



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**26.06.2019 Bulletin 2019/26**

(51) Int Cl.:  
**D06F 39/02 (2006.01) D06F 39/14 (2006.01)**

(21) Application number: **18213640.8**

(22) Date of filing: **18.12.2018**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**  
Designated Validation States:  
**KH MA MD TN**

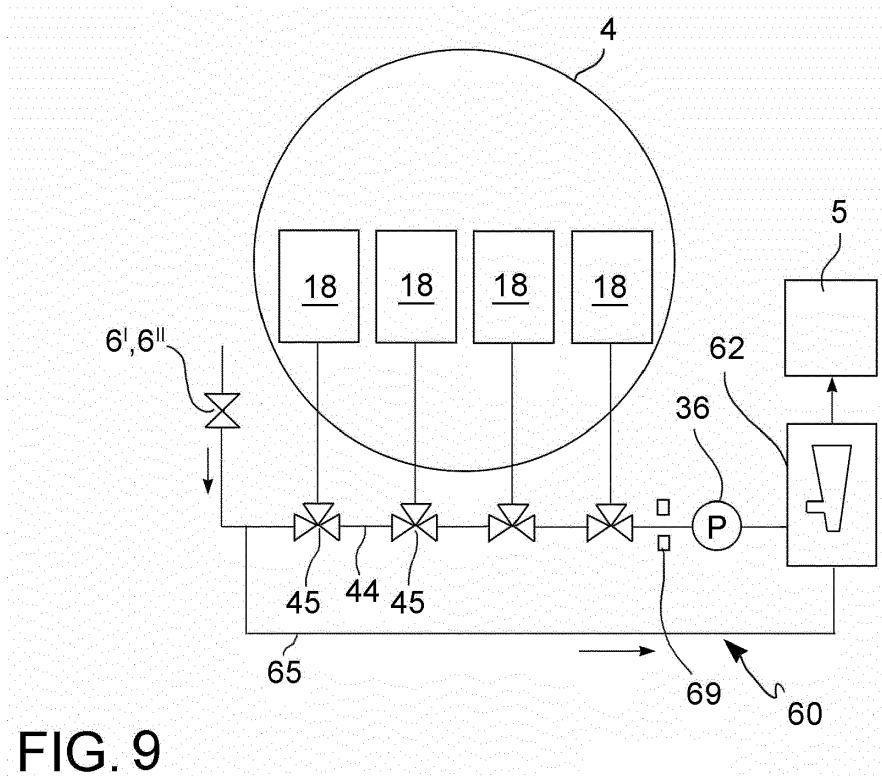
(71) Applicant: **Candy S.p.A.**  
**20052 Monza (MB) (IT)**  
(72) Inventor: **FUMAGALLI, Aldo**  
**I-20900 Monza, Monza e Brianza (IT)**  
(74) Representative: **Leihkauf, Steffen Falk Jacobacci & Partners S.p.A.**  
**Via Senato, 8**  
**20121 Milano (IT)**

(30) Priority: **22.12.2017 IT 201700149096**

(54) **WASHING MACHINE**

(57) A washing machine (1) comprises a housing (2), a washing tub (3) arranged inside the housing (2) which can be closed by means of a porthole door (4), a basket (5) in the washing tub (3) for containing the laundry to be washed, a water loading system (20) connectable to the water mains and in communication with the washing tub (3), a dispensing system (17) for dispensing laundry treatment agents having a plurality of tanks (18) posi-

tioned in the porthole door (4) and dimensioned to contain a sufficient volume of treatment agent for a plurality of washing cycles, wherein the dispensing system (17) comprises, for each tank (18), a dedicated dosing pump (36'), and the tanks (18) are connected to the respective dedicated dosing pumps (36') by means of respective dedicated transfer ducts (44'), each equipped with a non-return valve (63).



**FIG. 9**

## Description

**[0001]** The present invention relates to a device and method for washing laundry, in particular to a domestic washing machine.

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

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

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

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

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

**[0007]** Washing machines with so-called "multiple dispensing" washing substance dispensing and dosing systems are also known configured to contain an amount of treatment agent sufficient for a plurality of washing cycles and to automatically dispense a controlled dose of treatment agent for each washing cycle.

**[0008]** It is also known to position the multiple dispensing system in the front door and, more precisely, in the porthole of the front door of the washing machine.

**[0009]** For heating the washing liquid contained in the tank, an electric resistor is provided, arranged inside the tank in the gap between the wall of the laundry basket.

**[0010]** In order to reduce the consumption of water and detergent, it is known to equip washing machines with recirculation systems which recover the washing liquid from the bottom of the tub (where it accumulates even before touching the laundry in the basket) and reintroduce the recovered liquid into the laundry basket, so that a reduced volume of liquid is repeatedly poured on the laundry to be washed.

**[0011]** Recirculation systems usually comprise a recirculation duct which extends outside the washing tub from a lower opening of the washing tub (for drawing the liquid to be recirculated) to an upper opening of the washing tub (for reintroducing the recirculated liquid), as well as

an electric recirculation pump or ejector.

**[0012]** The features described hereto in relation to washing machines of the prior art known by the applicant may be entirely or partially also implemented in at least some embodiments of an improved laundry washing machine according to the invention.

**[0013]** The known washing machines, while being satisfactory from many points of view, until now require an intense and very complex user interaction, in particular with reference to choosing the amount and type or types of treatment agents for each wash, as well as the loading operation of the treatment agents in the washing machine and, last but not least, the manipulation, cleaning and maintenance operations of the detergent loading or multiple dispensing system.

**[0014]** It is the main object of the present invention to provide a front-loading laundry washing machine with an improved dispensing system of laundry treatment agents.

**[0015]** Specific objects of the embodiments of the invention are to facilitate the interaction between user and washing machine, to reduce the number of loading and/or cleaning and/or maintenance and/or manipulation operations of the detergent loading system, to assist users in choosing the type and amount of the treatment agents for each washing cycle.

**[0016]** Further objects of the invention are to improve laundry washing and treatment performance, as well as save resources, in particular of washing and/or treatment agents, electricity, water, volumes, dimensions.

**[0017]** It is a further object of the invention to overcome the problem of poor treatment efficacy of multi-use pre-packaged washing compositions.

**[0018]** Further objects of the invention relate to a simplification of use perceived by the user and a greater versatility and capacity of the washing machine to adjust and influence a multiplicity of laundry washing and treatment conditions and parameters.

**[0019]** These and other objects are achieved by a washing machine according to the independent claim. The dependent claims relate to advantageous and preferred embodiments of the invention.

**[0020]** A washing machine comprises:

- a housing,
- a washing tub arranged inside the housing and having a front opening closable by means of a porthole door frontally hinged to the housing,
- a basket arranged inside the washing tub and rotatable about a horizontal or inclined axis, wherein the basket defines a loading opening at the front opening of the washing tub, for loading and unloading the laundry to be washed,
- a water loading system connectable to the water mains and in communication with the washing tub to load water in the washing tub,
- a draining duct connected to the washing tub and to a draining pump to remove the washing liquid from

the washing tub and to adjust a liquid level inside the wash tub together with the water loading system,

- a dispensing system for dispensing laundry treatment agents, said dispensing system comprising a plurality of tanks for containing said treatment agents, said plurality of tanks being positioned in the porthole door and the individual tanks being dimensioned to contain a sufficient volume of treatment agent for a plurality of washing cycles,

**[0021]** In accordance with an aspect of the invention, the dispensing system (17) comprises a dosing pump (36) either fixed in the door (4) or outside the door (4), said dosing pump (36) comprising:

- a cylinder (37) defining a dosing volume and forming an inlet opening (38) with an inlet non-return valve (39) and an outlet opening (40) with an outlet non-return valve (41),
- a piston (42) movable by means of an actuator (43),

wherein said tanks (18) are connected to the inlet opening (38) of the dosing pump (36) by means of one or more transfer ducts (44) and one or more selection valves (45) for selectively opening and interrupting the fluid connection between each of the tanks (18) and the dosing pump (36).

**[0022]** This allows the use of a single volumetric dosing pump (36) for the dosed dispensing of a plurality of different treatment agents contained in a plurality of different tanks (18). Moreover, the positioning of the dosing pump (36) fixed in the door (4) rather than in the washing machine housing avoids the need to provide ducts with hydraulic coupling and uncoupling systems for the transporting the treatment agents from the movable porthole door to the fixed part of the washing machine housing.

**[0023]** According to a further aspect of the invention, the plurality of tanks (18) comprises an individual tank (34) and a multi-tank unit (35) having a plurality of said tanks (18) connected to one another, wherein the multi-tank unit (35) may be reversibly coupled to the door (4) as an individual body and independent from the individual tank (34), and wherein the individual tank (34) may be reversibly coupled to the door (4) independently of the multi-tank unit (35).

**[0024]** This allows to simplify and reduce the manipulation, extraction, cleaning, filling and re-insertion operations of the refillable tanks (18). Indeed, not all wash cycles require the dispensing of all available types of treatment agents and various washing cycles require different amounts of one or the other treatment agent, with the result that the consumption of some treatment agents is different from the consumption of other treatment agents. For example, in some embodiments, the consumption of enzymes is lower than the consumption of soap and softener. The structural construction of the tanks as a separate and independent multi-tank unit and individual tank allows to extract and manipulate the strict-

ly indispensable tanks only, i.e. those which have been emptied, leaving the tanks which are not yet empty in their place.

**[0025]** In accordance with a further aspect of the invention, the dispensing system (17) comprises, for each tank (18), a dedicated dosing pump (36'), and the tanks (18) are connected to the respective dedicated dosing pumps (36') by means of respective dedicated transfer ducts (44'), optionally each equipped with a non-return valve (63).

**[0026]** This allows a simplification of the pipe system and avoids the need for selection solenoid valves for controlling the dispensing of different treatment agents from a plurality of different tanks.

**[0027]** In accordance with a further aspect of the invention, the plurality of tanks (18) comprises:

- a first tank containing a first detergent for white and resistant fabric items,
- a second tank containing a second detergent for colored and delicate fabric items,
- a third tank containing a fixing and/or softening agent,
- a fourth tank containing enzymes and / or an additional reservoir containing stain-removing substances other than enzymes.

**[0028]** This allows to form a mixture or composition of treatment agents with an adjustable quantity ratio which can be optimized for a specific selected washing cycle, thus increasing washing effectiveness and saving treatment agents.

**[0029]** In accordance with a further aspect of the invention, each of the tanks (18) forms a dispensing opening (19) directly facing the basket (5).

**[0030]** This avoids the need to arrange pipes, valves and pumping systems externally with respect to the tanks (18) within the dimensions of the porthole door. Thereby, the structure of the porthole door is simplified and the volume available for the tanks (18) is increased and therefore so is the number of washing cycles which can be performed without needing to fill the tanks. Additionally, with reference to all the embodiments, an introduction of detergent directly into the laundry basket is advantageous because it ensures that all the dispensed detergent is actually in contact with the laundry.

**[0031]** Further advantageous aspects of the invention will become apparent from the following description of some embodiments provided by way of non-limiting example with reference to the accompanying drawings, in which:

- figure 1 is a front view of a washing machine according to an embodiment of the invention;
- figure 2 is a section view of a tank for treatment agents of the washing machine according to a further embodiment;
- figure 3 shows a multiple dosing diagram of the

- washing machine according to an embodiment;
- figure 4 shows an embodiment of the implementation of the multiple dosing diagram in figure 3;
- figure 5 shows a dosing and dispensing diagram of the washing machine according to an embodiment;
- figure 6 shows a multiple dosing system with individual and multiple tank assemblies of the washing machine according to an embodiment,
- figures 7 and 8 show further multiple dosing diagrams with alternative dispensing of detergent powder, according to embodiments,
- figures 9 and 10 show multiple dosing schemes according to embodiments, in which the treatment agent tanks are positioned in the door of the washing machine and a dispensing assembly containing the dosing pump is positioned in the housing outside the door of the washing machine,
- figure 11A shows a multiple dosing scheme with a duct washing system according to a further embodiment,
- figure 11B shows a multiple dosing scheme with a duct washing system according to another further embodiment,
- figures 12, 13 and 14 are perspective views of a washing machine according to an embodiment, in which the treatment agent tanks are positioned in the door of the washing machine and a dispensing unit containing the dosing pump is positioned in the housing outside the door of the washing machine,
- figure 15 is a perspective view of a door for a washing machine according to an embodiment, said door containing a multiple dispensing assembly with tanks and an outer cover removed,
- figures 16, 17, 18 are views from the outside of doors of a washing machine according to embodiments,
- figure 19 is a perspective view of a door of a washing machine according to an embodiment.
- figures 20, 21, 22 show a door of a washing machine according to an embodiment, with a detergent tank assembly removed and inserted,
- figure 23 shows a detergent tank assembly for the door in figure 22,
- figure 24 shows an individual detergent tank with gripping portion and opening/filler cap,
- figures 25 shows a door of a washing machine according to an embodiment, with a detergent tank assembly or rigid disposable cartridges,
- figures 26 and 27 are views of the disposable cartridge assembly in figure 22,
- figure 28 shows a door of a washing machine according to an embodiment, with a disposable detergent flexible wall container assembly,
- figures 29 and 30 are views of disposable detergent flexible wall containers.

**[0032]** With reference to the figures, a washing machine 1 or washer-dryer comprise a supporting and housing structure 2, inside which a washing tub 3 is housed,

provided with a front opening which can be closed by a porthole door 4 frontally hinged to the housing 2. A basket 5 to accommodate the laundry to be washed 3 is arranged inside the washing tub in a rotatable manner about a horizontal or inclined axis. The basket 5 also defines a front opening positioned at the opening of the washing tub, in order to be able to load and unload of the laundry.

**[0033]** The washing tub 3 is adapted to contain the washing liquid during the steps of the laundry washing.

**[0034]** A water loading system connectable to the water mains is provided in order to allow the loading of the tank 3 with water from the mains. The loading system 20 may comprise a plurality of ducts which extend, e.g. from one or more, e.g. two supply solenoid valves 6, 7, either directly or through detergent compartments of a detergent basin 8 (optional), to the washing tub 3.

**[0035]** A draining duct 10 is connected to the bottom of the washing tub 3 with associated draining pump 11 which removes the washing liquid from the tank 3 and which controls, together with the supply solenoid valves 6, 7, the liquid level inside the tank 3.

**[0036]** For heating the washing liquid contained in the tank 3, an electric resistor 12 may be provided arranged inside the tank 3, in particular on the bottom of the tank 9, in the gap between the wall of the laundry basket 5.

**[0037]** For agitating and remixing the laundry with the washing liquid, the laundry basket 5 can be actuated in rotation by an electric motor 13 and a transmission 14, e.g. a belt.

**[0038]** The operation of the washing machine 1 is controlled by an electronic control unit 15, operatively connected to a user control interface 16 positioned at an outer wall or at the door 4 of the housing 2 and which allows the selection of washing and/or drying cycles (more generally, of treatment cycles) and their features. In response to the selections made by the user by means of the user interface 16, the control unit 15 controls the various components of the washing machine 1 for automatically washing the laundry.

**[0039]** The washing machine 1 further comprises a dispensing system 17 of the "multiple dosing" type for dispensing laundry treatment agents.

**[0040]** Either in addition or alternatively to the detergent tray 8, the dispensing system 17 comprises a plurality of tanks 18 to contain the treatment agents, e.g. detergent for resistant white fabric items, detergent for delicate colored fabric items, detergent for wool, perfuming substances, enzymes and / or stain-removing substances other than enzymes, fixing agents and/or fabric softener. The plurality of tanks 18 is preferably positioned in the porthole door 4 and the individual tanks 18 are dimensioned to each contain a volume of the treatment agent sufficient for a plurality of washing cycles.

#### **Multi-dosing tanks with dispensing openings and integrated pumps**

**[0041]** According to an embodiment, each of the tanks

18 forms a dispensing opening 19 directly facing the basket 5, so as to directly dispense the treatment agent and not require modifications to the water loading system 20. Particularly advantageously, the porthole door 4 is free from water pipes.

**[0042]** According to an embodiment, each of the tanks 18 includes an internal dosing and dispensing mechanism 21 directly on the tank 18, but configured to interact with an external dispensing actuator 22, positioned in the door 4 externally to the tank 18.

**[0043]** With particular advantage, the internal dosing and dispensing mechanism 21 and the external dispensing actuator 22 are configured for magnetic interaction.

**[0044]** According to an embodiment, the dosing and dispensing mechanism 21 comprises:

**[0045]** - a dispensing chamber 23 delimiting a dosing volume in communication with the dispensing opening 19, via the interposition of a non-return valve 24, and with the inside of the tank 18,

**[0046]** - at least one dosing member 25 movable from a retracted position outside the dosing chamber 23, in which it allows the filling of the dispensing chamber 23 with the treatment agent, to a protracted position in the dosing chamber 23, in which it pushes a dosed volume of treatment agent from the dosing chamber 23 through the non-return valve 24 and the dispensing opening 19.

**[0047]** According to an embodiment, the dosing chamber 23 is shaped as a cup or as a cylinder open on one side, with a bottom wall 26 which accommodates the non-return valve 24 and with a peripheral wall 27 which delimits together with the bottom wall 26 said (predetermined) dosing volume.

**[0048]** By moving from the retracted position to the protracted position, the dosing member 25, e.g. a dosing piston, sealingly engages the peripheral wall 27 so as to prevent the return of treatment agent from the dosing chamber 23 into the inner space 29 of the tank 18 and to force the treatment agent through the non-return valve 24 and the dispensing opening 19 into the basket 5. During the return of the dosing piston 25 from the protracted position to the retracted position, a further non-return valve 28 positioned between the dosing chamber 23 and the inner space 29 (e.g. in a channel formed in the dosing piston 25) allows the passage of liquid from the inner space 29 into the dosing chamber 23.

**[0049]** The dosing member 25 comprises a magnetically susceptible (in particular attractable) element 30, e.g. a ferromagnetic or magnetic block, for a displacement of the dosing member 25 via magnetic actuation from the outside of the tank 18.

**[0050]** The flow actuator 22 may comprise an electromagnet 31 positioned outside the tank 18 but near the dosing and dispensing mechanism 21 and can be energized by the control unit 15 so as to actuate the displacements of the dosing member 25.

**[0051]** Alternatively, the flow actuator 22 may comprise a magnetic or magnetically susceptible structure 32 positioned outside the tank 18 but near the dosing and dis-

persing mechanism 21 and movable (e.g. by means of a motor or a solenoid controlled by the control unit 15) so as to actuate the displacements of the dosing member 25.

**[0052]** According to an advantageous embodiment, the tank 18 or each tank 18 comprises a loading opening which can be closed by means of a plug 33 and the dosing mechanism and dispensing mechanism 21 is integrated, at least in part, in said plug 21.

10

### **Multi-dosing dispensing system with a single dosing pump**

**[0053]** According to a further embodiment, the dispensing system 17 comprises a dosing pump 36 which is fixed in the door 4 (figure 15).

**[0054]** Alternatively, and with reference to multiple dosing systems with a single pump or with multiple pumps (figures 9 - 14), one or more dosing pumps 36, 36' is arranged in the housing 2 outside the door 4, while the tanks 18 are either formed or positioned in the door 4 and connected to the single or multiple dosing pumps 36, 36' by means of connection ducts 59 extending at a hinge 61', 61" which connects the door 4 to a front wall of the housing 2.

**[0055]** Advantageously, the hinge 61', 61" comprises a lower hinge 61' and an upper hinge 61" and the connection ducts 59 extend in a (protected) space between the lower hinge 61' and the upper hinge 61" (figure 13).

**[0056]** According to an embodiment, the dosing pump 36 comprises a cylinder 37 which defines a predetermined dosing volume and which forms an inlet opening 38 with an inlet non-return valve 39 and an opening outlet 40 with an outlet non-return valve 41, as well as a piston 42 movable by means of an actuator 43, e.g. a solenoid or actuating motor, which in turn is controlled by the control unit 15.

**[0057]** The tanks 18 are or can be connected to the inlet opening 38 of the dosing pump 36 by means of respective transfer ducts 44 each provided with a selection valve 45 for selectively opening and interrupting the fluid connection between each of the tanks 18 and the dosing pump 36.

**[0058]** Advantageously, in order to avoid the formation of scaling and deposits in the dosing cylinder 37, a rinsing duct 46 may be provided positioned in the door 4 and in communication with the transfer duct 44. The rinsing duct 46 is connected to the water loading system 20, by means of a supply valve 6' and an air gap 58, and connects to a portion of the transfer duct or ducts 44 upstream of the inlet non-return valve 39 of the dosing pump 36.

**[0059]** Also in this embodiment, the tanks 18 can be either fixed in the door 4 or extractable from door 4 for the purpose of filling them.

**[0060]** According to an embodiment, the single outlet openings of the tanks 18 are placed in communication with a single transfer duct 44 respectively by means of a plurality of selection valves 45 arranged in series (one

behind the other) along the transfer duct 44. Each selection valve 45 has a first inlet opening 47 and an outlet opening 48 which connect the selection valve 45 in the transfer duct 44 (ensuring the continuity), as well as a second inlet opening 49 which connects the selection valve 45 to the outlet opening of the respective tank 18. The first 47 and second 49 inlet openings and the outlet opening 48 of the selection valve 45 are in mutual communication to allow:

- a flow passage (of rinsing water and/or of the treatment agent introduced into the transfer duct 44 in a position upstream of the selection valve 45) from the first inlet 47 to the outlet aperture 48, and
- an input flow (of the treatment agent) from the second input opening 49 to the outlet opening 48.

**[0061]** The selection valve 45 also comprises a shutter 50 movable to:

- a passage position, in which it closes the second inlet opening 49, thus leaving the second inlet opening 47 and the outlet opening 48 open, to allow only the passage flow and prevent the inlet flow of treatment agent,
- an inlet position, in which it closes the first inlet opening 47, thus leaving the second inlet opening 49 and the outlet opening 48 open, to allow only the inlet flow of treatment agent and prevent the passage flow.

**[0062]** The rinsing duct 46 is connected to the transfer duct 44 upstream of the selection valves 45 and the transfer duct 44 is connected to the dosing pump 36 downstream of the selector valve 45, as shown for example in figures 3 and 4.

**[0063]** Thereby, by taking the selection valve 45 associated with a selected tank 18 to the inlet position and leaving the selection valves 45 of the remaining tanks 18 in the passage position, the dosing pump 36 can aspirate and dose in a selective manner the treatment agent of the selected tank, while the flow of the rinsing water is intercepted (blocked) at the selection valve 45 of the selected tank and all remaining input flows of the treatment agents are intercepted (blocked) at the selection valves 45 of the non-selected tanks 18.

**[0064]** Similarly, taking the selection valves 45 of all the tanks 18 to the passage position, the entire transfer duct 44, including all selection valves 45, and the dosing pump 36 can be crossed and cleaned by the flow of the rinsing water, while all the input streams of the treatment agents are intercepted (blocked) at the selector valve 45 (figures 3, 4, 5).

**[0065]** According to an embodiment (figure 9), a pumping unit 60 containing:

- the dosing pump 36,
- the rinsing duct 46, 46', 66, 67, 68,

- the selection valves 45, and
- a portion of the transfer duct 44 at which the selection valves 45 are arranged,

5 is arranged in the housing 2 outside the door 4 and connected to the tanks 18 in the door 4 by means of the aforesaid connection ducts 59. This avoids the need to extend electrical wires from the housing 2 in the door 4.

**[0066]** In this embodiment, the outlet opening 40 of the dosing pump 36 can be connected to (an ejector 62 placed in) a supply duct 65 connected to the water loading system 20 by means of a supply solenoid valve 6" and in communication with the inside of the basket 5 or of the tub 3, so as to transport (by aspiring by the ejector 62) the treatment agents, dispensed by means of the dosing pump 36, into the basket 5 or into the washing tub 3.

**[0067]** According to an embodiment (figure 11B), the transfer duct 44 connects the selection valves 45 in series to one another and with the dispensing pump 36 and a plurality of dedicated transfer ducts 44' connect the selection valves 45 (which can be outside the door 4, for example) to the respective tanks 18 (inside the door 18).

**[0068]** A rinsing duct 46' located completely outside the door 4 may be provided in order to avoid the formation of scaling and deposits in selection valves 45 and in the transfer ducts 44, 44'. The rinsing duct 46' comprises a distribution duct 66 connected to the water loading system 20 by means of a supply valve 6', and a plurality of dedicated ducts 67 branched from the distribution duct 66. Each of the dedicated ducts 67 comprises a non-return rinsing valve 68 and is connected to respectively one of the dedicated transfer ducts 44' at a point upstream of the selection valve 45 and downstream of a non-return valve 63 of the tank 18 (figure 11B).

**[0069]** When the supply solenoid valve 6' is open, the mains water fills the entire rinsing duct 46' and washes the transfer ducts 44, 44' downstream of the non-return valves 63 and the selection valves 45. During this washing, the mains water pressure in the dedicated transfer ducts 44' keeps the non-return valves 63 closed thus preventing the mains water from entering into the tanks 18.

**[0070]** At the end of the step of cleaning, the supply valve 6 is closed and the dosing pump 36 is activated to fill the dedicated transfer ducts 44' again with liquid treatment agent aspirated from the tanks 18.

**[0071]** For a selective dispensing of a treatment agent selected from a selected tank 18, the supply valve 6' is held closed and the dosing pump 36 and a selected selection valve 45 is activated, thus generating a vacuum in the corresponding dedicated transfer duct 44' which opens the non-return valve 63 associated with the selected tank 18 and aspirates the selected treatment agent from selected tank 18. By virtue of the closure of the supply valve 6' and of the rinsing non-return valves 68, the vacuum in the dedicated transfer duct 44' cannot aspirate mains water from the rinsing duct 46' or treatment agents from the other tanks 18.

**[0072]** Alternatively, the pumping assembly 60 may be completely inside the door 4, thus allowing a direct dispensing in the basket 5 and avoiding the need for a further duct with ejector for transporting the dosed treatment agents into the tank 3 or in the basket 5.

#### **Multi-dosing dispensing system with a plurality of dedicated pumps**

**[0073]** According to a further embodiment, the dispensing system 17 comprises a dedicated dosing pump 36' (figures 10, 11, 14), preferably volumetric pumps, such as a cylinder-piston-pump, for each treatment agent tank 18.

**[0074]** The tanks 18 are connected or can be connected to the respective dedicated dosing pumps 36' by means of respective dedicated transfer ducts 44', optionally each equipped with a non-return valve 63.

**[0075]** If the dedicated dosing pumps 36' are fixed in the door 4, their outlet openings may be in direct communication with the inside of the basket 5 or connected to a common output duct 64 which opens into the drum 5.

**[0076]** In the embodiment in which the dedicated dosing pumps 36' are positioned in the housing 2 outside the door 4, the dedicated dosing pumps 36' are connected to a common output duct 64 connected to (an ejector 62 placed in) a supply duct 65 connected to the water loading system 20 by means of a supply solenoid valve 6" and in communication with the inside the basket 5 or, optionally, of the tub 3, so as to transport (by means of the aspiration of the ejector 62) the treatment agents dispensed by the dedicated dosing pumps 36' up to the basket 5 or to the washing tub 3.

**[0077]** Advantageously, in order to avoid the formation of scaling and deposits in the dedicated dosing pumps 36' and in the ducts 44', 64 of the dispensing system 17, a rinsing duct 46' may be provided positioned, according to embodiments, either at least partly in the door 4 or completely outside the door 4. The rinsing duct 46' comprises a distribution duct 66 connected to the water loading system 20 by means of a supply valve 6', and a plurality of dedicated ducts 67 branched from the distribution duct 66. Each of the dedicated ducts 67 comprises a non-return rinsing valve 68 and is connected to respectively one of the dedicated transfer ducts 44' at a point upstream of the dedicated dosing valve 36' and downstream of the non-return valve 63 (figure 11A).

**[0078]** When the supply solenoid valve 6' is open, the mains water fills the entire rinsing duct 46' and washes the dedicated transfer ducts 44' downstream of the non-return valves 63 and the dedicated dosing valves 36'. During this washing, the mains water pressure in the dedicated transfer ducts 44' keeps the non-return valves 63 closed thus preventing the mains water from entering into the tanks 18.

**[0079]** At the end of the step of cleaning, the supply valve 6' is closed and the dedicated dosing pumps 36' are activated to fill the dedicated transfer ducts 44' again

with liquid treatment agent aspirated from the tanks 18.

**[0080]** For a selective dispensing of a treatment agent selected from a selected reservoir 18, the supply valve 6' is held closed and the selected dedicated dosing pump 36 is activated, thus generating a vacuum in the corresponding dedicated transfer duct 44' which opens the non-return valve 63 associated with the selected tank 18 and aspirates the selected treatment agent from selected tank 18. By virtue of the closure of the supply valve 6' and of the rinsing non-return valves 68, the vacuum in the dedicated transfer duct 44' cannot aspirate mains water from the rinsing duct 46' or treatment agents from the other tanks 18.

**[0081]** Also in the embodiments with dedicated dosing pumps 36' (figures 10, 11), the tanks 18 may be either fixed to the door 4 or extractable from door 4 for filling.

**[0082]** According to an embodiment, a pumping unit 60' containing:

- the dedicated dosing pumps 36',
- the rinsing duct 46', 66, 67, 68,
- the portions of the dedicated transfer ducts 44 to which the rinsing duct 46', 66, 67, 68 is connected,

is arranged in the housing 2 outside the door 4 and connected to the tanks 18 in the door 4 by means of the aforesaid connection ducts 59. This obviates the need to extend electrical wires from the housing 2 in the door 4.

**[0083]** Alternatively, the pumping assembly 60' may be completely inside the door 4, thus allowing a direct dispensing in the basket 5 and obviating the need for a further duct with ejector for transporting the dosed treatment agents into the tank 3 or in the basket 5.

#### **Multi-dosing dispensing system with additional dispensing of powder detergent**

**[0084]** According to a further embodiment (figures 7, 8), the dispensing system 17 further comprises:

- an auxiliary compartment 51 positioned in the door 4 and adapted to contain powder detergent and a channel 54 (e.g. overflow channel), also formed in the door 4 for draining (by rinsing) the powder detergent from the auxiliary compartment 51 into the basket 5 or into the tub 3, as well as
- an auxiliary duct 52 connected to the water loading system 20, for example by means of a supply valve 6', 7' and an air gap 58, 58', and in communication with the auxiliary compartment 51 so as to conduct an auxiliary water flow into the auxiliary compartment 51 and dispense the powder detergent from the auxiliary compartment 51 into the basket 5 or into the tub 3.

**[0085]** This further increases the versatility of the dispensing system 17.

**[0086]** According to an embodiment (figure 7), the aux-

iliary duct 52 is branched from (or connected to) the rinsing duct 46 in a branching point 53 downstream of the air gap 58 (in the rinsing duct 46) and upstream of the transfer duct 44, and forms an elevated segment 55 (e.g. in the form of inverted siphon) positioned higher than the transfer duct 44 but lower than the air gap 58, so that the dispensing of liquid treatment agent from the tanks 18 can occur while maintaining the water level in the auxiliary duct under the height of the segment 55, and therefore without dispensing detergent powder from the auxiliary compartment 51.

**[0087]** This enables the auxiliary duct 52 without on-off valves.

**[0088]** The dispensing of detergent powder from the auxiliary compartment 51 without simultaneous dispensing of liquid treatment agent from the tanks 18 may be performed by filling the rinsing duct 46 beyond the level of the elevated segment 55 so as to achieve the aforesaid auxiliary flow in the auxiliary compartment 51, e.g. by blocking the water flow into the transfer duct 44 by means of the non-return valves 39, 41 or one of the selection valves 45.

**[0089]** Either alternatively or selectively, the dispensing of detergent powder from the auxiliary compartment 51 may be performed simultaneously with a dispensing of the treatment liquid agent from one of the tanks 18.

**[0090]** Alternatively, the auxiliary duct 52 may comprise an on-off valve 56 which can be operated to control the dispensing of detergent powder from the auxiliary compartment 51. In this embodiment, it is possible to avoid the elevated segment 55.

**[0091]** According to an embodiment (figure 8), the auxiliary duct 52 is connected to the water loading system 20 by means of an own supply valve 7' and an own air gap 58', thus providing a second water path, independent from the rinsing duct 46, for dispensing detergent powder from the auxiliary compartment 51 and for introducing water into the basket 5 or in the tub 3.

**[0092]** According to an embodiment, the auxiliary compartment 51 and, possibly, the channel 54 can be formed in an auxiliary insert 57 which can be inserted in the door 4 to operate the washing machine 1 with dispensing of detergent powder, and removable from the door 4 to operate the washing machine 1 without dispensing detergent powder from the door 4.

**[0093]** In this embodiment, the insert 57 or an accessory cover 57' free from auxiliary compartment can be applied, as desired, from the inner side (facing in the basket 5) to the door 4 and form an inner surface facing in the basket 5 and in direct contact with the laundry to be washed (figure 19).

#### **System for detecting presence/level of detergent in the tanks 18**

**[0094]** According to a further embodiment, the dispensing system 17 comprises a detergent detection device configured to detect the presence and absence of

treatment agents inside the tanks 18 and generate a corresponding warning for the user.

**[0095]** In an embodiment (figures 3, 4, 7, 8, 9), the detergent detection device may comprise an optical sensor 69, e.g. a turbidity sensor, connected to the control unit 15 and associated with a transparent detection duct section formed in a transfer duct 44 downstream of the selection valves 45 and upstream of the dosing pump 36 and configured to generate an empty tank signal in case of air aspiration in the detection duct section.

**[0096]** In an embodiment (figures 10, 11), the detergent detecting device may comprise a plurality of optical sensors 69', e.g. turbidity sensors, connected to the control unit 15 and each associated with a transparent detection duct section formed in the dedicated transfer duct 44' of each tank 18, upstream of the dedicated dosing pump 36' and, if provided, downstream of the non-return valve 63 (figures 7, 8). The optical sensors 69' are configured to generate a tank empty signal in case of air aspiration into the detection duct segment with which they are associated.

**[0097]** The filling state detection of the tank 18 occurs during the aspiration of a selected treatment agent from a tank 18 and the control unit 15 attributes the detergent presence or absence signal generated by the optical sensor 69, 69' to the selected tank 18 and generates an "empty tank" alert for the user.

#### **Multi-tank unit 35**

**[0098]** According to a further embodiment, the plurality of tanks 18 comprises an individual tank 34 and a multiple-tank unit 35 having a plurality of said tanks 18 connected to one another. The multiple-tank unit 35 is connectable/detachable to/from the door 4 as an independent unit from the individual tank 34, and the individual tank 34 can also be connected/detached to and from the door 4 independently from the multiple-tank unit 35. This is particularly advantageous if different treatment agents with different amounts of use and emptying times are used.

**[0099]** For example, the individual tank 34 may contain enzymes and / or stain-removing substances other than enzymes, and require a filling at very low frequency, while the tanks 18 of multi-tank unit 35 may separately contain a first detergent for white and resistant items, a second detergent for colored and delicate items and a fixing and/or softening agent and require more frequent filling.

**[0100]** Advantageously, the tank 18 containing the enzymes and / or stain-removing substances other than enzymes is arranged so as to be separated from the other tanks 18 and from the inside of the basket 5 by an air gap which constitutes a thermal insulation adapted to protect the enzymes and / or stain-removing substances other than enzymes from heat deterioration.

**[0101]** In order to permit a selective manipulation of each tank 18 according to an embodiment, each tank 18 can be coupled/detached to and from the door 4 inde-

pendently of the other tanks 18.

#### **System for accessing tanks 18, replacing the tanks 18**

[0102] According to a further embodiment, the tanks 18 and, possibly, the pumping unit 60, 60', are positioned in a lower portion 70 of the door 4, which can have a vertical extension of at least or more than half, preferably between 1/2 and 2/3, of the total height of the door 4 and which is covered by an outer cover 71, preferably opaque so as to conceal the dispensing system 17 to the user.

[0103] In an embodiment (figures 12, 18) the tanks 18 are either received or formed in an oscillating drawer 72' partially extractable from and insertible into the door 4 by means of a pivoting movement about a horizontal axis so as to allow access to the tanks 18 from the outside of the door 4 (opposite side to the basket 5) and from the top (figure 18), for filling and for extracting and inserting or for replacing the tanks 18, e.g. for maintenance or cleaning of the tanks 18.

[0104] In a further embodiment (figure 17), the tanks 18 are either received or formed in a translatable drawer 72 partially extractable from and inserted into the door 4 by means of a translational movement along a horizontal axis so as to allow access to the tanks 18 from the outside of the door 4 (opposite side to the basket 5) and from the top, both for filling and for extracting and inserting or for replacing the tanks 18, e.g. for maintenance operations or for cleaning the tanks 18.

[0105] In order to allow the movement of the drawer 72, 72', as well as the extraction and re-insertion of the tanks 18, the tanks 18 and transfer ducts 44, 44' of the pumping units 60, 60' are connected by means of male-female hydraulic connectors 73 (figures 15, 20, 21), which in the disconnecting configuration close both the tank and the transfer duct 44, 44' and in the connecting configuration open a fluid passage between the tank 18 and the transfer duct 44, 44'.

[0106] An upper portion 74 of the door 4 formed above the lower portion 70 containing the tanks 18 is preferably transparent and forms a porthole area to allow viewing the inside of the basket 5 from the outside of the door 4.

[0107] The auxiliary insert 57 forming the auxiliary compartment 51 for detergent powder and the auxiliary attachment 57' (if provided), are preferably housed in the upper portion 74 of the door 4 (figures 15, 19).

#### **Refillable rigid tanks 18**

[0108] According to an embodiment (figures 20 - 24), the tanks 18 comprise refillable, rigid or semi-rigid containers having a stable shape which can be inserted into and removable from the door 4 through a front opening on the outer side of the door 4, which can be closed by the outer cover 71, preferably a swinging cover which can be opened by tilting downwards.

[0109] The refillable containers are provided with a fill-

ing opening with cap 75 and a manual grip portion 76 to facilitate extraction from the door 4 (figure 24).

[0110] The fluid connection of the tanks 18 to the pumping unit 60, 60' is achieved by means of the male-female hydraulic connectors 73.

#### **Disposable rigid or semi-rigid tanks 18**

[0111] According to a further embodiment (figures 25 - 27), the tanks 18 comprise disposable, rigid or semi-rigid containers having a stable shape which can be inserted into and removable from the door 4 through a front opening on the outer side of the door 4, which can be closed by the outer cover 71, preferably a swinging cover which can be opened by tilting downwards.

[0112] In order to maximize the volume of the tanks 18 inside the circular door 4, the refillable or disposable containers may comprise one or more first arc-shaped containers with a peripheral surface in the shape of a circular arc and one or more second containers with a shape complementary to the shape of the first containers, so as to form together a volume in the shape of a semi-disc compatible with the circular shape of the door 4 (figures 22, 23, 25-27). Advantageously, the volume of the first containers is greater than the volume of the second containers to adapt their capacity to different consumptions of treatment agents.

#### **Disposable flexible bag-like tanks 18**

[0113] According to a yet further embodiment (figures 28, 29, 30), the tanks 18 comprise disposable flexible wall containers (bladder bags) which can be inserted into and removable from the door 4 through a front opening on the outer side of the door 4, which can be closed by the outer cover 71, preferably a swinging cover which can be opened by tilting downwards.

[0114] Advantageously, the tanks 18 comprise disposable containers, in particular flexible plastic bags, for soaps and softeners (the consumption of which is notoriously high), as well as an individual refillable tank with stable form and smaller volume than the volumes of the disposable containers, for containing enzymes (the consumption of which is very low) and / or stain-removing substances other than enzymes.

[0115] The disposable flexible bag-like containers may have a generally elongated prism shape and possibly form together a volume with a trapezoidal shape which tapers downward, which fills well the lower portion semi-circular section of the door 4 (figure 28).

[0116] The disposable tanks 18 may be fluidically connected to the pumping unit 60, 60' by means of the male-female hydraulic connectors 73, or by means of hydraulic connectors adapted to pierce the disposable containers and be inserted therein in a sealed manner.

[0117] The washing machine 1 may further comprise a system for recirculating the washing liquid from the bottom of the tank to the laundry basket, similarly to the

recirculation systems described with reference to the prior art.

[0118] Finally, the present invention also relates to the washing method described with reference to the washing machine 1, the features of which are not repeated herein for brevity.

[0119] Obviously, those skilled in art may make further changes and variants to the washing method according to the present invention all without departing from the scope of protection of the invention, as defined in the following claims.

## Claims

### 1. A washing machine (1) comprising:

- a housing (2),
- a washing tub (3) arranged inside the housing (2) and having a front opening which can be closed by means of a porthole door (4) frontally hinged to the housing (2),
- a basket (5) arranged inside the washing tub (3) and rotatable about a horizontal or inclined axis, wherein the basket (5) defines a loading opening at the front opening of the washing tub (2), for loading and unloading the laundry to be washed,
- a water loading system (20) connectable to the water mains and in communication with the washing tub (3) to load water in the washing tub (3),
- a dispensing system (17) for dispensing laundry treatment agents, said dispensing system (17) comprising a plurality of tanks (18) for containing said treatment agents, said plurality of tanks (18) being positioned in the porthole door (4) and the individual tanks (18) being dimensioned to contain a sufficient volume of treatment agent for a plurality of washing cycles,

### characterized in that:

- the dispensing system (17) comprises a dedicated dosing pump (36') for each tank (18),
- the tanks (18) are connected to the respective dedicated dosing pumps (36') by means of respective dedicated transfer ducts (44').

### 2. A washing machine (1) according to claim 1, wherein the dedicated transfer ducts (44') are each provided with a non-return valve (63) and the dispensing system (17) comprises a rinsing duct (46') forming:

- a distribution duct (66) connected to the water loading system (20) by means of a supply valve (6'), and
- a plurality of dedicated ducts (67) branched

from the distribution duct (66),

wherein each of the dedicated ducts (67) comprises a non-return rinsing valve (68) and connects to respectively one of the dedicated transfer ducts (44') at a point upstream of the dedicated dosing pump (36') and downstream of the non-return valve (63).

### 3. A washing machine (1) according to claim 2, wherein:

- during a cleaning step, the supply solenoid valve (6') is open and the mains water fills the entire rinsing duct (46') and washes the dedicated transfer ducts (44') downstream of the dedicated non-return valves (63) and dosing pumps (36'), wherein the mains water pressure in the dedicated transfer ducts (44') keeps the non-return valves (63) closed, thus preventing the mains water from entering the tanks (18),
- in a step of dispensing a treatment agent from a tank (18), the supply valve (6') is closed and an operation of one of the dedicated dosing pumps (36') generates a depression in the corresponding transfer duct (44') which opens the non-return valve (63) associated with the tank (18) and sucks the treatment agent from the tank (18), wherein the closure of the supply valve (6') and the non-return rinsing valves (68) prevent the depression in the dedicated transfer duct (44') from sucking mains water from the rinsing duct (46') or treatment agents from the other tanks (18).

### 4. A washing machine (1) according to claim 2, wherein a pumping assembly (60') containing:

- the dedicated dosing pumps (36'),
- the rinsing duct (46', 66, 67, 68),
- portions of the dedicated transfer ducts (44) to which the rinsing duct (46', 66, 67, 68) is connected,

is arranged in the housing (2) outside the door (4) and connected to the tanks (18) in the door (4) by means of connection ducts (59).

### 5. A washing machine (1) according to one of claims 1 to 3, wherein the dosing pump (36) is fixed in the door (4).

### 6. A washing machine (1) according to one of the preceding claims, wherein:

- the dedicated dosing pumps (36') are connected to a common outlet duct (64) connected to an ejector (62) placed in a supply duct (65),
- the supply duct (65) is connected to the water

loading system (20) by means of a supply solenoid valve (6") and in communication with the interior of the basket (5) or of the tub (3).

7. A washing machine (1) according to one of the preceding claims, wherein the tanks (18) are positioned in a tilting drawer (72') partially extractable from and insertable into the door (4) by means of a tilting movement about a horizontal axis so as to allow the tanks (18) to be accessed from the outside of the door (4) and from above. 5 10
8. A washing machine (1) according to one of the preceding claims, wherein the tanks (18) are positioned in a translatable drawer (72) partially extractable from and insertable into the door (4) by means of a translational movement along a horizontal axis so as to allow the tanks (18) to be accessed from the outside of the door (4) and from above. 15 20
9. A washing machine (1) according to one of the preceding claims, wherein the tanks (18) comprise rigid, refillable containers of stable shape, insertable into and extractable from the door (4) through a front opening on the outer side of the door (4), which may be closed by means of an outer lid (71), said refillable containers having a filling opening (75) with a plug and a manual gripping portion (76) to facilitate the extraction thereof from the door (4). 25 30
10. A washing machine (1) according to one of the preceding claims, wherein the tanks (18) comprise rigid disposable containers of stable shape, insertable into and extractable from the door (4) through a front opening of the door (4) which may be closed by means of an outer lid (71). 35
11. A washing machine (1) according to one of the preceding claims, wherein the tanks (18) comprise: 40
  - one or more first arc-shaped containers with a circular arc-shaped peripheral surface, and
  - one or more second containers with a shape complementary to the shape of the first containers, 45

so as to form together a semi-disc-shaped volume adapted to the circular shape of the door (4), wherein the first containers have a greater volume than the second containers. 50

- 12. A washing machine (1) according to one of the preceding claims, wherein the tanks (18) comprise disposable containers configured as flexible wall bags insertable into and extractable from the door (4) through a front opening of the door (4) which may be closed by means of an outer lid (71). 55

13. A washing machine (1) according to claim 12, wherein the tanks (18) comprise:

- flexible disposable bag-like containers made of plastics for soap and softeners, and
- an individual refillable tank of stable shape and having a smaller volume than the volumes of the disposable containers, for containing enzymes and/or an additional reservoir containing stain-removing substances other than enzymes.

14. A washing machine (1) according to one of the preceding claims, wherein the plurality of tanks (18) comprises:

- a first tank containing a first detergent for white and resistant cloths,
- a second tank containing a second detergent for colored and delicate cloths,
- a third tank containing a fixing and/or softening agent,
- a fourth tank containing enzymes and/or a stain-removing substances other than enzymes.

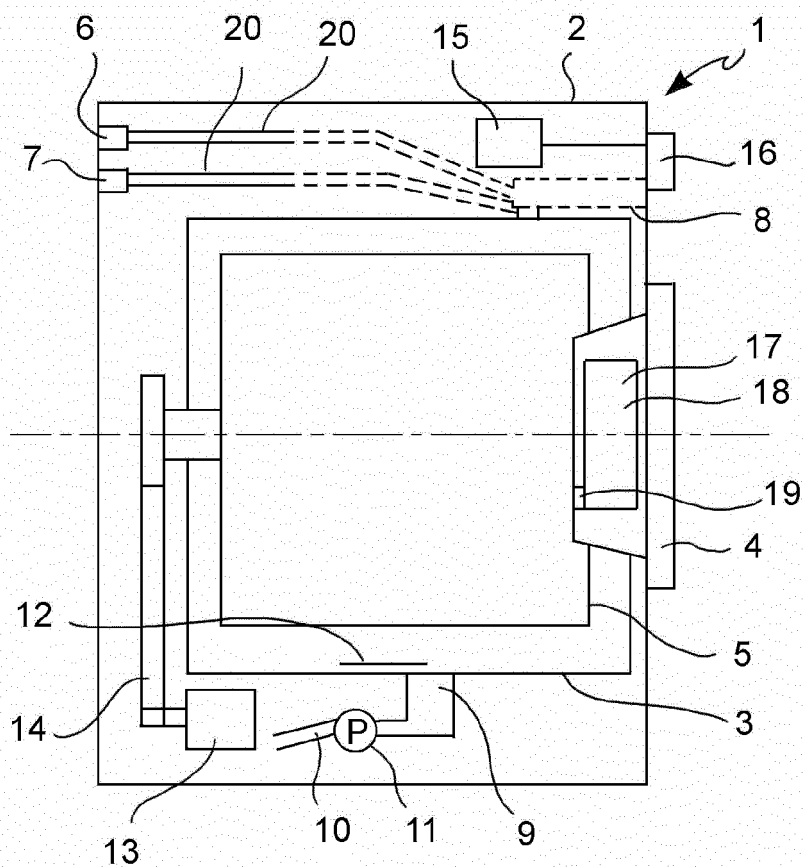
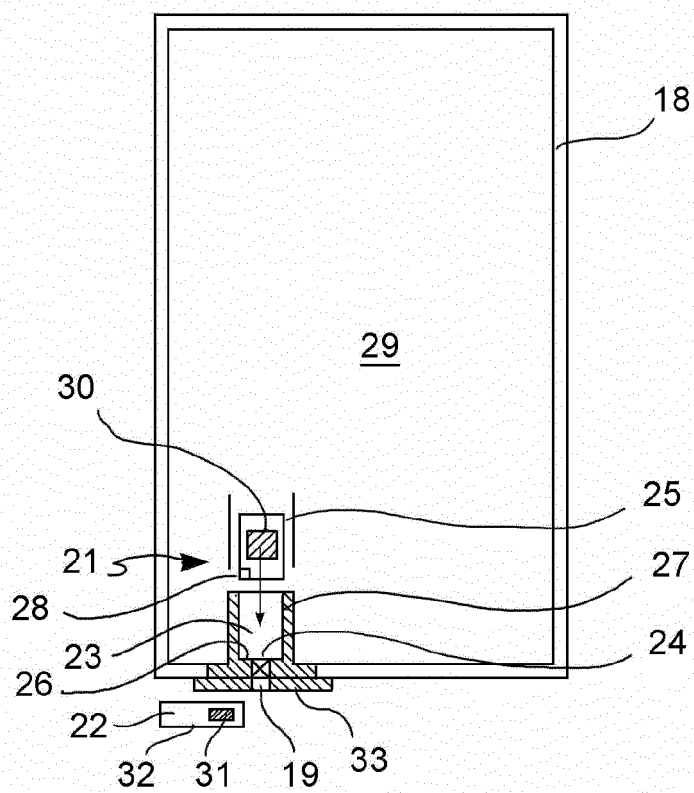


FIG. 1



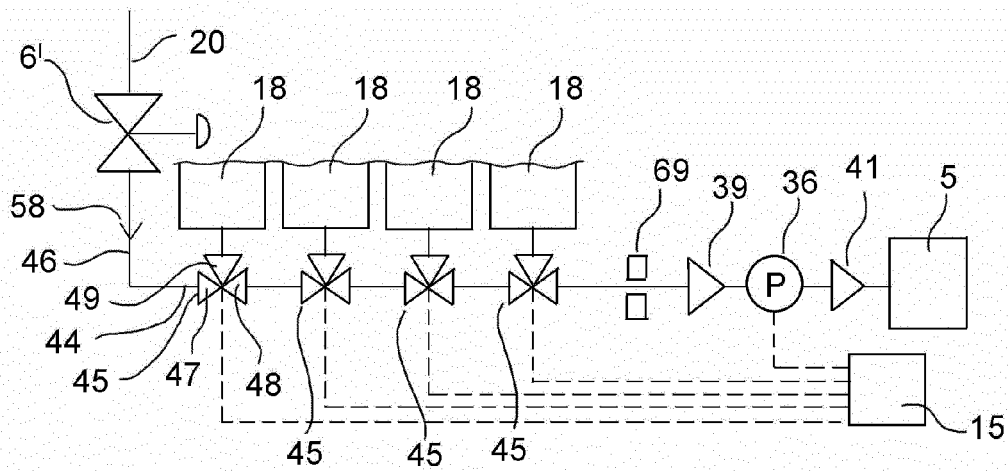


FIG. 3

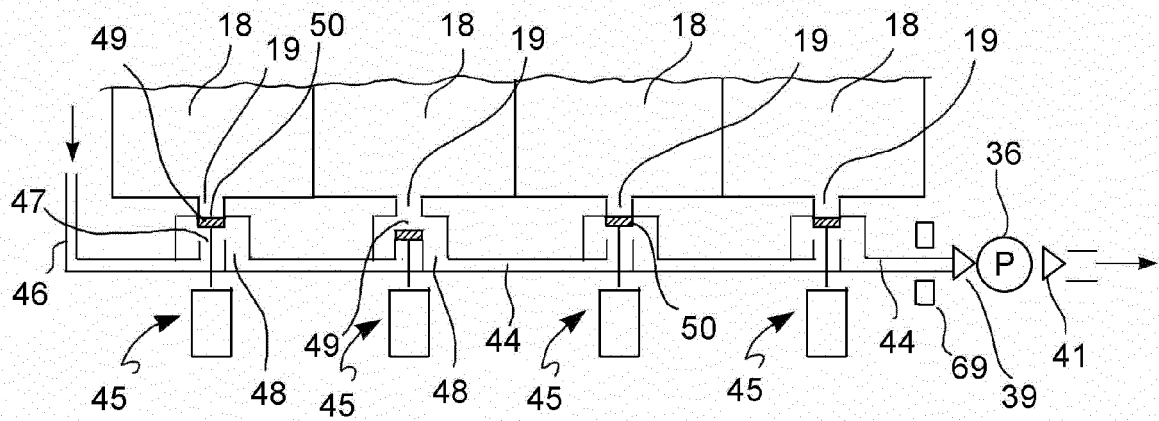


FIG. 4

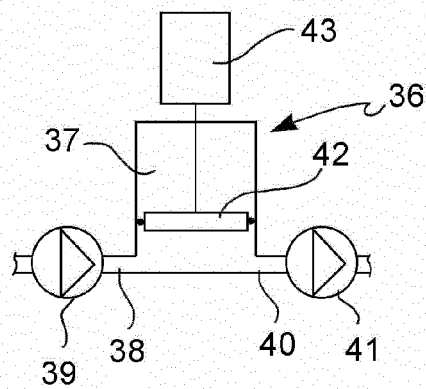
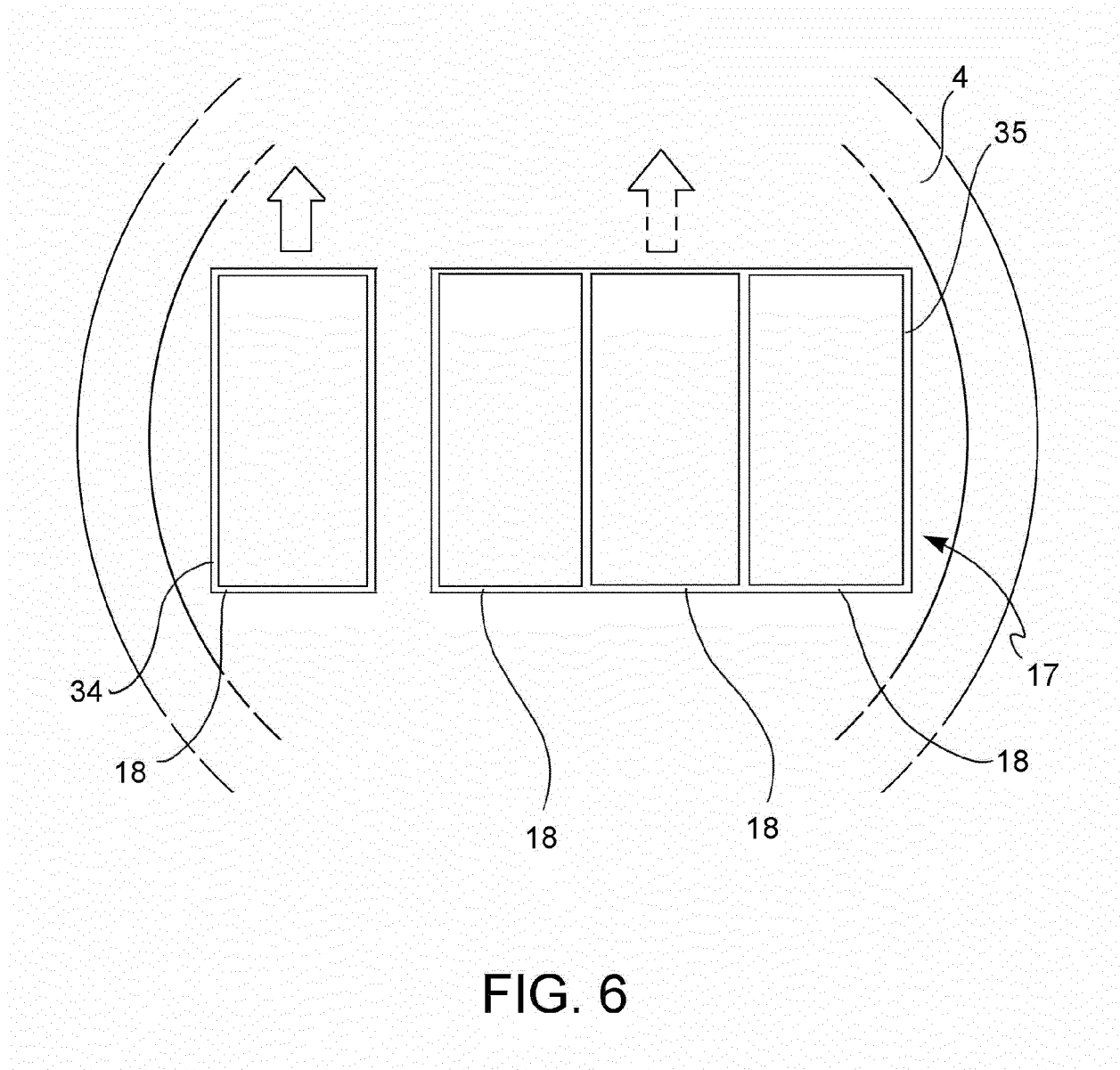


FIG. 5



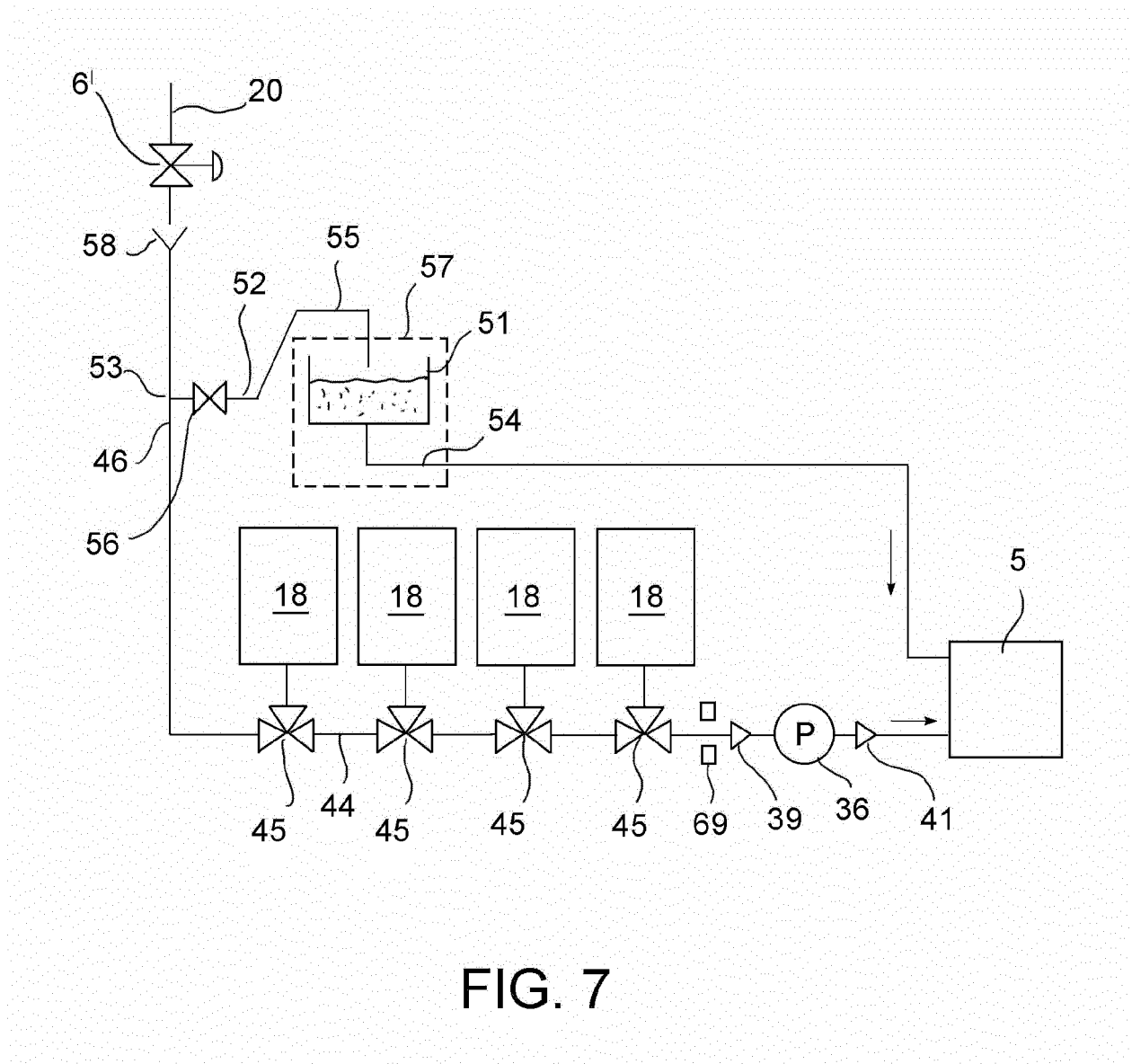


FIG. 7

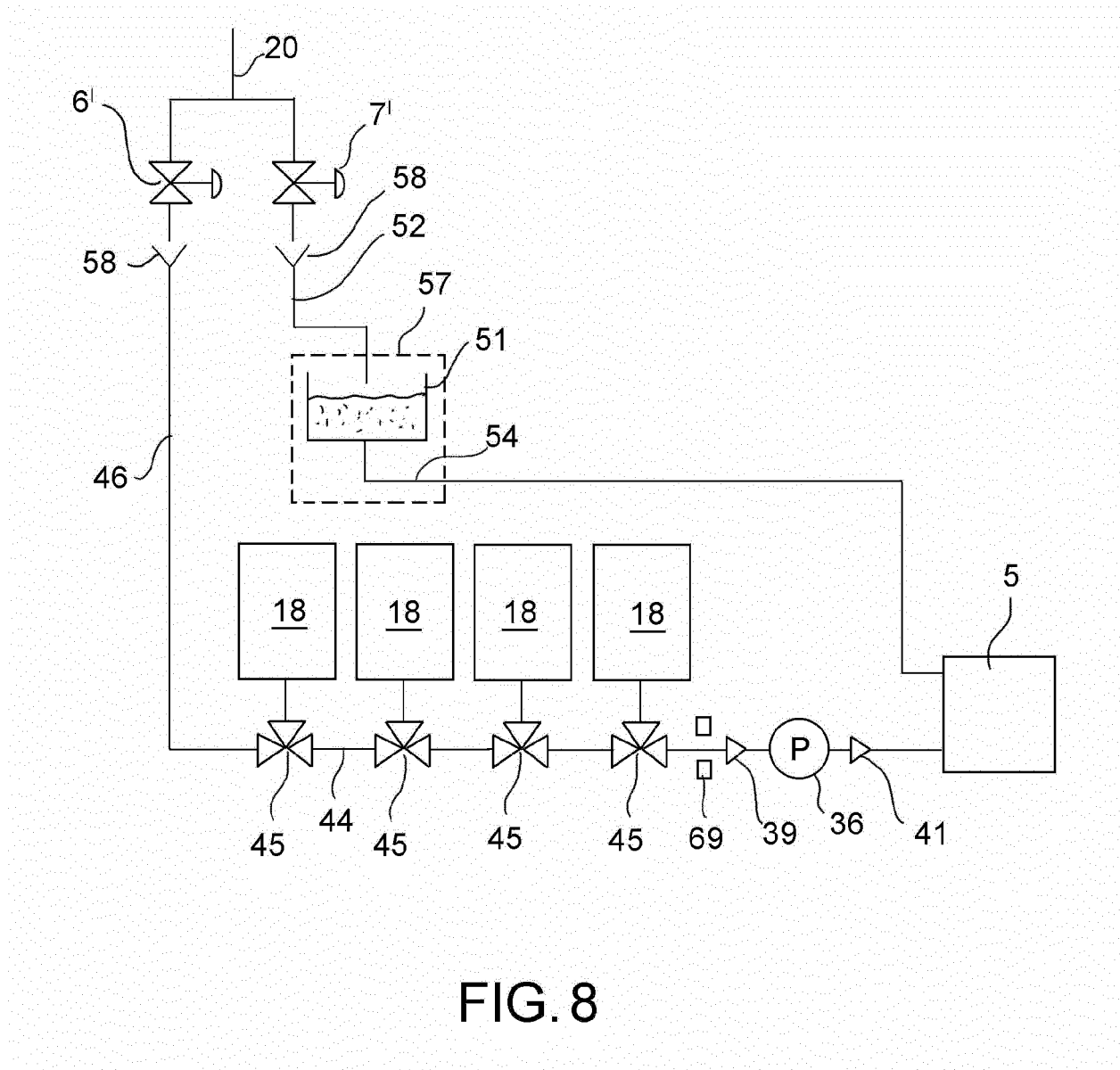


FIG. 8

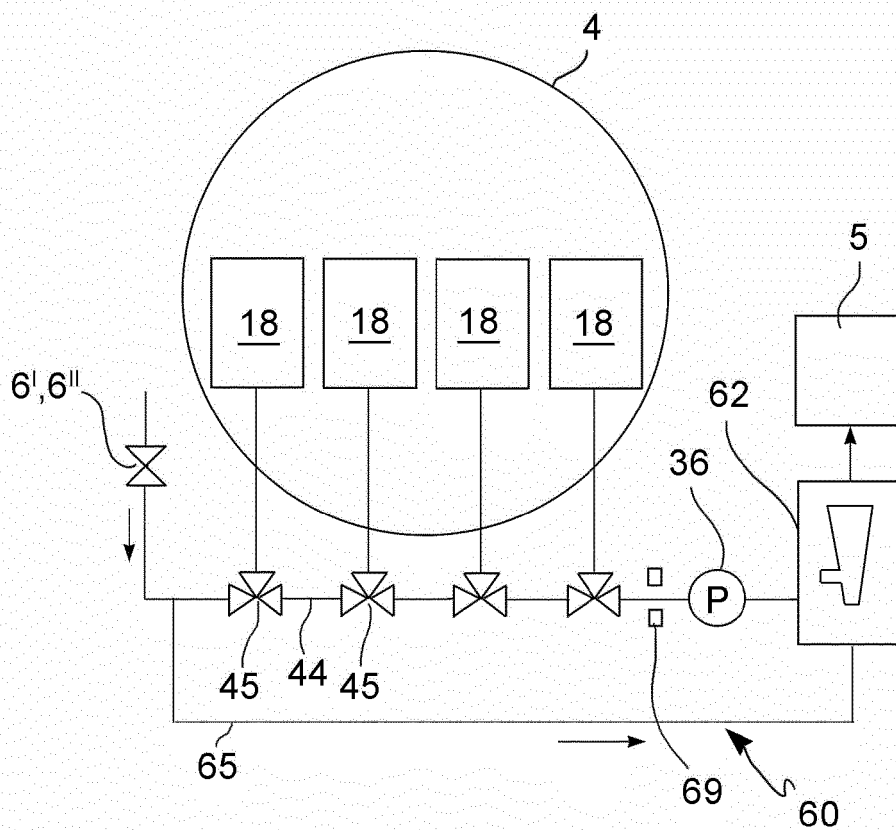


FIG. 9

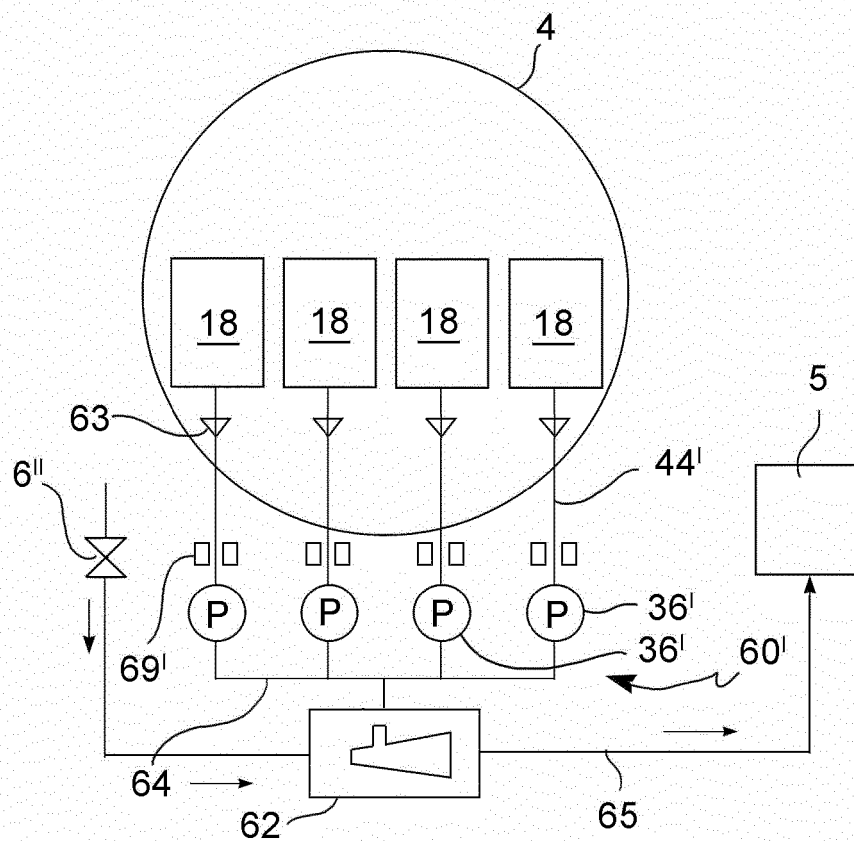


FIG. 10

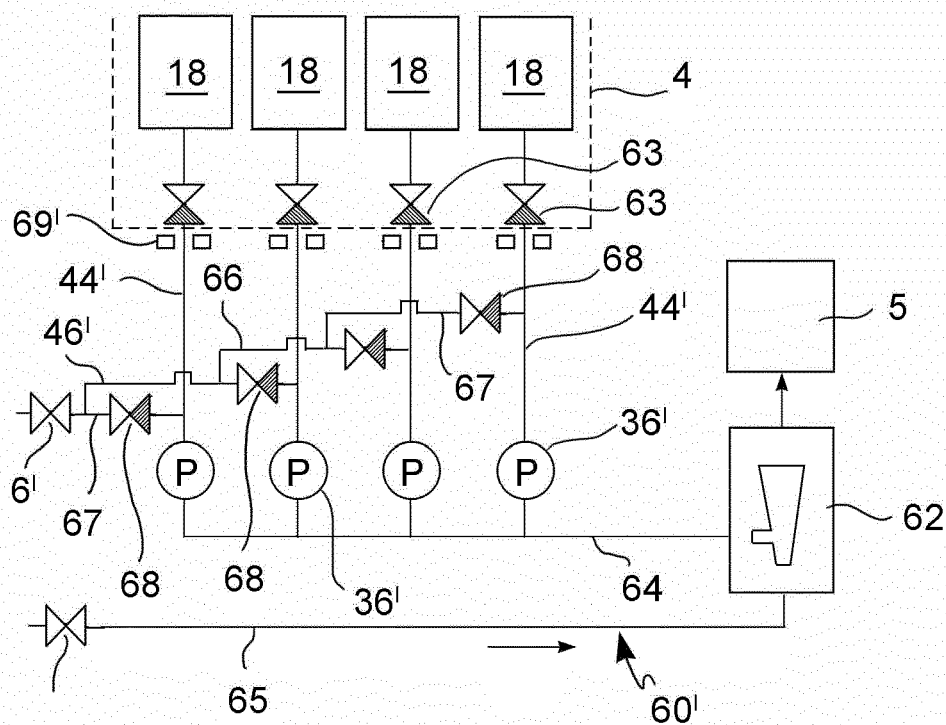


FIG. 11A

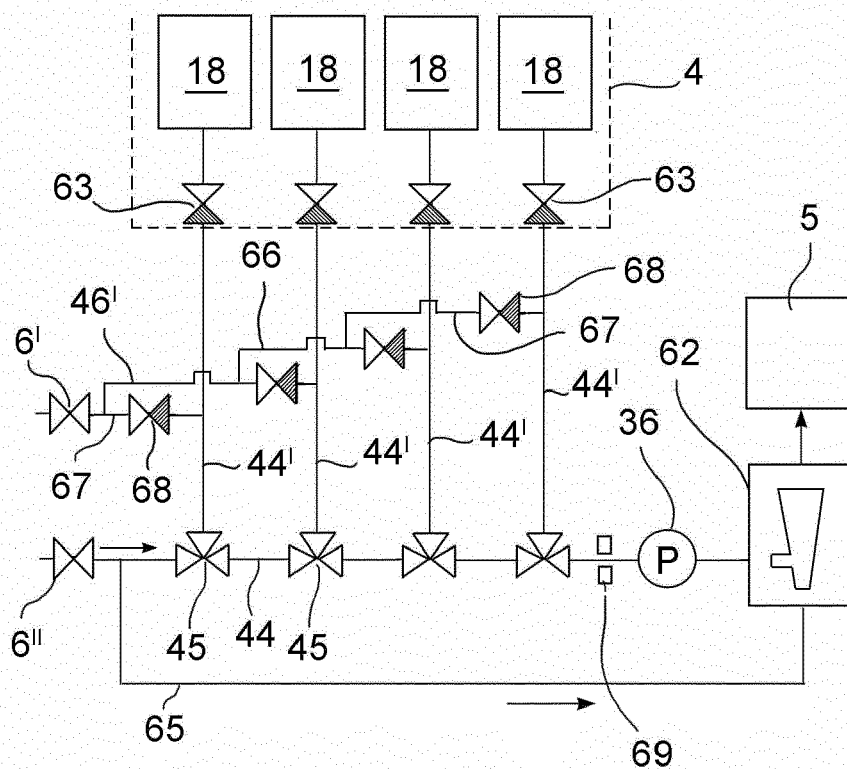
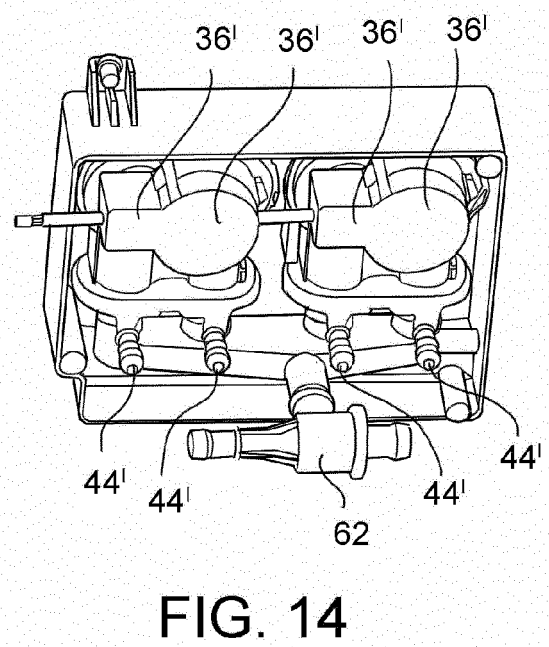
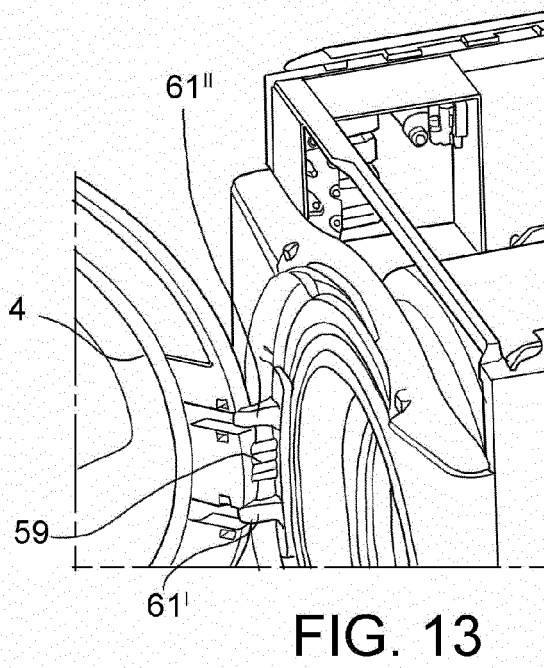
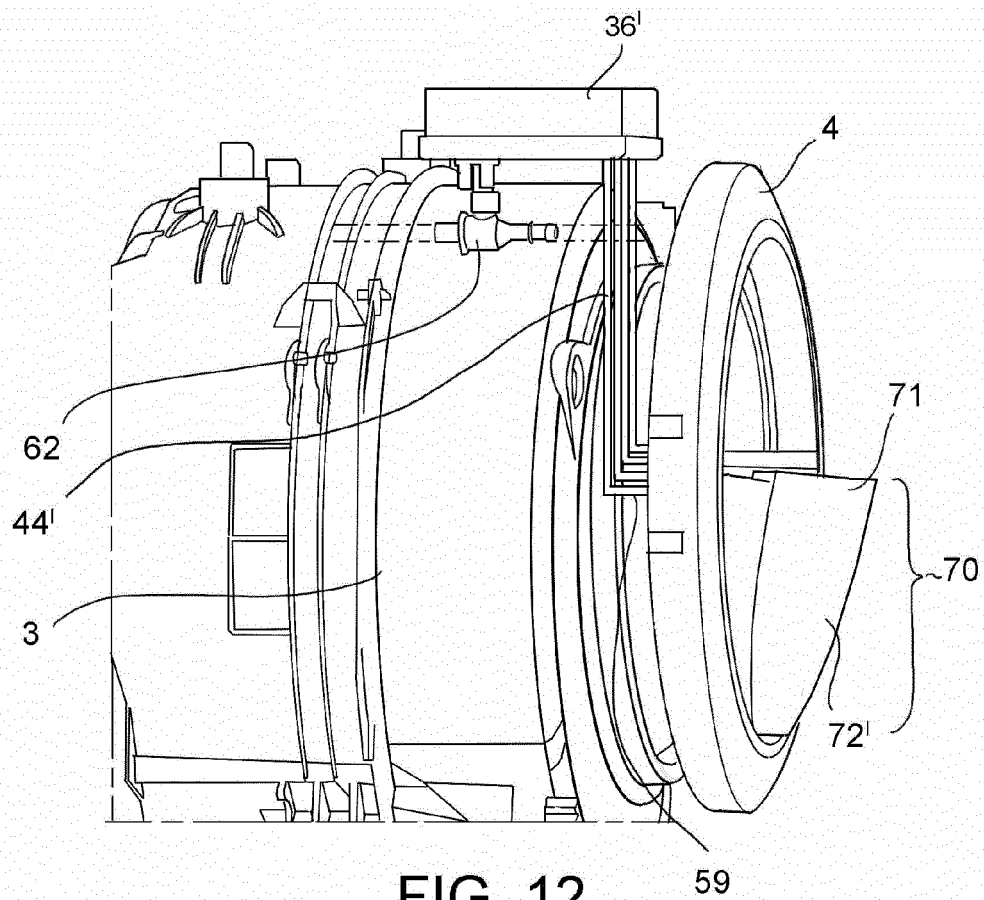


FIG. 11B



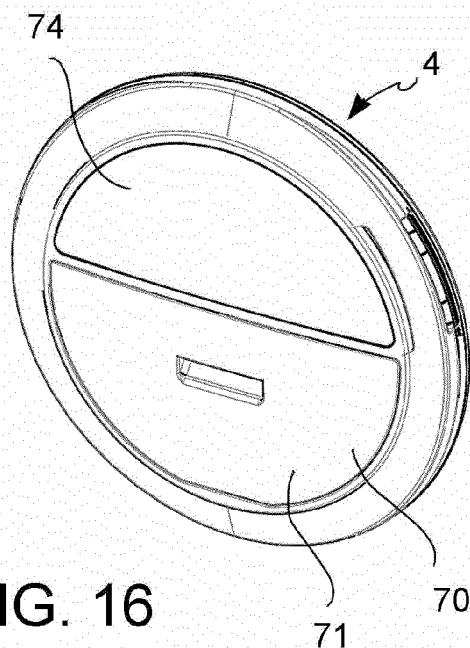


FIG. 16

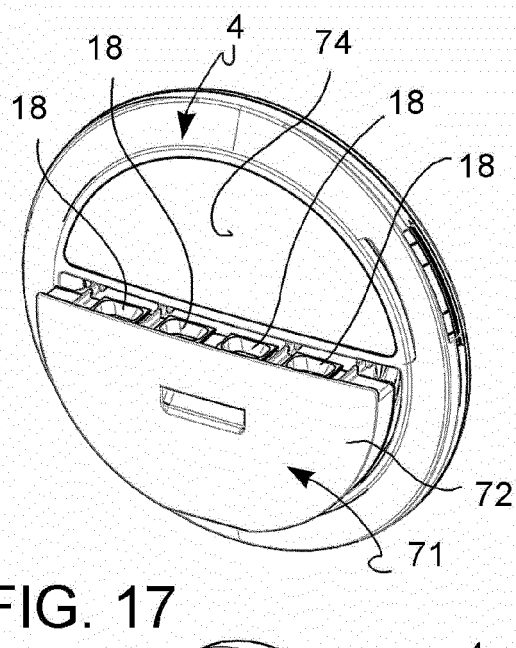


FIG. 17

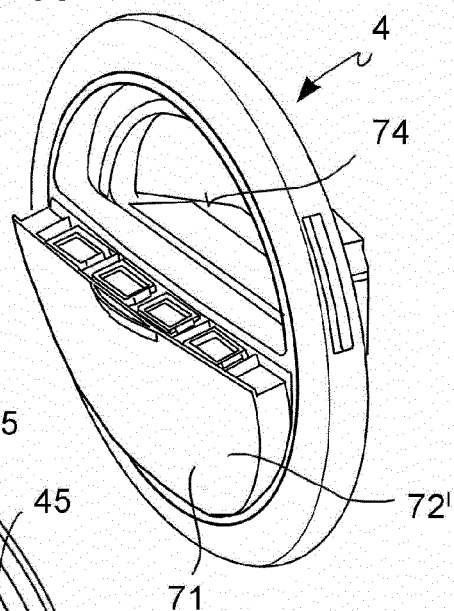


FIG. 18

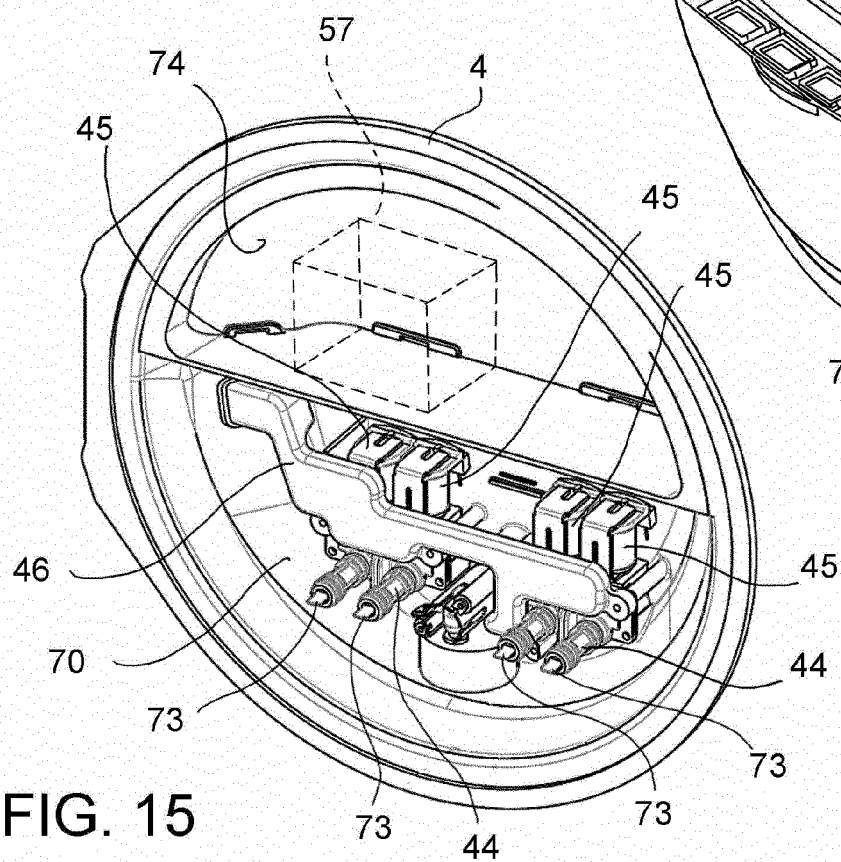


FIG. 15

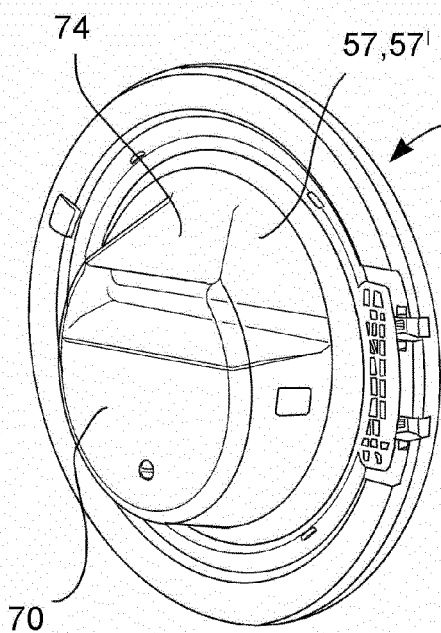


FIG. 19

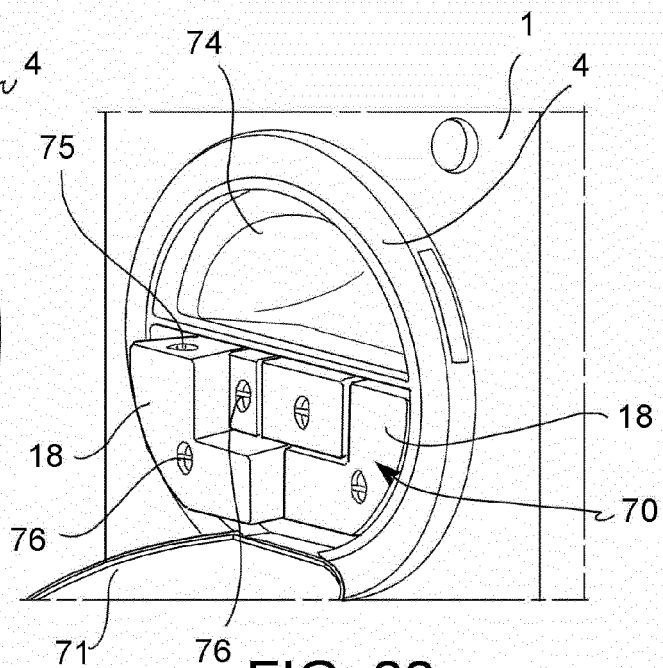


FIG. 22

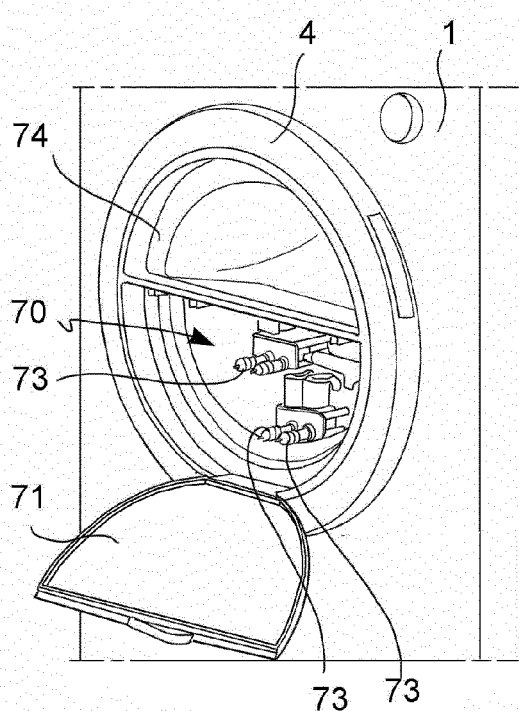


FIG. 20

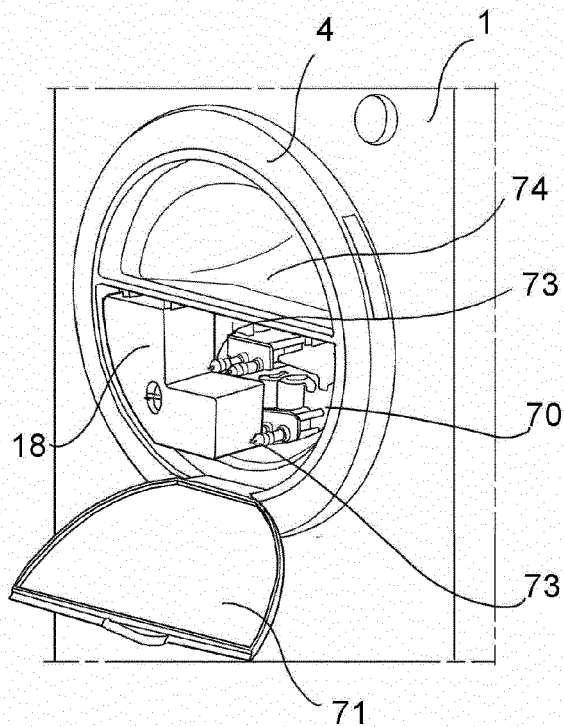


FIG. 21

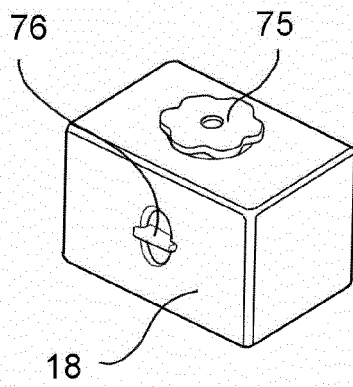


FIG. 24

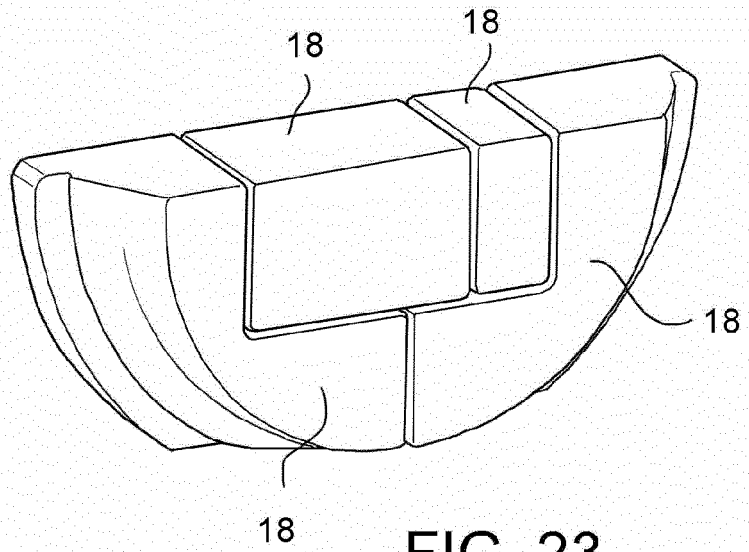


FIG. 23

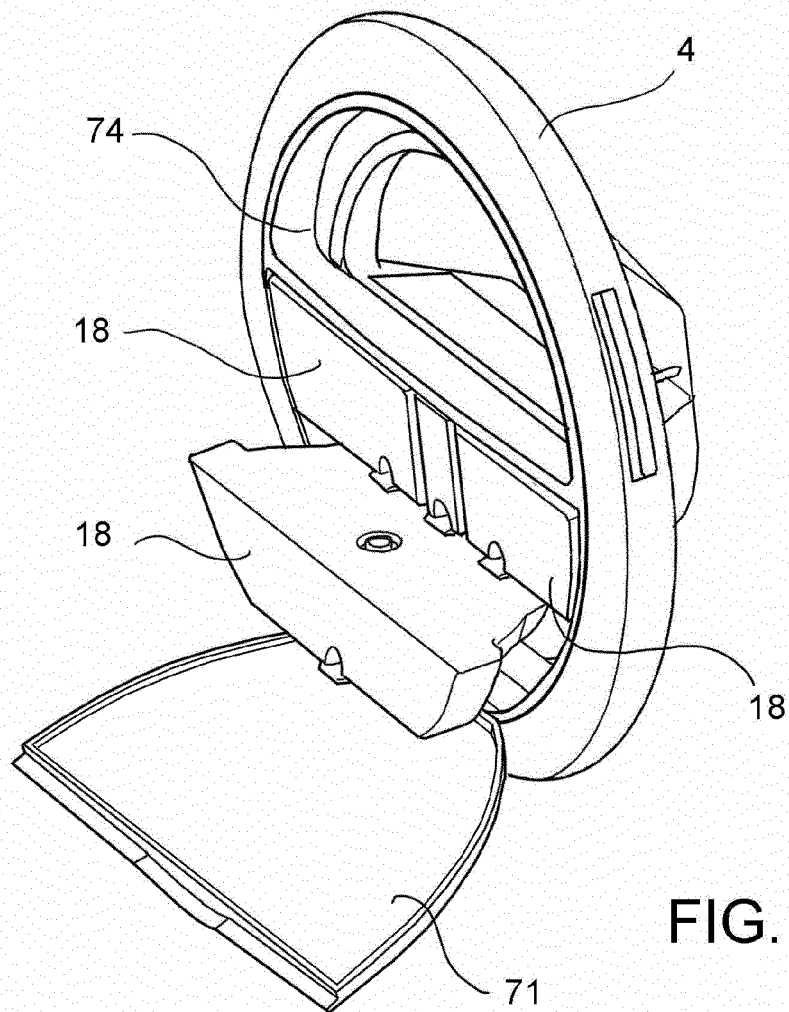


FIG. 25

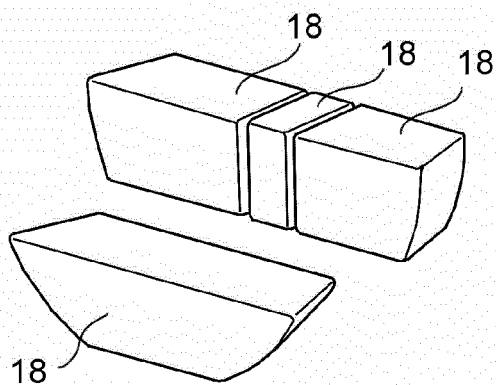


FIG. 26

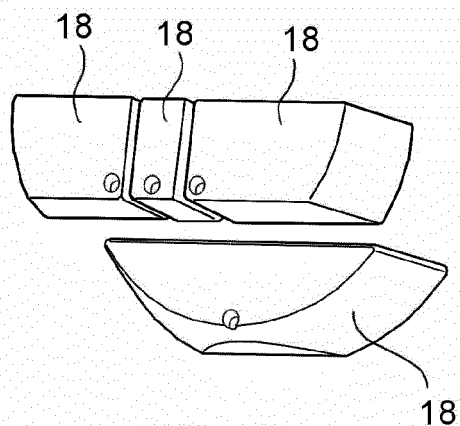


FIG. 27

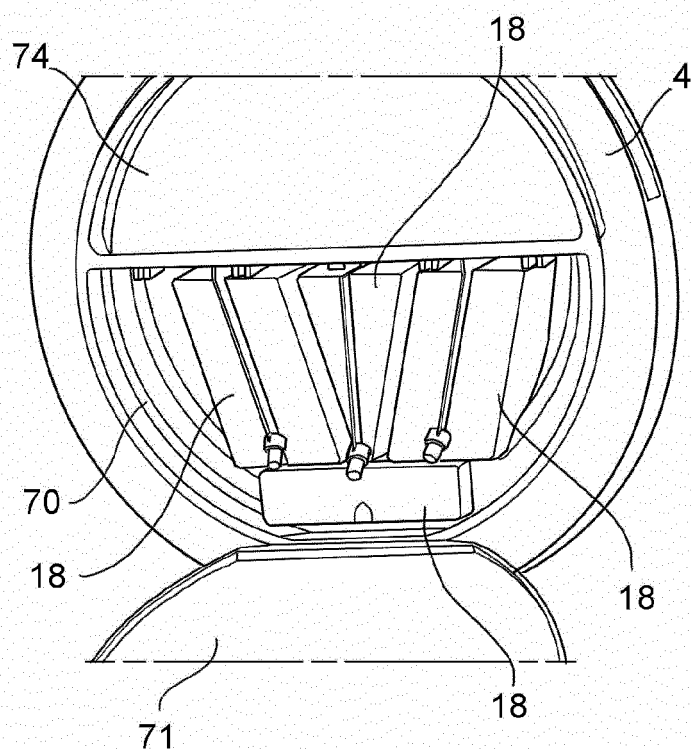


FIG. 28

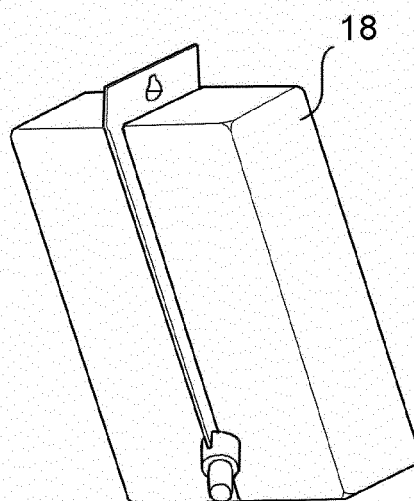


FIG. 29

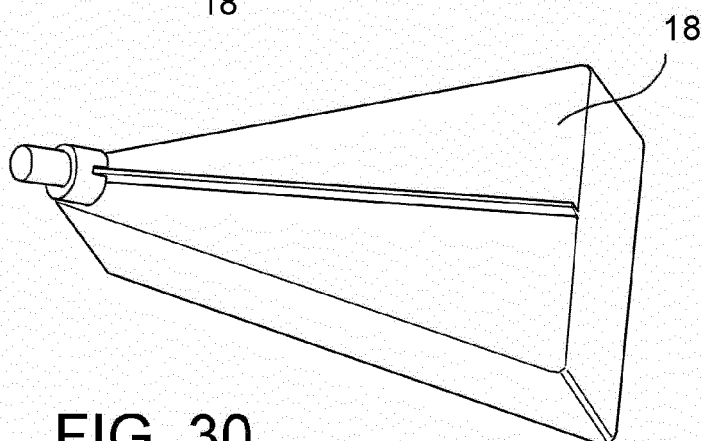


FIG. 30



## EUROPEAN SEARCH REPORT

 Application Number  
 EP 18 21 3640

5

10

15

20

25

30

35

40

45

50

55

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                               |                                                          |                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                 | Relevant to claim                                        | CLASSIFICATION OF THE APPLICATION (IPC) |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP 2 602 378 A1 (INDESIT CO SPA [IT])<br>12 June 2013 (2013-06-12)<br>* paragraphs [0052] - [0056]; figures *<br>-----        | 1,5,9,10                                                 | INV.<br>D06F39/02<br>D06F39/14          |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EP 2 743 393 A1 (INDESIT CO SPA [IT])<br>18 June 2014 (2014-06-18)<br>* paragraphs [0058] - [0061]; figures *<br>-----        | 1,5,9,10                                                 |                                         |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 2017/306551 A1 (KIM YOUNGWOO [KR] ET AL) 26 October 2017 (2017-10-26)<br>* paragraphs [0054] - [0057]; figure 2 *<br>----- | 1-14                                                     |                                         |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DE 10 2009 045580 A1 (HENKEL AG & CO KGAA [DE]) 14 April 2011 (2011-04-14)<br>* the whole document *<br>-----                 | 1-14                                                     |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                               |                                                          | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                               |                                                          | D06F                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                               |                                                          |                                         |
| Place of search<br><b>Munich</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                               | Date of completion of the search<br><b>27 March 2019</b> | Examiner<br><b>Stroppa, Giovanni</b>    |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                               |                                                          |                                         |

 3  
 EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 21 3640

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

27-03-2019

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| EP 2602378 A1                             | 12-06-2013          | EP 2602378 A1              | 12-06-2013          |
|                                           |                     | PL 2602378 T3              | 30-06-2017          |
| EP 2743393 A1                             | 18-06-2014          | NONE                       |                     |
| US 2017306551 A1                          | 26-10-2017          | CN 106715781 A             | 24-05-2017          |
|                                           |                     | EP 3202968 A1              | 09-08-2017          |
|                                           |                     | KR 20160038270 A           | 07-04-2016          |
|                                           |                     | US 2017306551 A1           | 26-10-2017          |
|                                           |                     | WO 2016052907 A1           | 07-04-2016          |
| DE 102009045580 A1                        | 14-04-2011          | DE 102009045580 A1         | 14-04-2011          |
|                                           |                     | EP 2452007 A1              | 16-05-2012          |
|                                           |                     | US 2012247158 A1           | 04-10-2012          |
|                                           |                     | WO 2011045108 A1           | 21-04-2011          |