens de pressurisation à commande électrique (28, 30) qui sont structurés de manière à former, dans ledit récipient pouvant être fermé hermétiquement (14), un volume d'air ou une bulle d'air sous pression qui pressurise la saumure contenue dans le récipient pouvant être fermé hermétiquement (14).
2. Machine à laver le linge selon la revendication 1, **caractérisée en ce que** le récipient pouvant être fermé hermétiquement (14) est pourvu d'une entrée ou d'une embouchure de chargement exposée ou pouvant être exposée et pouvant être fermée hermétiquement, qui est structurée de manière à permettre à l'utilisateur de charger l'agent de régénération consommable dans ledit récipient pouvant être fermé hermétiquement (14).
3. Machine à laver le linge selon la revendication 1 ou 2, **caractérisée en ce que** les moyens de pressurisation (28, 30) comprennent le circuit d'alimentation en eau (28) du dispositif d'adoucissement de l'eau (12).
4. Machine à laver le linge selon la revendication 3, **caractérisée en ce que** le circuit d'alimentation en eau (28) du dispositif d'adoucissement de l'eau (12) est apte à commander le niveau du liquide contenu dans le récipient pouvant être fermé hermétiquement (14), de manière à réguler la pression de l'air formant ledit volume d'air ou ladite bulle d'air.
5. Machine à laver le linge selon la revendication 3 ou 4, **caractérisée en ce que** le circuit d'alimentation en eau (28) du dispositif d'adoucissement de l'eau (12) comprend un ensemble de soupape (33, 70) qui est interposé entre la canalisation d'eau principale et le récipient pouvant être fermé hermétiquement (14), et qui est apte à commander/réguler le flux d'eau fraîche vers le récipient pouvant être fermé hermétiquement (14).
6. Machine à laver le linge selon la revendication 1, 2 ou 3, **caractérisée en ce que** les moyens de pressurisation (28, 30) comprennent une source d'air sous pression (30) à commande électrique qui est apte à pomper/canaliser de manière sélective un flux d'air sous pression ou d'un autre gaz à l'intérieur du récipient pouvant être fermé hermétiquement (14).
7. Machine à laver le linge selon la revendication 6, **caractérisée en ce que** la source d'air sous pression (30) à commande électrique comprend un dispositif de pompage d'air à commande électrique (35) qui présente la sortie ou la distribution en communication directe avec l'intérieur du récipient pouvant être fermé hermétiquement (14) de manière à pouvoir pomper de manière sélective un flux d'air sous pression dans ledit récipient pouvant être fermé hermétiquement (14).
8. Machine à laver le linge selon l'une quelconque des revendications précédentes, **caractérisée en ce que** le dispositif d'adoucissement de l'eau (12) comprend en outre une soupape marche-arrêt à commande électrique (29) qui est interposée entre le récipient pouvant être fermé hermétiquement (14) et le récipient d'agent adoucisseur d'eau (13), et qui est structurée de manière à mettre sélectivement et alternativement le récipient pouvant être fermé hermétiquement (14) en communication directe avec

- l'intérieur du récipient d'agent adoucisseur d'eau (13), ou à sceller/isoler de manière complètement étanche à l'eau le récipient pouvant être fermé hermétiquement (14) par rapport au récipient d'agent adoucisseur d'eau (13).
- 5
9. Machine à laver le linge selon l'une quelconque des revendications précédentes, **caractérisée en ce que** le dispositif d'adoucissement de l'eau (12) comprend en outre un capteur de niveau d'eau qui est structuré de manière à mesurer le niveau de l'eau fraîche et/ou de la saumure contenue à l'intérieur du récipient pouvant être fermé hermétiquement (14), et/ou un capteur de niveau de salinité qui est structuré de manière à mesurer le degré de salinité de la saumure contenue à l'intérieur du récipient pouvant être fermé hermétiquement (14), et/ou un capteur de pression qui est structuré de manière à mesurer la valeur de la pression de l'air restant piégé à l'intérieur du récipient pouvant être fermé hermétiquement (14).
10. Machine à laver le linge selon l'une quelconque des revendications précédentes, **caractérisée en ce que** le récipient pouvant être fermé hermétiquement (14) est logé/reçu à l'intérieur du boîtier extérieur (2) de manière à pouvoir être détaché manuellement.
11. Machine à laver le linge selon l'une quelconque des revendications précédentes, **caractérisée en ce que** le récipient pouvant être fermé hermétiquement (14) comprend un réservoir de stockage (53) qui est structuré de manière à pouvoir être rempli manuellement avec une quantité donnée dudit agent de régénération consommable, et un capuchon de fermeture étanche pouvant être enlevé manuellement (54) qui est structuré de manière à fermer hermétiquement le réservoir de stockage (53).
12. Machine à laver le linge selon la revendication 11, **caractérisée en ce que** le réservoir de stockage (53) est pourvu d'un certain nombre de connecteurs hydrauliques à fermeture automatique (55, 56) qui sont structurés de manière à s'accoupler de manière détachable avec des connecteurs hydrauliques complémentaires correspondants à fermeture automatique (58, 59) disposés à l'intérieur du boîtier (2), de manière à mettre de manière sélective le réservoir de stockage (53) en communication avec le circuit d'alimentation en eau (28) du dispositif d'adoucissement de l'eau (12) et avec la soupape marche-arrêt (29) du dispositif d'adoucissement de l'eau (12).
13. Machine à laver le linge selon la revendication 11 ou 12, **caractérisée en ce que** le réservoir de stockage (53) est pourvu d'un connecteur pneumatique à fermeture automatique (57), qui est structuré de manière à s'accoupler de manière détachable avec un
- connecteur pneumatique complémentaire correspondant à fermeture automatique (60) disposé à l'intérieur du boîtier (2), de manière à mettre de manière sélective le réservoir de stockage (53) en communication avec lesdits moyens de pressurisation (28, 30).
14. Procédé de fonctionnement d'une machine à laver le linge (1) ayant un dispositif d'adoucissement de l'eau interne (12) qui comprend : un récipient d'agent adoucisseur d'eau (13) qui est parcouru par l'eau fraîche s'écoulant le long du circuit d'alimentation en eau fraîche (10), et qui est rempli d'un agent adoucisseur d'eau apte à réduire le degré de dureté de l'eau fraîche s'écoulant à travers ledit récipient d'agent adoucisseur d'eau (13), et un réservoir d'agent de régénération (14) comportant un récipient pouvant être fermé hermétiquement (14) qui est connecté fluidiquement au récipient d'agent adoucisseur d'eau (13) et qui est structuré de manière à recevoir un agent de régénération consommable pour effectuer une régénération de la fonction d'adoucissement de l'eau de l'agent adoucisseur d'eau stocké dans le récipient d'agent adoucisseur d'eau (13) ; le procédé de fonctionnement de la machine à laver le linge (1) **étant caractérisé en ce qu'il** comprend l'étape consistant à canaliser une quantité donnée d'eau fraîche dans le réservoir d'agent de régénération (14) de manière à dissoudre au moins en partie les agents de régénération stockés dans celui-ci pour former de la saumure ; et l'étape consistant à générer à l'intérieur du réservoir d'agent de régénération (14) un volume d'air ou une bulle d'air sous pression qui pressurise la saumure contenue dans le récipient pouvant être fermé hermétiquement (14).
15. Procédé de fonctionnement selon la revendication 14, **caractérisé en ce que** l'étape consistant à créer ledit volume d'air ou ladite bulle d'air à l'intérieur du réservoir d'agent de régénération (14) comprend l'étape consistant à pomper/canaliser un flux d'air sous pression ou d'un autre gaz à l'intérieur du récipient pouvant être fermé hermétiquement (14) après avoir canalisé l'eau fraîche dans ledit réservoir d'agent de régénération (14).
16. Procédé de fonctionnement selon la revendication 14, **caractérisé en ce que** l'étape consistant à créer ledit volume d'air ou ladite bulle d'air à l'intérieur du réservoir d'agent de régénération (14) comprend l'étape consistant à canaliser l'eau fraîche dans le réservoir d'agent de régénération (14) de manière à réguler le niveau du liquide contenu dans le récipient pouvant être fermé hermétiquement (14).
17. Procédé de fonctionnement selon la revendication 14, 15 ou 16, **caractérisé en ce qu'un** ensemble de

soupape (29) est interposé entre le récipient pouvant être fermé hermétiquement (14) et le récipient d'agent adoucisseur d'eau (13) ; ledit ensemble de soupape (29) étant structuré de manière à sélectivement sceller/isoler de manière étanche à l'eau le récipient pouvant être fermé hermétiquement (14) par rapport au récipient d'agent adoucisseur d'eau (13), le procédé de fonctionnement comprenant l'étape consistant à ouvrir le ledit ensemble de soupape (29) pour permettre à la saumure de s'écouler depuis le récipient pouvant être fermé hermétiquement (14) dans le récipient d'agent adoucisseur d'eau (13) après la création du volume d'air ou de la bulle d'air dans le récipient pouvant être fermé hermétiquement (14).

18. Procédé de fonctionnement selon la revendication 17, **caractérisé en ce qu'il** comprend également l'étape consistant à canaliser de l'eau fraîche supplémentaire dans le réservoir d'agent de régénération (14) lorsque l'ensemble de soupape (29) est ouvert pour forcer la saumure à s'écouler depuis le récipient pouvant être fermé hermétiquement (14) dans le récipient d'agent adoucisseur d'eau (13).

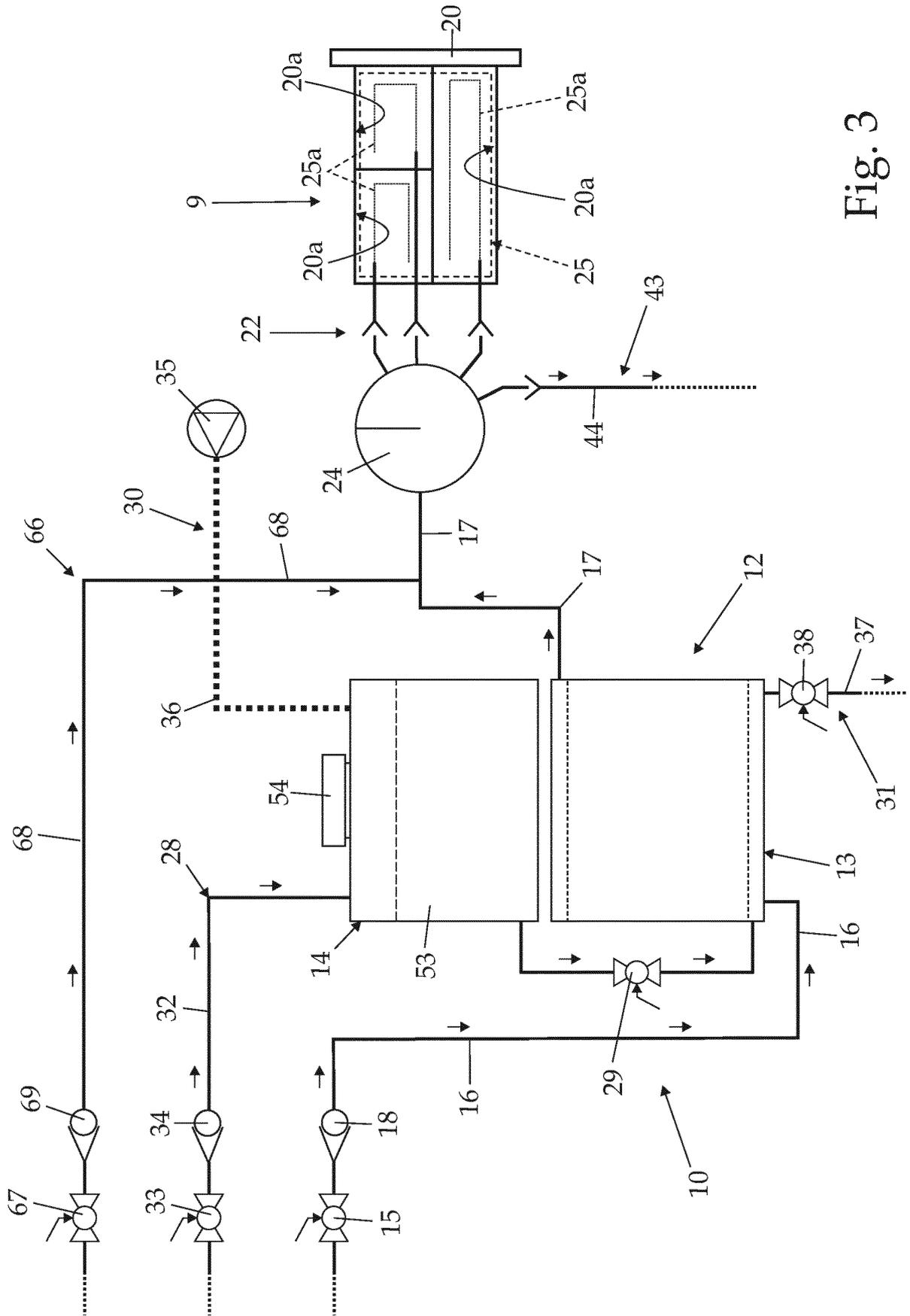


Fig. 3

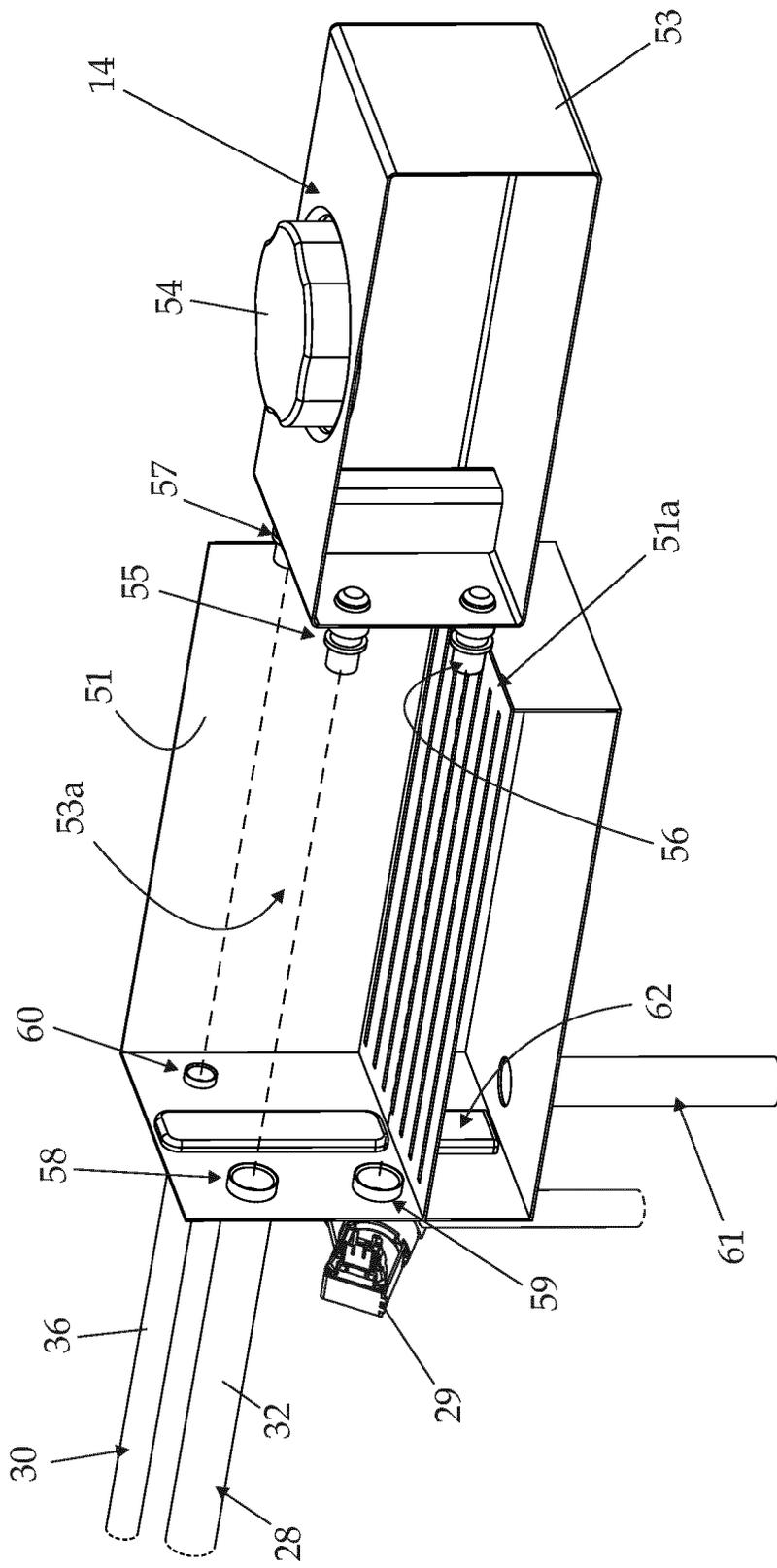


Fig. 4

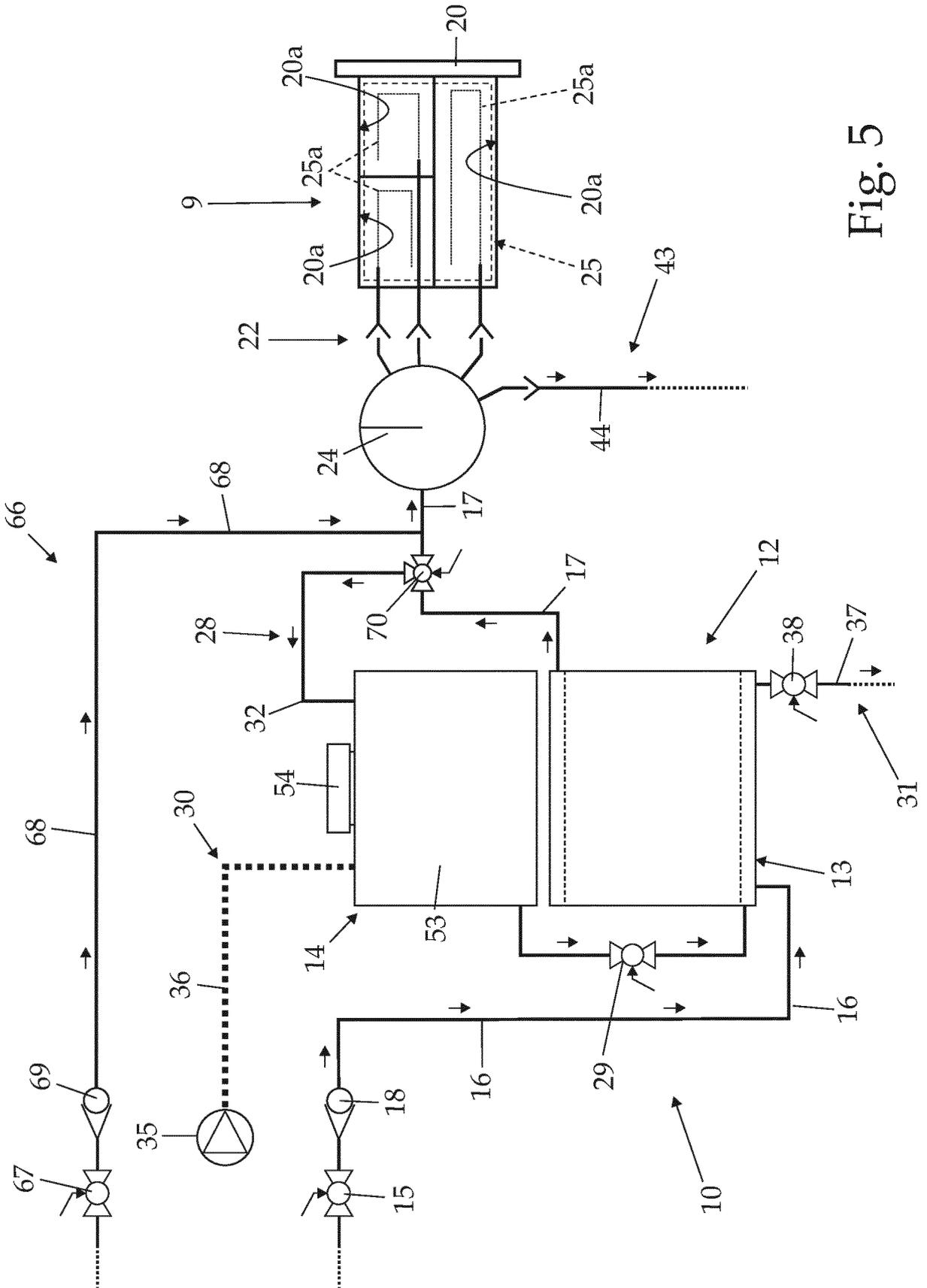


Fig. 5

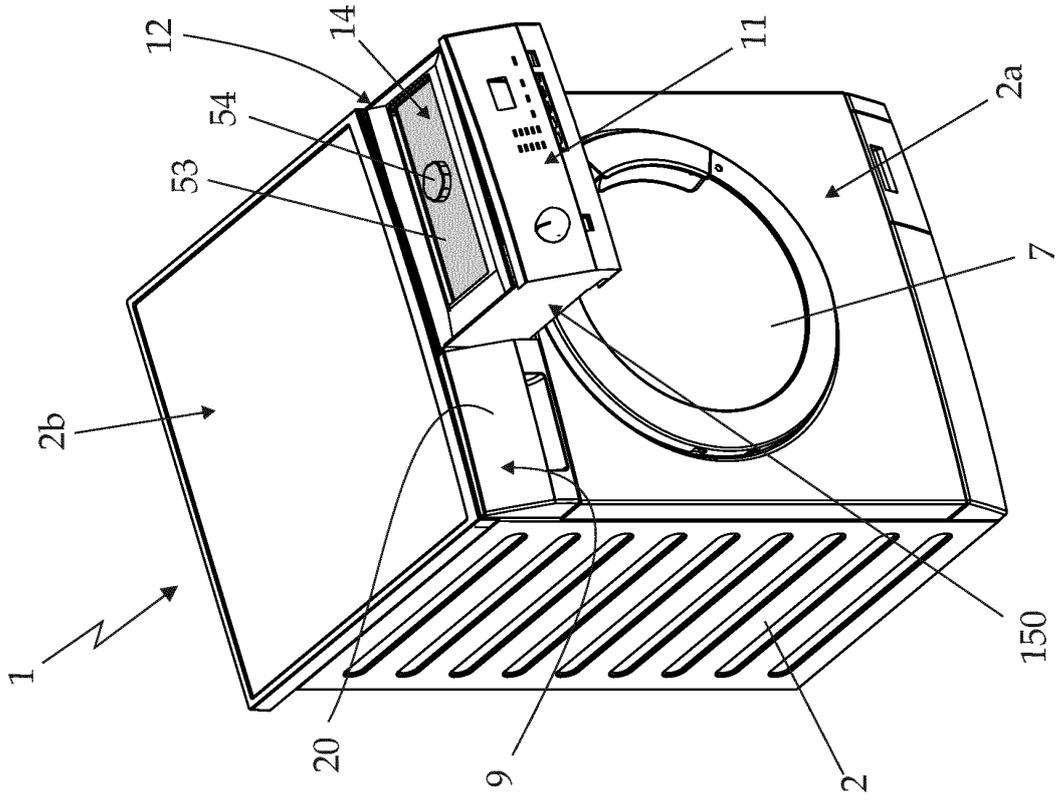


Fig. 7

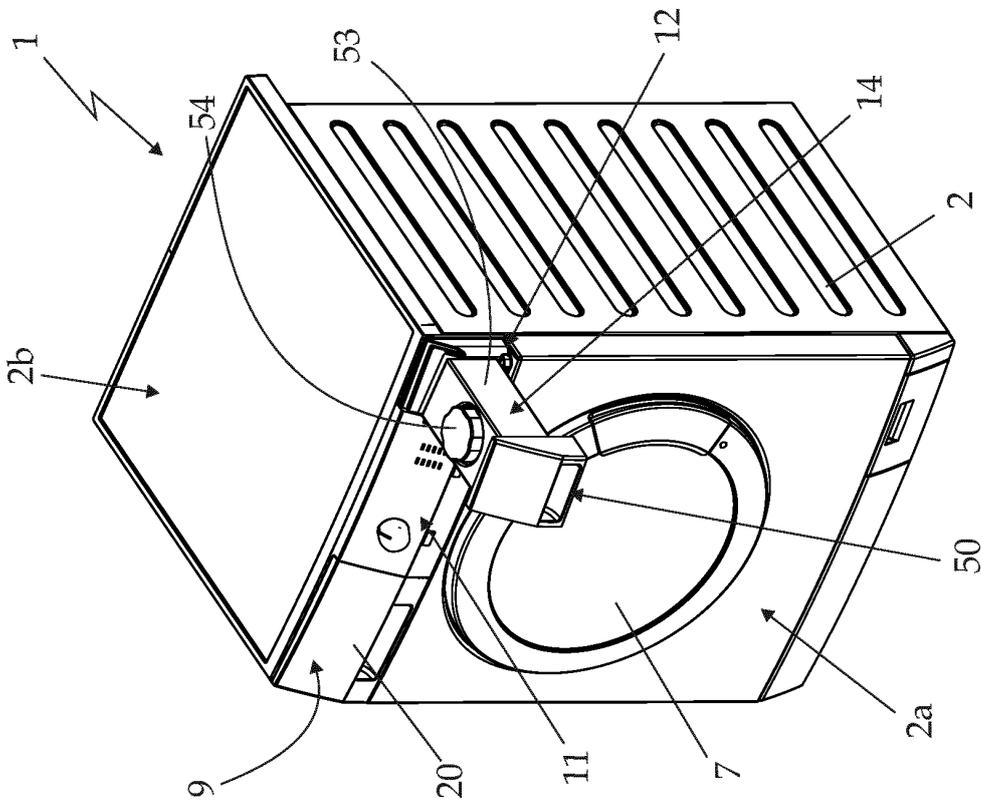
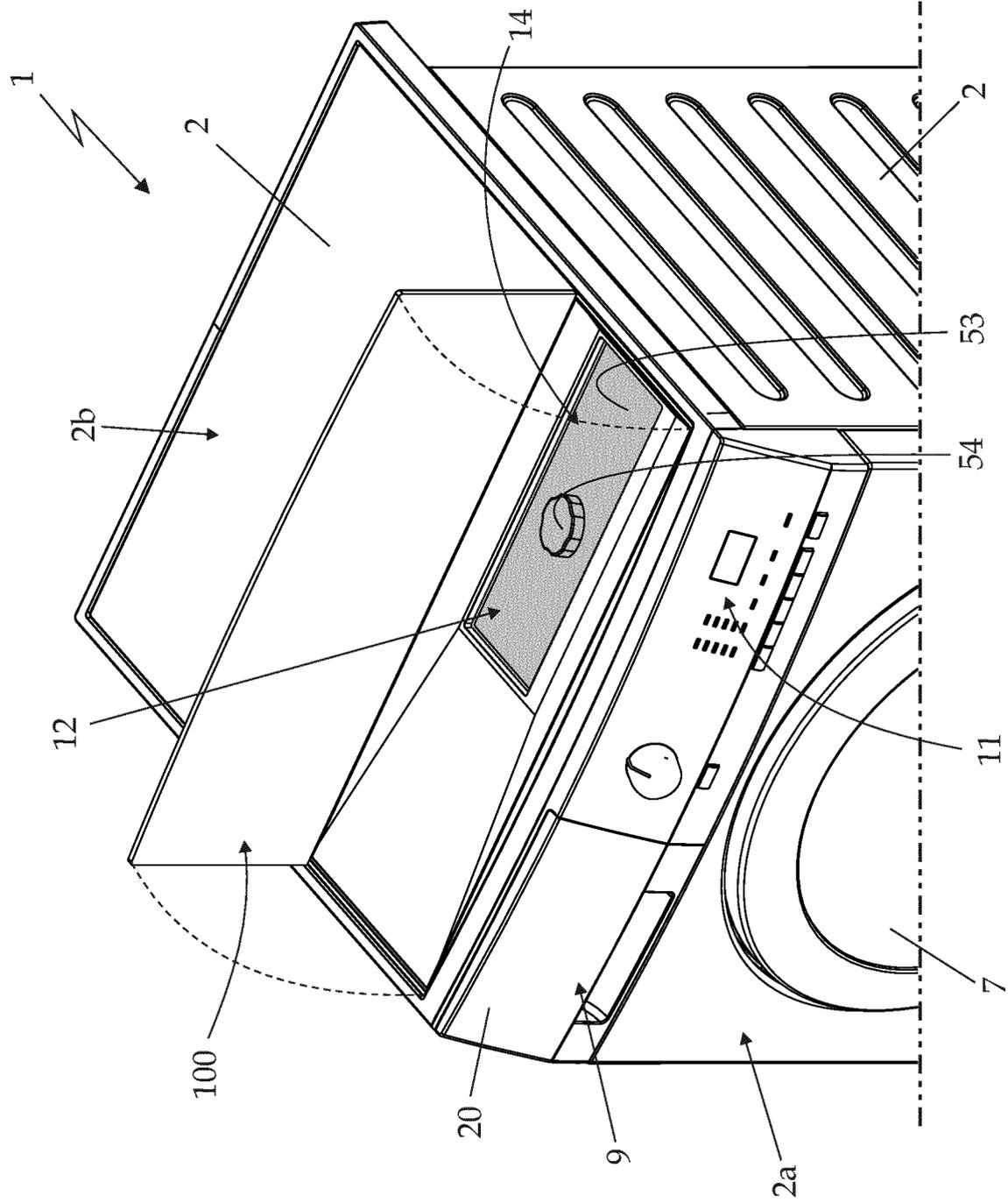


Fig. 6

Fig. 8



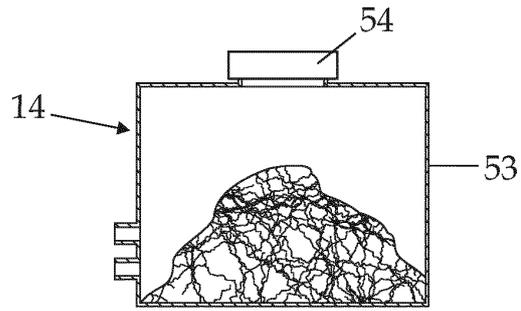


Fig. 9a

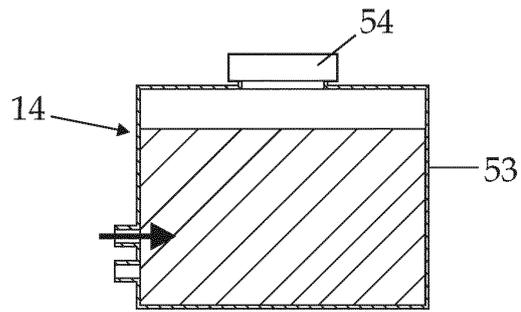


Fig. 9b

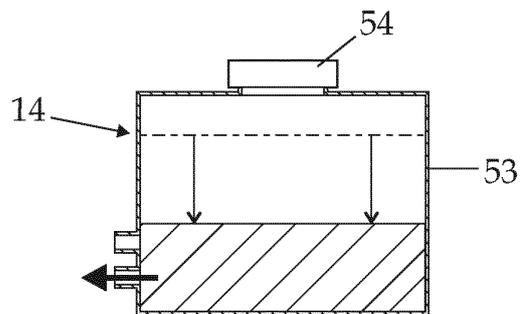


Fig. 9c

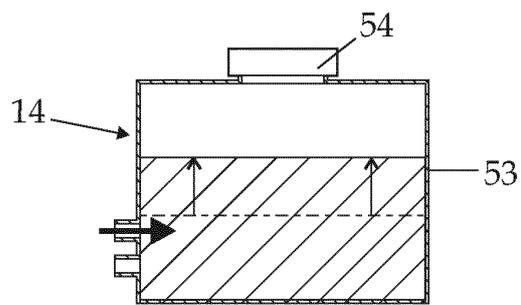


Fig. 9d

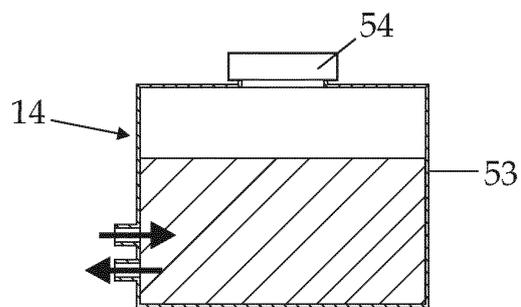


Fig. 9e

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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