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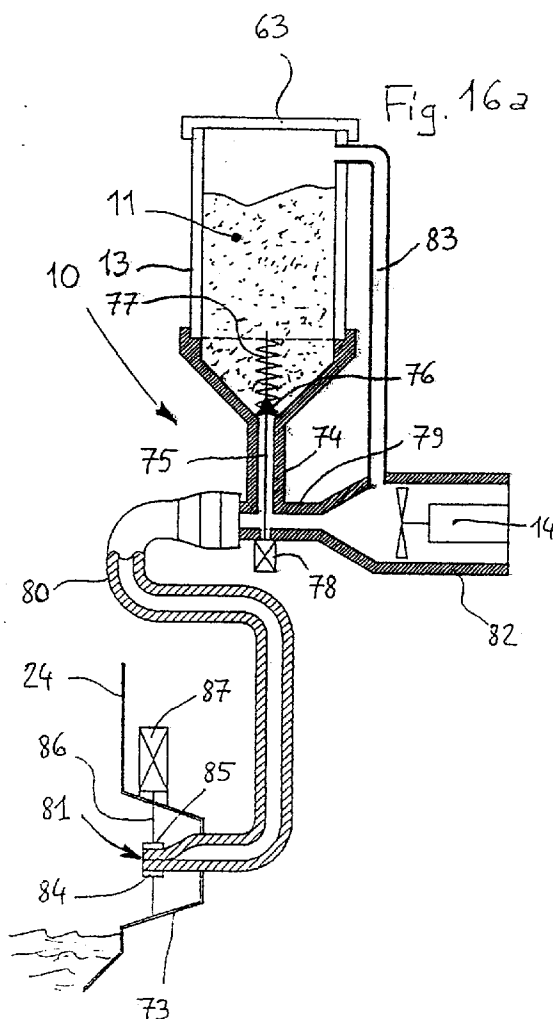
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(54) **Automatic powdered detergent dispensing and metering system for washing machines.**

(57) Automatic powdered detergent dispensing and metering system for washing machines, in particular dishwashing and clothes washing machines, comprising a reservoir (13) adapted to hold the powdered detergent (11), whose addition into the washing tank or tub (24 ; 681) of said machines occurs through a flow of air generated by pneumatic generator means (14, 46 ; 14) of a *per se* known type. The system comprises actuation means (16 ; 85) that may be embodied in a number of different ways, described in the patent specification, for determining the conveyance of the powdered detergent into the washing tank or tub (24 ; 681) when said pneumatic generator means (14, 46 ; 14) are operating.



The present invention relates to an automatic powdered detergent dispensing and metering system for washing machines, in particular dishwashing machines and clothes washing machines, comprising substantially the features described in the main claim appended hereto, this automatic powdered detergent dispensing and metering system being installed in the above cited washing machines in order to enable the powdered detergent contained in an appropriately provided reservoir to be metered and dispensed.

A powdered detergent metering and dispensing apparatus for washing machines of the above cited kind is known from EP-A-0217209, in which the detergent contained in a reservoir is supplied by gravity through a metering funnel which is closed on its lower side by a metering plate.

Such apparatus is operated by displacing said metering plate axially by means of an actuating shaft connected thereto.

In an embodiment according to such a solution, the reservoir must necessarily be located anywhere in the upper portion of the washing machine, where no means are provided to effectively prevent vapours being present in the machine from getting into contact with the detergent contained in the related holding reservoir, with a resulting formation of clots of detergent that may obstruct the passage through the metering funnel. Furthermore, the grains or particles of detergent that are compressed between the periphery of the metering funnel and the top surface of the metering plate may in the long run cause the sealing effect between said two elements to be reduced.

According to a solution disclosed in FR-A-2593697, the powdered detergent is contained in a reservoir featuring in its lower portion a screw feeder supplying a feeding chamber that is tightly closed by a lid.

Detergent dispensing into the washing tub of the washing machine occurs by operating said screw feeder and opening said lid for a time that is proportionate to the amount of detergent to be dispensed. This system inevitably requires the reservoir to be situated in a higher position, ie. at a higher level, with respect to said washing tub of the washing machine. Furthermore, said screw feeder may become obstructed or even jammed, in the following dispensing operations, due to clots of powdered detergent forming due to contact with vapours or water splashes that may penetrate the feeding chamber during a detergent dispensing operation.

Now, all such systems seem to involve drawbacks connected to the fact that the powdered detergent is delivered by means of mechanical-type conveyance systems that are implemented with the use of means in which moving mechanical parts are present, which are subject to considerable wear owing to the kind of powder they are required to handle and convey, as well as to tendency of such powder to easi-

ly become clotted.

Furthermore, no means are provided in the proposed systems, which may be effective in preventing the powdered detergent from getting clotted when the latter happens to contain moisture to an excessive extent.

As a consequence, powdered detergent metering and dispensing systems of this kind may be considered as not being very reliable and, therefore, are not used very widely.

It has further to be considered that modern environment-friendly powdered detergent products being marketed today actually require to be kept at storage temperatures that may not exceed approx. 40°C in order to prevent their properties from being spoiled, so that they practically cannot be used in washing machines in which the reservoir provided to hold such detergents is directly exposed to splashes of hot water that heat up its walls to temperatures that may be as high as approx. 60 to 65°C.

It is therefore the purpose of the present invention to overcome all afore cited drawbacks by providing an automatic powdered detergent metering and dispensing system for washing machines, which is capable of adding in an effective way appropriately metered amounts of powdered detergents into environments with a particularly high moisture content, such as for instance the washing tub of clothes washing machines or the washing tank of dishwashing machines.

Such an automatic metering and dispensing system is implemented with the substantially described construction features, with particular reference to the appended claims.

In order that the present invention may more readily be understood, the following description is given, merely by way of non-limiting example, reference being made to the accompanying drawings in which:

- Figure 1 is a perspective view of a dishwashing machine equipped with the powdered detergent dispensing and metering apparatus according to the present invention;
- Figure 2 is a schematical view of a first embodiment of the powdered detergent dispensing and metering apparatus according to the present invention;
- Figure 3 is a schematical view of a variant of the powdered detergent dispensing and metering apparatus embodiment appearing in Figure 2, shown in the phase in which it is dispensing the detergent;
- Figure 4a is a schematical view of the detail showing the connection of the powdered detergent dispensing and metering apparatus according to the present invention, as shown in the phase in which it is not dispensing any detergent, with the reservoir holding the detergent;
- Figure 4b is a view of the dispensing and me-

- tering apparatus appearing in Figure 4a, as shown when it is dispensing detergent;
- Figure 4c is a view of the dispensing and metering apparatus appearing in Figure 4a, as shown with the associated detergent holding reservoir which is partially pulled out; 5
 - Figure 5 is a front view of the inner wall of the door of a dishwashing machine, which is equipped with a detergent dispensing and metering apparatus according to the present invention; 10
 - Figures 6a and 6b are sectional views taken along the A-A line of the apparatus shown in Figure 5, in its resting and detergent dispensing positions, respectively;
 - Figure 7 is a view of a detail of a variant of the embodiment shown in Figure 4b; 15
 - Figure 8 is a view of a variant of the detail shown in Figure 7;
 - Figure 9 is a schematical view through a longitudinal section of a further embodiment of the reservoir according to the present invention; 20
 - Figure 10 is a cross-sectional view along the B-B line of the reservoir shown in Figure 9;
 - Figure 11 is a view of a variant of the reservoir shown in Figure 9; 25
 - Figures 12a and 12b are views, to an enlarged scale, of two possible sections along the C-C line of the reservoir shown in Figure 11;
 - Figure 13 is a perspective view of a clothes washing machine equipped with the powdered detergent dispensing and metering apparatus according to the present invention; 30
 - Figure 14 is a view of a variant of the machine shown in Figure 13;
 - Figure 15a is a schematical view of the detail of the connection of the dispensing and metering apparatus according to the invention, as shown in its resting position, ie. when it is not dispensing any detergent, with the detergent holding reservoir; 35
 - Figure 15b is a view showing the apparatus appearing in Figure 15a, however when it is dispensing detergent; 40
 - Figure 15c is a view showing the dispensing and metering apparatus appearing in Figure 15a, as shown with the associated detergent holding reservoir in a partially pulled out position; 45
 - Figures 16a and 16b are schematical views of a still further embodiment of the detergent dispensing and metering apparatus according to the present invention, as installed in a certain type of washing machine and displaced into two different operational positions, respectively; 50
 - Figures 17a and 17b are schematical views of a still further embodiment of the detergent dispensing and metering apparatus according to 55

the present invention, as installed in the same type of washing machine as shown in Figures 16a and 16b, but displaced into two different operational positions, respectively;

- Figures 18a and 18b are schematical views of a detail of the detergent dispensing and metering apparatus shown in Figures 16a and 16b, as displaced into two different operational positions, respectively;
- Figures 19 and 20 are schematical views of still further embodiments of the detergent dispensing and metering apparatus according to the present invention;
- Figure 21 is a schematical view of a detergent dispensing and metering apparatus according to the present invention, as installed in another type of washing machine;
- Figures 22 and 23 are perspective views showing schematically a detergent dispensing and metering apparatus according to the present invention, as applied in a different way to two different types of washing machines.

With reference to the accompanying Figures, it can be noticed that the reference numeral 10 is used to generally indicate an automatic system for dispensing and metering powdered detergent 11 according to the present invention, to be used in conjunction with washing machines and, particularly, a household-type dishwashing machine as shown in the Figures 1-12, 16, 17, 18-20 and 22, and a household-type clothes washing machine as shown in the Figures 13-15, 21 and 23.

Turning now to the Figures from 1 to 12, they are shown to schematically illustrate the automatic system 10 according to the invention for dispensing and metering powdered detergent 11, as installed in a dishwashing machine 12 provided with a pull-out type of detergent holding reservoir 13, the latter being provided with a cap 63 to enable the detergent to be filled in.

Such detergent holding reservoir 13 is in an advantageous manner removably installed in a seat 25 that is provided between the door 52 and the inner door liner 53 of the dishwashing machine 12, said seat 25 being advantageously provided with sealing means consisting, in this particular case, of a rubber gasket 64 arranged along the periphery of the same seat and co-operating with the closure wall 67 of the reservoir 13. The positioning of the reservoir 13 inside said seat 25 is ensured by locking and positioning means 58.

In the particular case being considered here, these locking and positioning means 58 are constituted by at least a magnet 59 attached to a wall of said seat 25 and co-operating with a small ferromagnetic plate 60 attached to said reservoir 13.

In a first preferred embodiment of the present invention, the powdered detergent dispensing and me-

tering system 10 according to the present invention comprises a fan unit 14, such as formed for instance by a turbo-fan, a turbo-blower or a small compressor driven by an electric motor 15, the delivery conduit 18 of which is associated to an ejector 16.

The suction conduit connected with said ejector 16 is constituted by an extraction conduit 17 that is connected with said detergent holding reservoir 13.

The bottom of said detergent holding reservoir 13 may in an advantageous manner be equipped with appropriate dispensing means 49 that are adapted to ensure a substantially uniform suction effect throughout said reservoir 13, so as to avoid preferential suction channels forming inside the mass of detergent 11. Said dispensing means 49 are made up by a channel 50 extending inside the reservoir 13 and connected with the same reservoir through a plurality of appropriately arranged and sized passages 51, in the case shown in Figures 7 and 8, or through a longitudinal screw feeder arrangement 53, associated with a motor 54 and situated on the bottom of said reservoir 13, in the case illustrated in Figures 9 and 10.

Said motor 54 is operated at the same time that appropriate shut-off means 20 are switched open, so as to ensure a substantially uniform unloading of the detergent from said reservoir 13 along with a substantially constant flow rate of the powdered detergent 11. In a further variant illustrated in Figures 11 and 12, said dispensing means 49 are constituted by a plurality of small-sized hoppers 55 which are arranged on the bottom of said reservoir 13 and unload the powdered detergent 11 into said extraction conduit 17, said hoppers 55 being so shaped, sized and arranged as to be able to ensure that detergent unloading takes place in a substantially uniform way throughout the reservoir 13. Such hoppers 55 may for instance have a crescent-like (Figure 12a) or linear (Figure 12b) shape, or they may have any other shape that proves to be suitable to the application.

The outlet opening of said hoppers 55 is appropriately separated by a distance "S" from the bottom of the extraction conduit 17 so as to ensure a regular flow of the detergent 11. The air stream delivered by the fan unit 14 passes through the Venturi tube 21 of the ejector 16, thereby bringing about a negative pressure in the suction chamber 22 of said ejector 16, which in turn causes a flow of air and powdered detergent 11 to be sucked and extracted, through said extraction conduit 17, from the detergent holding reservoir 13. The delivery pipe 18 of the fan unit 14 is in an advantageous way associated with heating means 19, such as for instance of the electric resistance or thermistor type, which are used to heat up said air stream in view of drying the conduits situated downstream thereof.

The extraction conduit 17 is provided with shut-off means 20, which are for instance formed by a valve of the sealing lip type (see Figure 8) or a conical

needle valve (see Figures 2 and 3) or any other type of valve that may prove suitable to the particular application. In the case considered here, such valves 20 are of the electrically actuated type.

The delivery conduit 23 coming out of the ejector 16 is in turn connected to the washing tank 24 of the dishwashing machine 12 and is provided in correspondence of its end portion a unidirectional or one-way valve 26, for instance of the conical, elastically biased needle type (Figure 2) or of the flap type (Figures 3 and 6), said unidirectional valve being effective in preventing vapours and water splashes from passing from the washing tank 24 into the delivery conduit 23 and reaching the devices that are situated upstream thereof, thereby avoiding any formation of detergent clots.

In order to ensure an adequate air flow rate from outside in view of a correct operation of the dispensing and metering apparatus 10 according to the present invention, the reservoir 13 is provided with an opening 27 that is connected with the ambient and acts as an air intake provision.

Said air intake opening 27 is associated with air dehumidifying means 28, which in this case may be formed by a filter 29, most advantageously of the regenerative type.

In the case considered herein, such filter 29 is provided with drying means 30 for the absorbing material. By heating up this absorbing material after each operation cycle, for instance with electric resistance-type heating means 31, such drying means are therefore able to restore said material to its original state, thereby ensuring a constant efficiency of the dehumidifying treatment.

According to a variant thereof, the air intake opening 27 is also associated with a unidirectional or one-way valve 44 which is effective in preventing an excessive amount of air from being let into said detergent holding reservoir 13, said unidirectional valve 44 being actuated automatically by the negative pressure that is created inside the detergent holding reservoir 13 during the dispensing phase of the powdered detergent 11.

The operation cycle of the powdered detergent dispensing and metering system 10 according to the present invention comprises following phases:

- energization of the fan unit 14 and the heating means 19 for the delivery air, which therefore start to deliver a flow of hot air for a pre-determined period of time in order to flush the conduits 18 and 23 and the ejector 16 clean and, at the same time, dry them up;
- opening of the shut-off means 20 of the extraction conduit 17 of the detergent 11 which is delivered into the washing tank 24 of the dishwashing machine 10; the duration of this phase is adjustable according to the desired amount of detergent that has to be metered into the

washing tank. During this phase, the air inside the reservoir 13 is restored, through the air intake 27, by a stream of outside air after appropriate drying through said dehumidifying provision 28;

- shutting of said shut-off means 20 which therefore interrupt dispensing of the powdered detergent 11;
- blowing-in of hot air alone in order to flush clean and dry up completely both the conduits 18 and 23 and the ejector 16;
- de-energization of the fan unit 14;
- energization of the regeneration device 30 of the dehumidifier filter 29 for a pre-determined length of time so as to enable the dehumidifying material to be dried up.

A control unit 32 is in an advantageous manner associated to the powdered detergent dispensing and metering system 10 according to the present invention, so as to appropriately switch the valves 20 open and closed, to appropriately switch on and off both the fan unit 14 and the heating means 19, as well as the drying means 30. In the herein considered case, the user is able to select the desired amount of detergent to be metered by means of the same button or knob 33 which is provided on the control/panel of the dishwashing machine 12 for the selection of the washing programme. In the case illustrated in Figures 1, 2 and 5, the detergent holding reservoir 13 is of the pull-out drawer type and is provided (see Figures 1, 2) with a level indicating provision 34 of the optical type.

Such a visual-type level indicator 34 may also be constituted by a piezo-ceramic ultrasound sensor connected to appropriate indicating means.

A second preferred embodiment of the automatic powdered detergent dispensing and metering system 10 according to the present invention is illustrated schematically in Figures 2, 7 and 8. In this case, the air stream carrying the powdered detergent 11 is generated by a suction fan unit 46 made up by an impeller 47 driven by a motor 48, said suction fan unit being built directly inside the conduit through which said air stream flows carrying the detergent 11 in suspension therewith, in an intermediate position between the suction chamber 22 and the delivery conduit 23.

In order to enable it to adequately withstand the abrasion brought about by said stream of air and powdered detergent, the motor 48 will be protected in any appropriate way, while the impeller 47 will be made of any abrasion-resistant material that may be suitable for the application. In the embodiment illustrated in Figure 8, only the impeller 47 is arranged inside the conduit, whereas the motor 48 is located outside the conduits 17, 23 through which the air and detergent stream is supposed to flow, and does not therefore require any special protection.

According to a variant thereto, in order to avoid that an excessive temperature of the reservoir 13

may in some way spoil the powdered detergent 11 contained therein, said detergent holding reservoir 13 is enclosed by an air jacket 43 in which a stream of cold air is circulated temporarily, said air stream being in this particular case generated by said fan unit 14 through a cooling air conduit 45 connected with the suction chamber of the ejector 16.

In this case, said fan unit 14 is operated automatically by a temperature sensing element, such as a thermostat 61, when the temperature of the powdered detergent 11 contained in said reservoir 13 rises above a pre-set temperature threshold.

In the case of a reservoir 13 of the pull-out or drawer type (see Figure 4), this is provided with a shut-off valve 39 associated to the outlet opening 40 for the powdered detergent 11, so as to prevent said powdered detergent 11 to flow out when said drawer-like or pan-like reservoir 13 is pulled out of its seat 25, for instance to re-fill detergent into it.

Such a shut-off valve 39 is kept in its shut position as long as said drawer-like or pan-like reservoir 13 is pulled out of its seat in the dishwashing machine 12 (Figure 4c), while it is returned in its opening position as soon as the same reservoir is pushed again in its seat in the dishwashing machine 12 (Figures 4a, 4b).

In the particular embodiments illustrated in Figures 4 and 7, said shut-off valve 39 coincides with, ie. is the same as the shut-off means 20 that are provided to control the inflow of detergent 11 into the suction chamber 22. According to different embodiments, said shut-off valve 39 and said shut-off means 20 are on the contrary distinct from each other.

In the case considered here, said shut-off valve 39 is of the conical needle type, which is biased elastically by a spring 41 to close the outlet opening 40. When pushing the drawer-like or pan-like detergent holding reservoir 13 into its seat in the dishwashing machine 12, the extraction conduit 17 is brought to co-operate with the outlet opening 40, thereby enabling an actuating rod 42, which is associated with said extraction conduit 17, to co-operate in turn with said shut-off valve 39 so as to open it.

In the herein considered case, said actuating rod 42 is operated by an actuator 54 and is provided, in an intermediate position, with a closing plate 55 capable of temporarily co-operating with a connecting orifice 56 that connects said air jacket 43 with the suction chamber 22 of the detergent dispensing and metering apparatus 10 according to the invention. According to its position, the shut-off valve 39 therefore connects either the air jacket 43 or the reservoir 13 with the suction chamber 22 of said powdered detergent dispensing and metering apparatus 10 according to the invention.

In particular, in the phase in which the powdered detergent 11 is being dispensed, said actuator 54 is positioned in such a way as to enable the actuating rod 42 to keep said shut-off valve 39 open, with said

closing plate 55 so positioned as to close the connecting orifice 56 (Figures 4 and 7). In the phase in which the detergent reservoir 13 is cooled down, as well as in the phase in which hot air is blown in, the actuator 54 is positioned so that the actuating rod 42 is disengaged from the shut-off valve 39, with said closing plate 55 so positioned as to let said connecting orifice 56 free, ie. unobstructed (Figures 2 and 4a).

In the dishwashing machine illustrated in Figure 1, the fan unit 14 is shown to be installed inside a sound-proofing cage-like housing 35 so as to minimize the noise generated by said fan unit 14 when it is operating. According to a variant thereto (Figure 4), the pull-out type detergent reservoir 13 is associated with switch means 62 that are arranged to only close the power supply circuit to the dishwashing machine 12, ie. establish the power supply to said dishwashing machine, when said reservoir 13 is in its correct working position, ie. correctly introduced in its seat 25. In this way, the operation of the dishwashing machine 12 is interrupted automatically when the detergent reservoir 13 is pulled out for any reason, so as to prevent water splashes from hitting and damaging the devices and the conduits included in the detergent dispensing and metering system 10 according to the present invention.

According to a variant illustrated in Figures 2 and 6, the detergent dispensing and metering system 10 in question is integrated with a rinsing aid dispensing device 57 of some traditional type. In such a case, said rinsing aid dispensing device 57 comprises an auxiliary reservoir 36 with a dispensing opening 37 and a rinsing-aid level indicator 38.

In the particular case shown in Figures 5 and 6, said auxiliary reservoir 36 is accommodated inside the same seat 25 that houses the pull-out type reservoir 13 containing the powdered detergent 11.

Turning now to the Figures 13 through to 15, the automatic detergent dispensing and metering system 10 being considered here is shown schematically to be installed in a clothes washing machine 68. It is provided with a detergent holding reservoir 13 having a cap 63 to enable it to be filled, and it is preferably made of the pull-out drawer-like type.

As in the previously considered cases, also this clothes washing machine is equipped with a fan unit 14 driven by an electric motor 15, the delivery pipe 18 of which is associated with an ejector 16, and is further provided with distribution means 49, all these component parts being made in the same way and to the same operational purposes as described in connection with the previously discussed cases.

Additionally, in this case the delivery conduit 23 coming out of the ejector 16 is connected to the outer stationary drum 681 containing the revolving drum 691, whereas the user can select the desired amount of detergent to be metered by means the same button or knob 33 provided on the control panel of the wash-

ing machine 68 for the selection of the washing programme.

In the case of a reservoir 13 of a pull-out type (see Figure 15), the latter is provided with a shut-off valve 39 associated with the outlet opening 40 for the powdered detergent 11, this valve being instrumental in preventing said powdered detergent 11 from flowing out therethrough when the drawer-like reservoir 13 is pulled out for any reason, such as for instance for re-filling. Such a shut-off valve 39 stays in its shutting position when the drawer-like reservoir 13 is pulled out of its seat in the washing machine 68 (Figure 15c), while it sets back to its opening position when said reservoir is pushed again in its seat in the washing machine 68 (Figures 15a, 15b).

In the particular case being considered here, said shut-off valve 39 is of the conical needle type which is elastically biased by a spring 41 to close the outlet opening 40. When the drawer-like reservoir 13 is introduced in its seat in the washing machine 68, the extraction conduit 17 is inserted in correspondence of the outlet opening 40, thereby causing a projection 70, which is provided in the end portion of said extraction conduit 17, to co-operate with said shut-off valve 39 so as to actuate it into opening position.

In the clothes washing machine illustrated in Figure 13, the fan unit 14 is shown to be installed inside a sound-deadening cage-like enclosure 35 so as to minimize the noise generated by said fan unit 14 during operation. The clothes washing machine illustrated in Figure 14 is provided, in its upper portion, with two auxiliary reservoirs 36 of the pull-out drawer type, the first one 36a of said reservoirs being adapted to contain the bleaching agent and the second one 36b of said reservoirs being adapted to contain a fabric conditioner.

In the particular case being considered here, with said auxiliary reservoirs 36 there are associated dispensing valves 71 which are operated automatically to dispense, in the case of a gravity dispensing arrangement, the respective liquid laundering aids through an inlet conduit 72.

With reference to the remaining Figures in the accompanying drawings, they are shown to illustrate further possible embodiments of the automatic dispensing and metering system 10 for powdered detergent 11 according to the present invention as applied to washing machines and, in particular to a household-type dishwashing machine as illustrated in the Figures 16, 17, 18-20 and 22, as well as a household-type clothes washing machine illustrated in Figures 21 and 23.

Referring now to Figures 16a and 16b, it can be noticed that the household-type dishwashing machine is provided with a washing tank 24 (only shown in part in said Figures), which is shaped so as to feature a housing 73 protruding sideways therefrom. Said tank is shown to be further provided with a de-

tergent holding reservoir 13 which is extractably housed in the same tank and is capable of being opened and closed by means of a cap 63 on top thereof so as to enable it to be filled with powdered detergent of the traditional type.

Such a reservoir 13, which in an advantageous way is shown to be situated in an upper position with respect to the position of the washing tank, is in an appropriate manner given a hopper-like shape with a downward taper and joins with a conduit 74 having a reduced cross-section area and extending downwards, in which the rectilinear rod 75 of a valve means provided to shut-off the outlet port of the conduit 74 is slidably and vertically housed, such a valve means being for instance constituted by a conical needle valve 76 of some soft material such as rubber or the like, attached to the upper end of said rod 75 and biased by a compression spring 77 or similar elastic means into an operational position against the mouth of the conduit 74, so as to prevent in this way the powdered detergent from passing through said conduit.

In turn, said rod 75 is connected at its lower end with an electromagnetic valve 78, or similar actuation means, such as for instance an electromagnetic actuator or a driving motor, capable of bringing about the required displacement of said rod 75 and, as a consequence, of the conical needle valve 76 against the action of the compression spring 77, from a resting position in which the electromagnetic valve is de-energized and the valve 76 is displaced by the action of the spring 77 against the mouth of the conduit 74, as it can be seen in Figure 16a, thereby obstructing its outlet port and preventing the powdered detergent from passing through such a conduit, to a working position in which said electromagnetic valve is energized and the valve 76 is displaced into a raised position with respect to the mouth of the conduit 74, thereby compressing the spring 77, as shown in Figure 16b, and enabling therefore the powdered detergent to pass through said conduit 74. In such a way, by appropriately regulating the energization times of the electromagnetic valve 78, it is possible to keep the conical needle valve 76 in its working, ie. open position for pre-determined periods of time adapted to enable pre-determined amounts of powdered detergent to be metered into the washing tank of the machine according to actual process needs, in the way that will be described further on.

It will of course be appreciated that the control of the detergent dispensing and metering process can be implemented and performed also with criteria and operational means that are different from the ones that have been described above by mere way of illustrative examples, as long as the desired effect, ie. the conveyance of the detergent into the washing tank of the machine, is in any case and by all means achieved without departing from the scope of the present invention.

The conduit 74 is furthermore communicating with a further conduit 79 that intersects it almost orthogonally and that is in turn connected, on one of its sides, with the end portion of a flexible conduit 80 of some appropriate elastic material, such as for instance silicone rubber of a very low hardness, the other end portion of which being tightly fitted into a corresponding opening (not shown) in the lateral housing 73 of the washing tank 24, penetrating to a certain depth with its open end portion 81 into said housing, and on the other one of its sides with a pneumatic source, such as for instance a motor-driven fan 14, a blower or other similar means capable of generating a flow of air under pressure, such a means being in the case in question housed in an enlarged conduit portion 82 connected with the conduit 79, although it may be of course arranged in any other appropriate position to perform its function of pneumatic generator. Such a pneumatic source being considered here is furthermore communicating also with the inside of the detergent holding reservoir 13 through a further conduit 83 having a reduced cross-section area, which in the particular case considered here is connected between said enlarged conduit portion 82 and the upper portion of said reservoir 13, in the zone which is not occupied by powdered detergent, in view of effectively bringing the pressure of the air generated by the motor-driven fan 14 into a balance with the air existing inside the reservoir, so as to ensure a constant, even and satisfactory detergent dispensing and metering effect.

In turn, the open end portion 81 of the flexible conduit 80 is resting externally, on one side, on a plane support 84 located in the housing 73, and, on the opposite side, is intercepted by an appropriate mechanical squeezing element 85 acting against the external surface of the same portion and connected with a linearly sliding stem 86 appropriately provided in the housing 73 and actuated by an electromechanical actuator, an electromagnetic valve, a motor or some other similar actuation means connected therewith (as indicated by the reference numeral 87 in the drawings) to be able to be displaced into two different operational positions, ie. from a position (that can be seen in Figure 16a) in which the actuator 87 is not energized and the squeezing element 85 is therefore compressed against the external surface of said end portion 81, so that the latter undergoes temporarily an elastic deformation and, as a consequence thereof, keeps the outlet port of the flexible conduit 80 closed, thereby preventing both the powdered detergent from being released into the washing tank and the humidity from the washing tank from penetrating into the conduit 80, to a position (that can be seen in Figure 16b) in which the actuator 87 is on the contrary energized and the squeezing element 85 is therefore completely raised from the external surface of said end portion 81, so that the latter is relaxed from its

elastically deformed state and, by doing so, sets the outlet port of the conduit 80 free, thereby creating a condition in which the detergent is actually enabled to pass through said conduit 80 in view of being released into the washing tank 24 of the machine.

In this way, the powdered detergent can be added into the washing tank or tub of the machine in appropriately metered quantities by displacing said squeezing element 85 from either one to either one of its operational positions, with an effective, safe and reliable operation of the whole apparatus and under avoidance of any possibility for the detergent to become exposed to washing liquors and the related vapours generated in the tank or tub, such an exposure being liable to bring about the formation of detergent clots and corresponding incrustations in the detergent-carrying conduits, thanks to an almost hermetically tight separation, achieved by pressing the flexible conduit flat according to the afore illustrated principles, between such a tank and the zone in which the detergent to be dispensed is held in the reservoir.

In particular, the addition of the powdered detergent into the washing tank of the machine occurs by first operating the electromechanical actuator 87 into its position in which said end portion 81 of the flexible conduit 80 is not pressed flat and, at the same time, the pneumatic generator 14 so as to preliminarily dry the conduits, and, shortly thereafter, by operating said actuator means 78 into its operational position in which the conical needle valve is raised, ie. a condition is established in which the detergent being held in the reservoir 13 is able to flow by gravity into the conduits 79 and 80 in such an amount as determined by the opening time of the conical needle valve 76 in compliance, as it has already been explained, with the energization time of the actuator means 78, whereas such a dispensed and metered amount of detergent is carried by the flow of air generated by the motor-driven fan 14 towards the washing tank of the machine by passing through the open outlet port of said end portion 81. At the end of this process, the above cited component parts are switched into their other operational position, thereby bringing detergent dispensing and metering to a stop and causing the end portion 81 of said flexible conduit 80 to be closed, under achievement of the various afore cited advantages.

Turning now to Figures 17a and 17b, in which the automatic powdered detergent dispensing and metering system according to the present invention is illustrated in a further possible embodiment, it can be noticed that the same is substantially made up by the same component parts as described previously, which therefore are in this case indicated by the use of the same reference numerals, except for the fact that in this case the squeezing element 85 interacting with the end portion 81 of the flexible conduit 80, said end portion being in this case still resting on a plane

vertical support 84 provided in the washing tank 24, is not actuated by an electromechanical actuator means, but by a pneumatic actuator means 88 applied externally against the washing tank 24, which in turn is not provided with any housing 73, said pneumatic actuator means comprising a sealed box 89 in which there is included an elastic diaphragm 90 which divides such a box into two separate, almost hermetically sealed chambers 91 and 92, said elastic diaphragm being connected with one of its surfaces with the stem 86 provided for actuating the squeezing element 85, and with the other one of its surfaces with a compression spring 93 arranged between it and the opposite wall of the sealed box 89 and biasing said diaphragm to push the squeezing element 85 against the above cited end portion 81, thereby pressing it flat.

The inner chamber 91 of said sealed box 89 also communicates with the enlarged conduit portion 82 through a further conduit 94 having a smaller cross-section area, so that in the operational position shown in Figure 17a, in which the motor-driven fan 14 and the actuator means 78 are de-energized, ie. a condition in which no dispensing and metering of detergent occur, the diaphragm 90 will not distort and get displaced from such a position due to the absence of pressurized air flow in said inner chamber 91, thereby keeping the squeezing element 85 compressed against the end portion 81 of the flexible conduit 80.

In Figure 17b it can on the contrary be noticed that all component parts included in the system are displaced or switched into their other operational position, ie. a condition in which the detergent is dispensed and metered while the motor-driven fan 14 is energized, thereby generating the flow of air required to carry the detergent toward the washing tank.

In this case, such a flow of air under pressure also penetrates the inner chamber 91 of the pneumatic actuator means 88, through the conduit 94, thereby displacing the diaphragm 90 against the action of the spring 93 and causing therefore the outlet port of said end portion 81 to be set open by the squeezing element 85.

In Figures 18a and 18b a detail is now shown of the automatic powdered detergent dispensing and metering system previously described with reference to the Figures 16a and 16b. From the therein illustrated detail it can be noticed that the squeezing element 85 is not only associated with an electromechanical actuator means 87, but also with a compression spring 95 acting in opposition to said actuator means, said spring normally keeping the squeezing element 85 compressed against the end portion 81 of the flexible conduit 80, thereby pressing it flat and closing it, in the condition in which the actuator means 87 and the motor-driven fan 14 are de-energized (see Figure 18a), so that no dispensing and metering of the detergent occur, whereas said squeezing element 85 is no

longer compressed against said end portion, and compresses on the contrary the spring 95, when the actuator means 87 and the motor-driven fan 14 are energized (see Figure 18b), ie. a condition in which detergent is actually dispensed and metered.

Two further possible embodiments of the automatic powdered detergent dispensing and metering system according to the invention will now be described with reference to Figures 19 and 20, both said embodiments operating substantially in the same manner as described above.

In particular, it can be seen in Figure 19 that the considered system is substantially identical to the one illustrated in Figures 17a and 17b, so that the corresponding component parts will be indicated here with the use of the same reference numerals, the only difference existing between said embodiments lying in that, in this case, the conduit 94 communicating with the inner chamber 91 of the pneumatic actuator means 88 is no longer connected with the enlarged conduit portion 82, as it has previously been the case, but is on the contrary connected directly with the flexible conduit 80 itself, so that the pressurized air flow moving through such a flexible conduit for carrying the powdered detergent will also supply the inner chamber 91 of said pneumatic actuator means by passing through the conduit 94.

Figure 20 shows a further embodiment of the automatic detergent dispensing and metering system according to the invention, which, although substantially different from the previously described embodiments, operates in much the same manner. In this case, in which the washing tank 24 of the machine is again provided with the sideways protruding housing 73 that accommodates the squeezing element 85 adapted to press flat and close the end portion 81 of the flexible conduit 80, it can be noticed that said squeezing element 85 is essentially formed by two elongated stems 96 and 97 arranged close to each other and articulated inside the washing tank 24 with a respective trunnion 98, so as to be able to slightly rotate about the same trunnion, said stems being respectively provided at one of their ends with orthogonally bent limbs 99 and 100 that are kept in an aligned and mutually joined arrangement by the action of a compression spring 101, said limbs extending in opposite directions and being terminated with rounded-off end portions that co-operate with corresponding rectilinear surfaces 102 and 103 of a recess 104 provided in a parallelepipedon plate 105 attached to the free end of the stem 86 that is operated rectilinearly and alternately by the respective actuator means (not shown), said surfaces being symmetrically inclined in a converging direction with respect to the position of the trunnions 98.

In turn, the other end portion of said stems 96 and 97 is adapted so as to be able to fittingly adapt itself around the outer surface of the end portion 81 of the

flexible conduit 80, so that it can be compressed against or released from said outer surface, as the case may be.

The operation of this embodiment of the detergent dispensing and metering system according to the invention is now fully apparent, since the displacement of the plate 105 brought about by the respective actuator means will at the same time determine a corresponding displacement of the stems 96 and 97 into different positions with respect to the end portion 81. From the illustration in Figure 20, in particular, it can be noticed that in the condition in which the actuator means is de-energized, so that the plate 105 is as a result displaced fully outwards by said actuator means and the limbs 99 and 100 are brought in a close arrangement with respect to the bottom surface 106 of the recess 104 blending into said inclined surfaces 102 and 103 thereof, the compression spring 101 keeps said limbs 99 and 100 separated from each other and, therefore, the stems 96 and 97 in a near parallel arrangement with respect to each other and compressed with their free ends against the outer surface of the end portion 81, thereby pressing it flat and preventing the detergent from passing through the flexible conduit 80.

In the opposite case, ie. when said actuator means is on the contrary energized, the plate 105 is attracted toward said actuator means, so that the limbs 99 and 100, by sliding along the inclined surfaces 102 and 103 of said plate, are gradually compressed toward each other, against the action of the spring 101, thereby bringing about a slight rotation of the stems 96 and 97 about the respective trunnions 98 and, as a result, causing the free ends of said stems to gradually open apart so that they are no longer compressed against the end portion 81 of the flexible conduit 80, thereby enabling the detergent to flow through the same conduit.

Turning now to Figure 21, it can be noticed that the automatic powdered detergent dispensing and metering system made according to any of the afore illustrated embodiments may be also incorporated in a household-type clothes washing machine 68 provided with a cylindrical washing tub 681, in which a rotating drum 691 is housed, wherein said dispensing and metering system is also in this case accommodated inside a corresponding sideways protruding housing 73 of said washing tub.

Finally, an automatic powdered detergent dispensing and metering system 10 according to the invention is shown in Figures 22 and 23 to be applied in a different manner to washing machines, ie. to a household-type dishwashing machine (Figure. 22) and a household-type clothes washing machine (Figure 23), respectively. In Figure 22, in particular, it can be noticed that such a system 10 comprises substantially a separate assembly 107 formed by the powdered detergent holding reservoir and the pneumatic

generator along with the related component parts (none of them shown), said assembly being arranged outside the machine and being connected by means of a flexible conduit 80, which is introduced in a corresponding through-opening 108 provided inside the machine, with an assembly (not shown) provided inside the same machine and consisting of an actuator means and a squeezing element of the afore described type, both of them interacting with the end portion of said flexible conduit in the same way and to the same purpose as previously described. An identical separate assembly 107 as the one shown in Figure 22 can be noticed in Figure 23 to be applied, in this particular case, on to the upper rear portion of the machine and to be further connected, through a flexible conduit 80 introduced in a corresponding through-opening 109 provided in the machine (in this case in the front upper control panel 110 thereof), with the corresponding actuator-squeezing element assembly provided inside the same machine. The so embodied and arranged automatic powdered detergent dispensing and metering system according to the invention enables therefore such detergent products to be added into the washing machines in precisely such amounts as actually needed or required by the washing process being performed, even in the presence of such particularly moist environments as the washing tubs or tanks thereof, in which the washing liquors and the related fumes are contained, thereby preventing the detergent from clotting and fouling the internal conduits of such machines, while ultimately ensuring an extremely satisfactory and reliable operation of the same machines.

Claims

1. Automatic powdered detergent dispensing and metering system for washing machines, in particular dishwashing and clothes washing machines, provided with a washing tank or tub (24; 681), resp., comprising a reservoir (13) adapted to hold the powdered detergent (11) and connected with said washing tank or tub through a conduit (23; 80); valve means (20; 76) actuated by *per se* known actuation means (32; 78) and associated to said reservoir (13) so as to enable the powdered detergent to be removed from the same reservoir and to be conveyed into said washing tank or tub through said conduit (23; 80); and pneumatic generator means (14; 46, 14), such as a fan unit, a blower, an air aspirator or the like, connected through respective conduits (18; 79, 74) with said reservoir (13), **characterized in that** further actuation means (16; 85) are associated with said conduit (23, 80) so as to establish a connection between said conduit and said pneumatic generator means through respective

conduits (18; 79, 74), said further actuation means being so adapted as to determine conveyance of the powdered detergent into said washing tank or tub (24; 681) when said pneumatic generator means (14, 46; 14) are operating.

2. Automatic powdered detergent dispensing and metering system according to claim 1, **characterized in that** said further actuation means comprise an ejector (16) provided with a Venturi tube (21) and a chamber (22), said ejector (16) being connected with the delivery pipe (18) of said pneumatic generator means (14, 46) and a delivery conduit (23) connected with said washing tank or tub (24), through valve means (26) adapted to prevent vapours and water splashes from reaching up from said washing tank or tub (24) into said delivery conduit (23), said ejector (16) being further connected with an extraction conduit (17) communicating with said reservoir (13) for removing the detergent therefrom.
3. Automatic powdered detergent dispensing and metering system according to claim 2, **characterized in that** said valve means comprise an elastically biased conical needle valve (26), a flap valve or the like, of a unidirectional type.
4. Automatic powdered detergent dispensing and metering system according to claim 1, **characterized in that** said pneumatic generator means (46) are arranged inside a respective conduit.
5. Automatic powdered detergent dispensing and metering system according to claim 3, **characterized in that** heating means (19) are provided for heating up the circulating air, wherein said heating means are capable of being energized temporarily, are associated with said delivery pipe (18) and are situated upstream of said chamber (22).
6. Automatic powdered detergent dispensing and metering system according to claim 5, **characterized in that** said reservoir (13) has an opening (27) communicating with the outside air, and acting as an air intake provision, said opening (27) being associated with air dehumidifying means (28).
7. Automatic powdered detergent dispensing and metering system according to claim 6, **characterized in that** said air dehumidifying means (28) comprise a filter (29), in an advantageous way of a regenerable type, provided with means (30) for drying the absorbant material, such as for instance electrical resistance-type heating means (31), capable of heating up said material after

each working cycle.

8. Automatic powdered detergent dispensing and metering system according to claim 7, **characterized in that** said opening (27) is also associated with a unidirectional-type valve means (44), which is operated by the negative pressure that creates inside said reservoir (13) when the detergent (11) is being dispensed, so as to prevent air from flowing in an excessively large amount into said reservoir (13). 5
9. Automatic powdered detergent dispensing and metering system according to claim 8, **characterized in that** said valve means are formed by a sealing-lip, conical-needle or similar valve (20) adapted to shut off said extraction conduit (17). 10
10. Automatic powdered detergent dispensing and metering system according to any of the preceding claims, **characterized in that** said reservoir (13) is capable of being at least partially pulled out and is associated to a shut-off valve (39) adapted to close or open the tract of said extraction conduit (17) extending within said reservoir (13) when the latter is pulled out and inserted in its operating position, respectively, with respect to the washing machine. 15 20 25
11. Automatic powdered detergent dispensing and metering system according to claim 10, **characterized in that** shut-off valve (39) coincides with said valve means (20). 30
12. Automatic powdered detergent dispensing and metering system according to any of the preceding claims, **characterized in that** said reservoir (13) is enclosed by a cooling jacket (43), in which cold air generated by said pneumatic generator means (14, 46) is circulated through a conduit (45) connected with said chamber (22), when the temperature of the powdered detergent (11) contained in said reservoir (13) rises above a predetermined threshold value. 35 40 45
13. Automatic powdered detergent dispensing and metering system according to claim 12, **characterized in that** the bottom of said reservoir (13) is associated to distribution means (49) adapted to ensure a substantially uniform suction of the detergent throughout said reservoir. 50
14. Automatic powdered detergent dispensing and metering system according to claim 1, **characterized in that** said further actuation means comprise at least a squeezing element (85) capable of being switched by corresponding actuator means (87, 88) from a first to a second operation-

al position, and vice-versa, said squeezing element (85) co-operating with the end portion (81) of said conduit (80), which is made of elastic material, so as it is compressed against said end portion (81), thereby pressing it temporarily flat, or it is not compressed against said end portion (81), when said actuator means are switched into their respective first or second working position, in the conditions in which said valve means (76) and said pneumatic generator means (14) prevent said powdered detergent from being conveyed or enable said powdered detergent to be conveyed toward said washing tank or tub (24; 681).

15. Automatic powdered detergent dispensing and metering system according to claim 14, **characterized in that** said actuator means comprise at least an electromagnetic valve (87), an electric motor or a similar electromechanical provision. 15
16. Automatic powdered detergent dispensing and metering system according to claim 15, **characterized in that** said actuator means (88) comprise at least a sealed box (89) associated with said washing tank or tub (24; 681) and provided with at least an inner elastic diaphragm (90) or the like, which is connected with said squeezing element (85) and is arranged so as to divide said box (89) into at least a first and a second almost hermetically sealed inner chamber (91, 92), of which said first inner chamber (91) is communicating with said pneumatic generator means (14), while said second inner chamber (92) is provided with elastic means (93) co-operating with said diaphragm (90), said diaphragm (90) being displaceable from a first to a second operational position, against the action of said elastic means (93), and vice-versa, when said first inner chamber (91) is not supplied or is pneumatically supplied by said pneumatic generator means (14), respectively, in the corresponding first or second operational position of said actuator means (88). 20 25 30 35 40 45
17. Automatic powdered detergent dispensing and metering system according to any of the preceding claims, **characterized in that** said squeezing element (85) is formed by a first and a second elongated stem (96, 97) arranged close to each other and articulated inside said washing tank or tub (24; 681), said stems (96, 97) being provided at one of their ends with a respective orthogonally bent limb (99, 100) and being adapted to be compressed or not compressed with their other end portion against said end portion (81), said limbs (99, 100) being joined to each other by elastic means (101) and co-operating with corresponding inclined surfaces (102, 103) of a recess (104) provided in a plate (105) attached to said actuator 50 55

means (87, 88), so that said stems (96, 97) can be displaced from their compressing position to their non-compressing position, against the action of said elastic means (101), in the respective first or second operational position of said actuator means (87, 88). 5

18. Automatic powdered detergent dispensing and metering system according to any of the preceding claims, **characterized in that** it comprises a separate assembly (107) outside the machine, formed by said detergent holding reservoir (13), said valve means (76), said actuation means (78) and said pneumatic generator means (14) with their respective conduits, said separate assembly (107) being capable of being connected through said flexible conduit (80) with said squeezing element (85) and said actuator means (87, 88) that are provided inside the washing machine. 10 15 20

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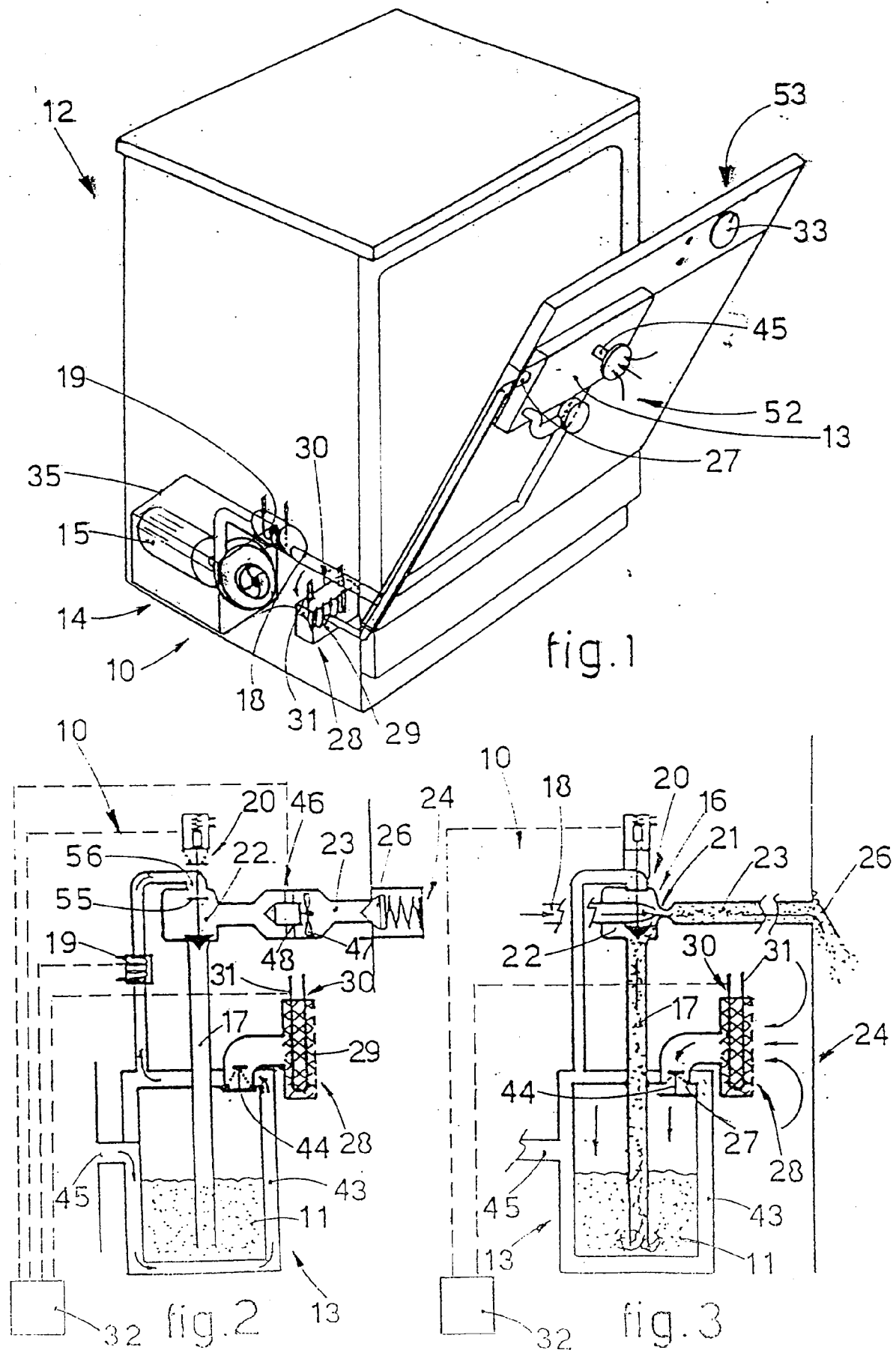
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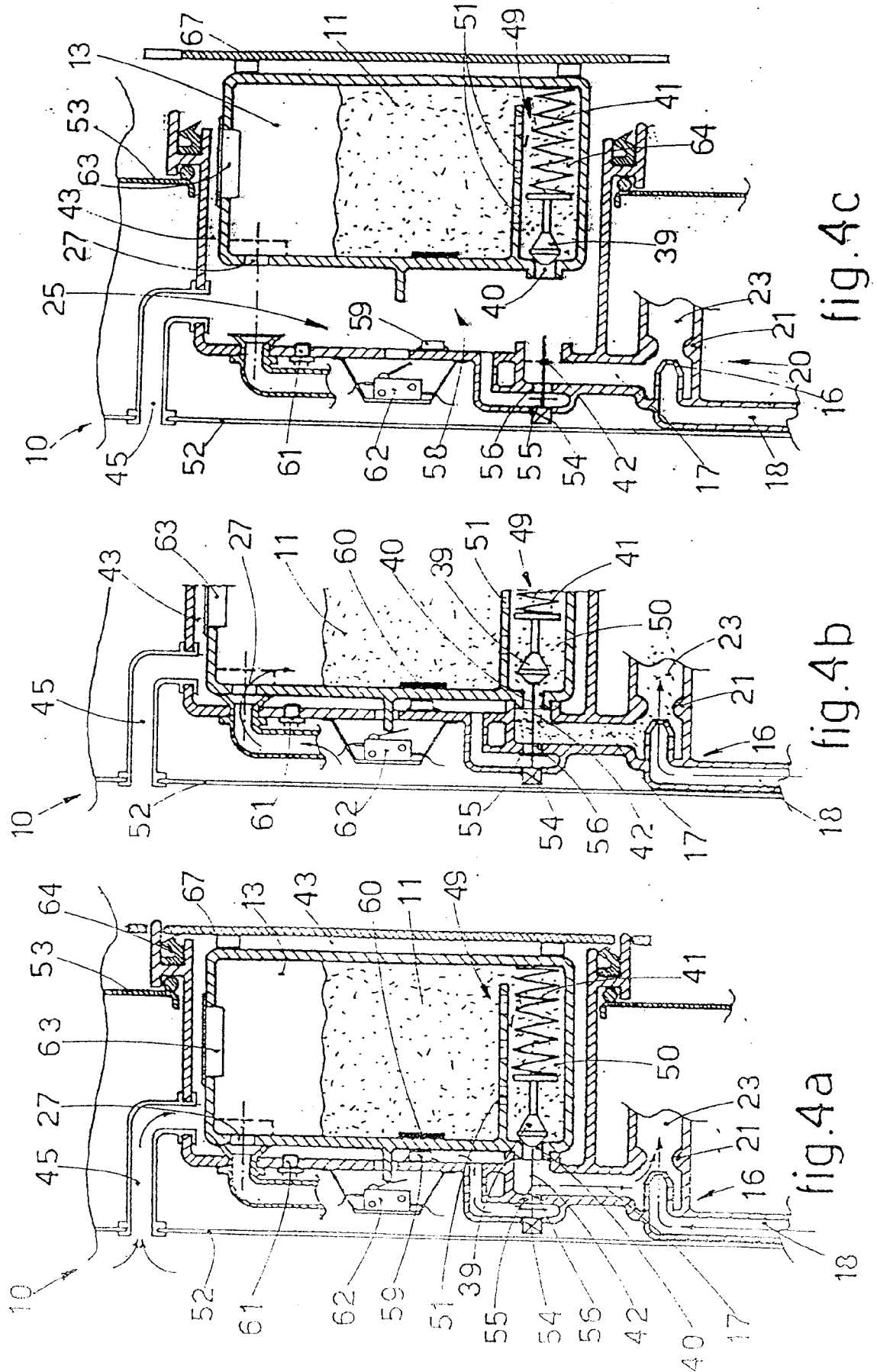
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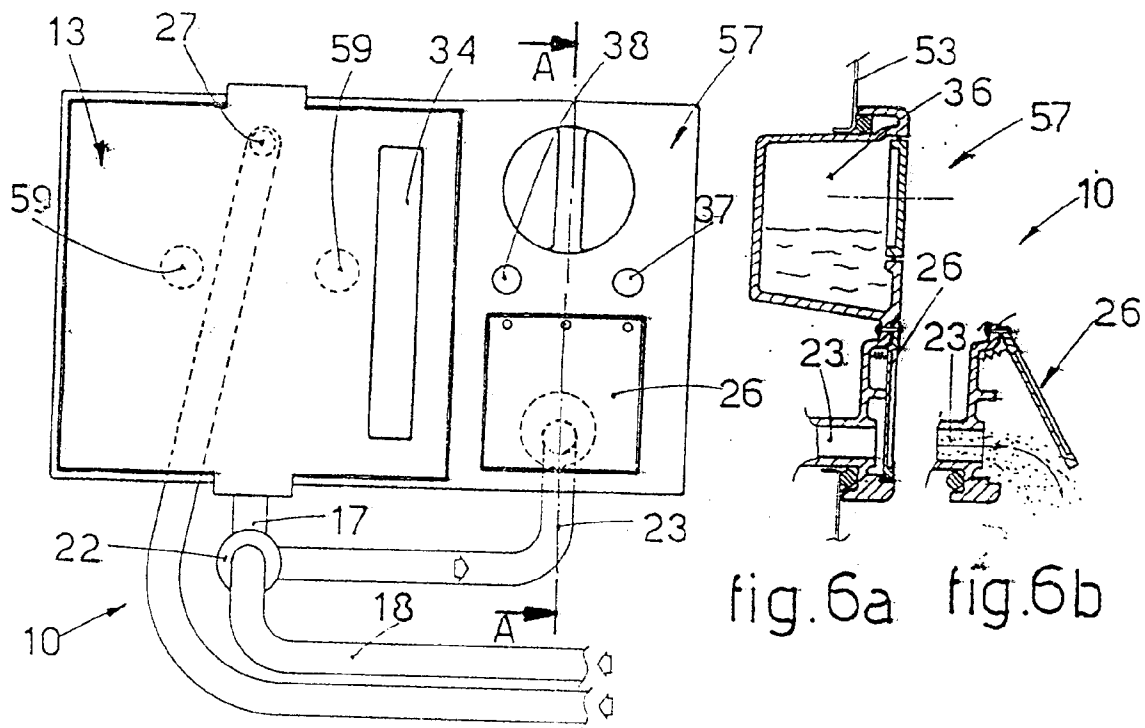


fig. 5

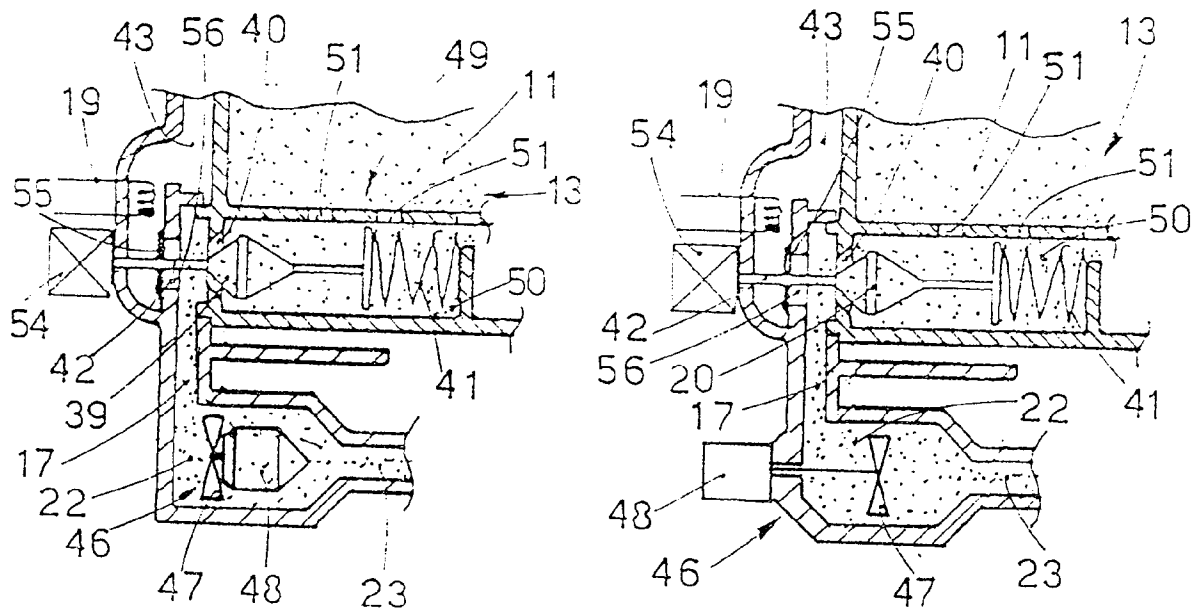
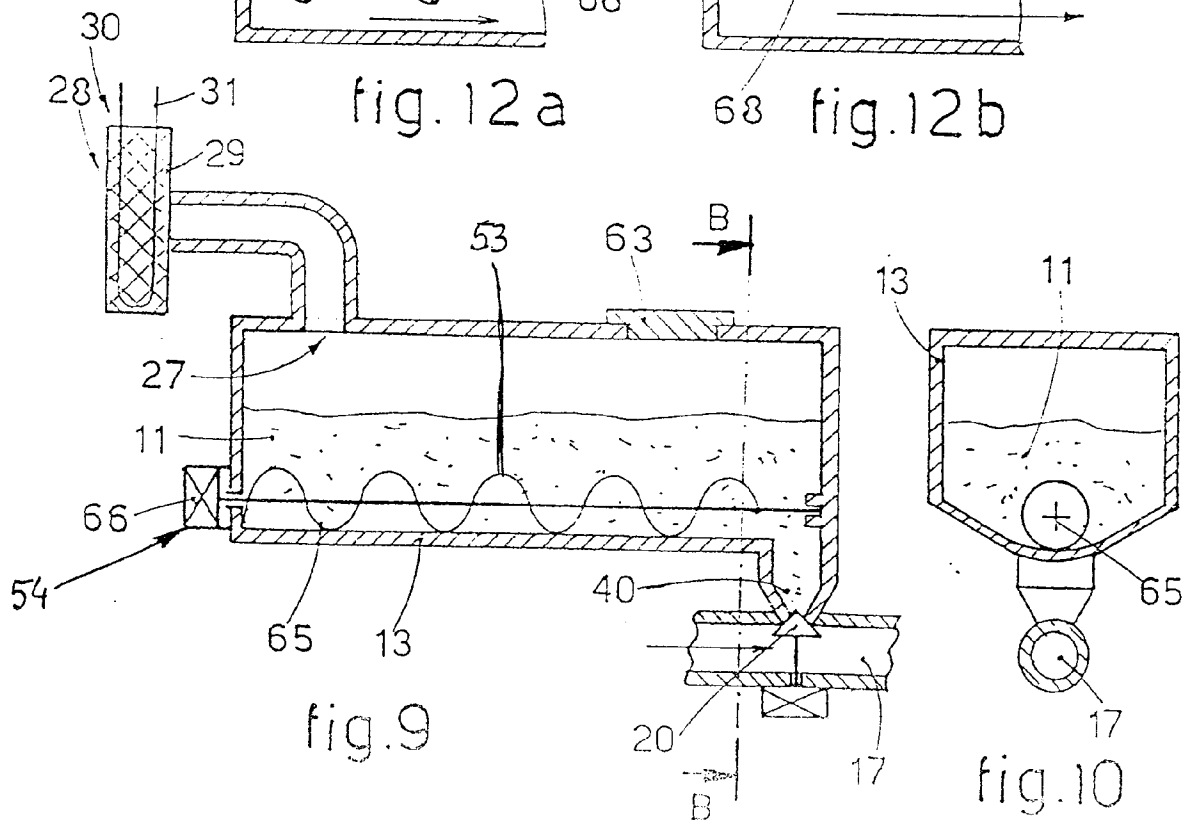
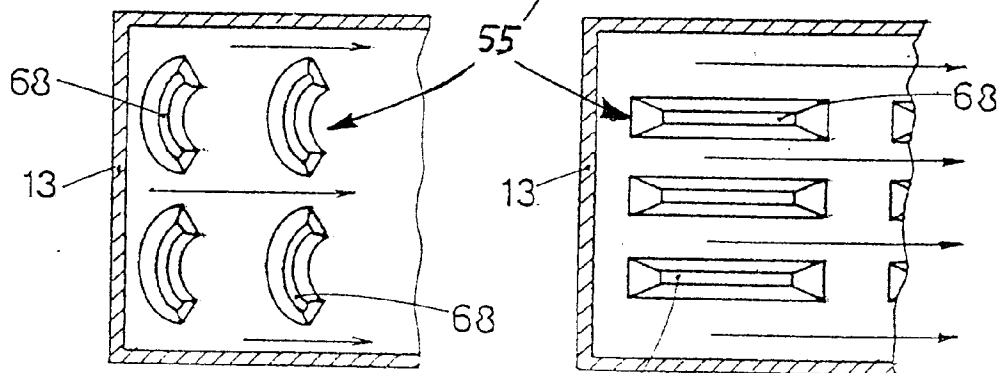
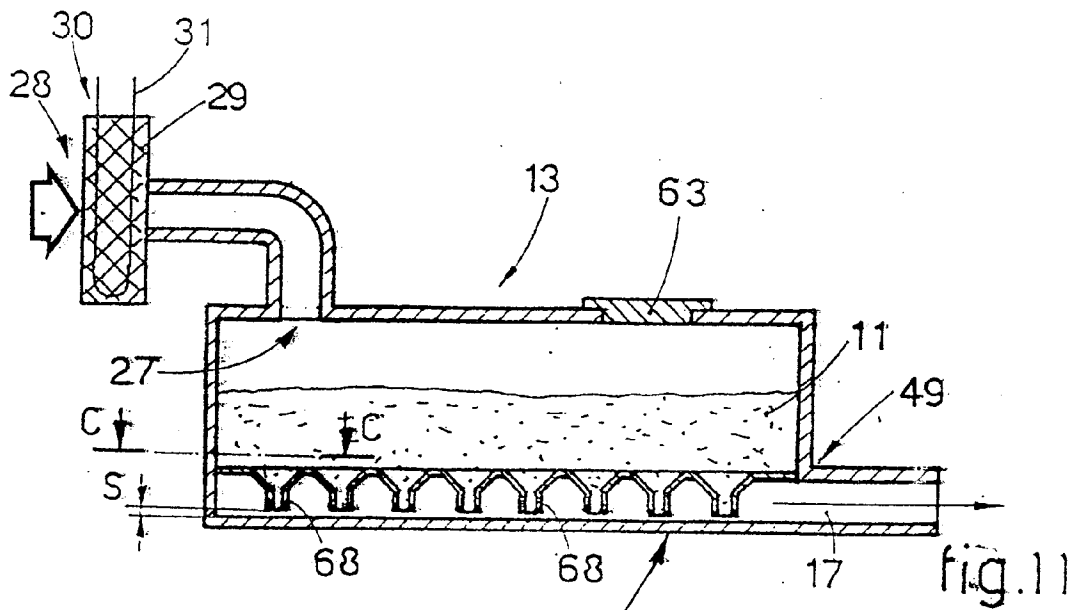
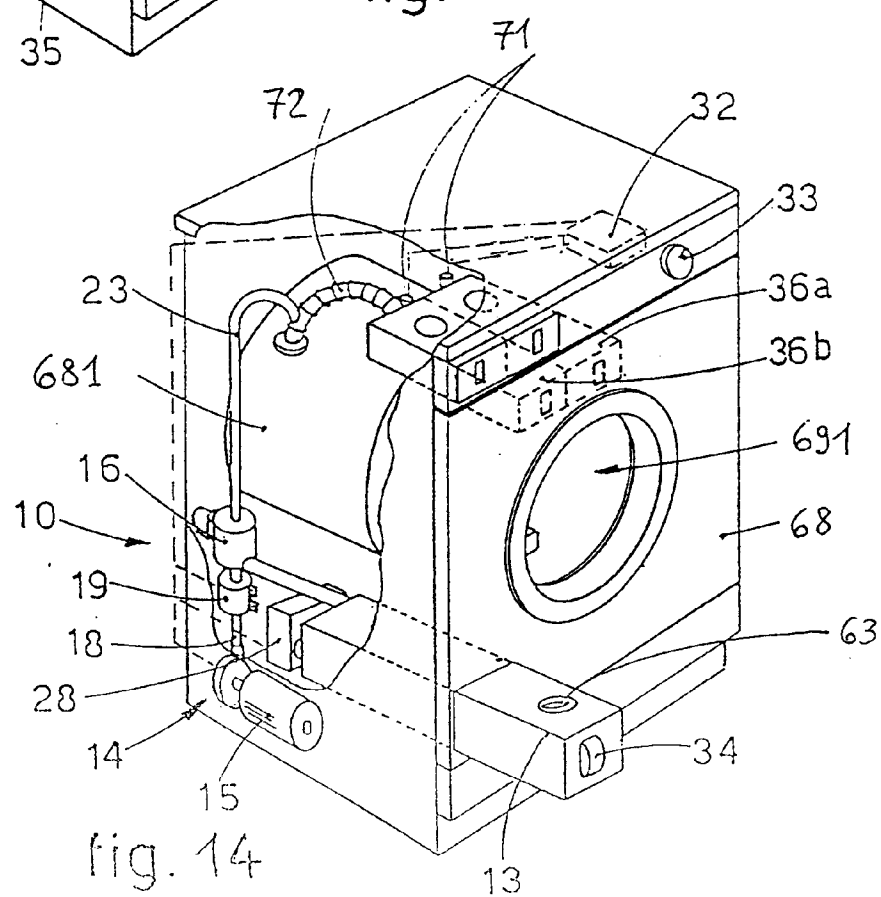
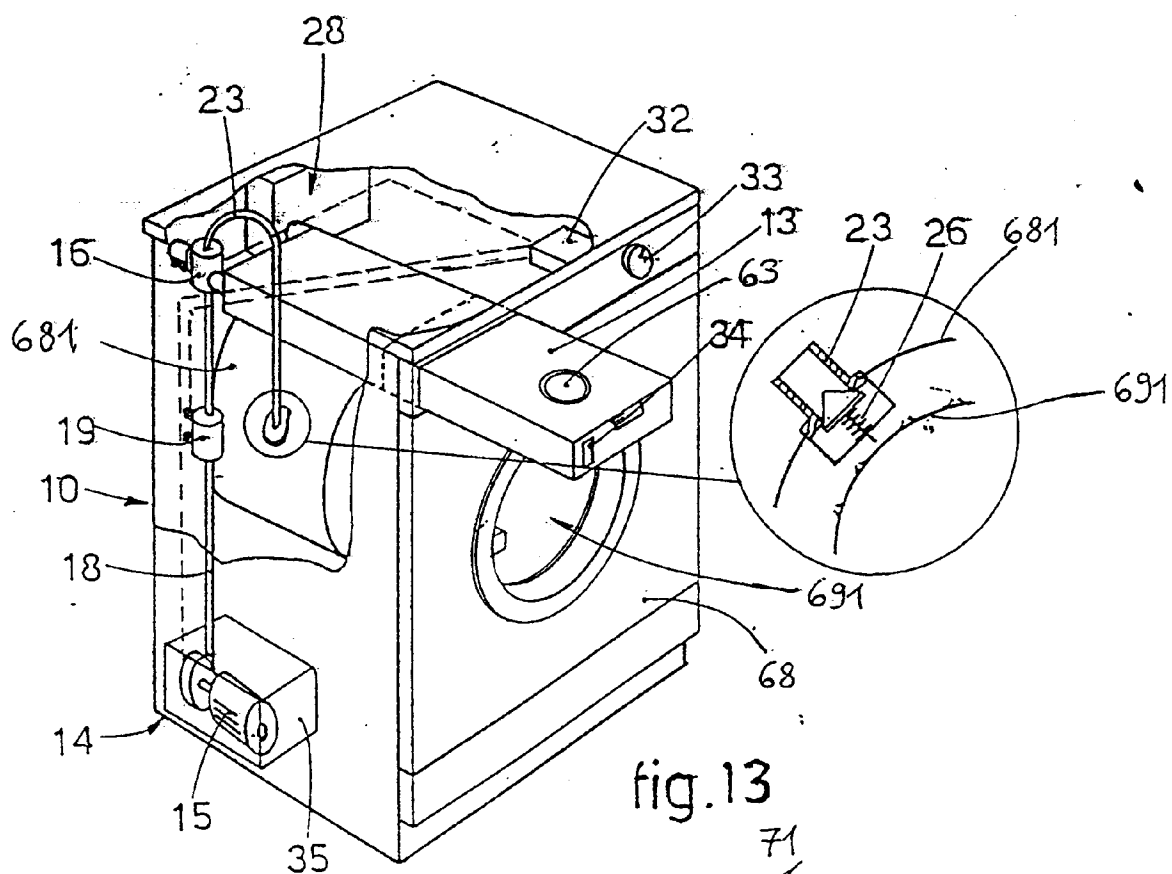
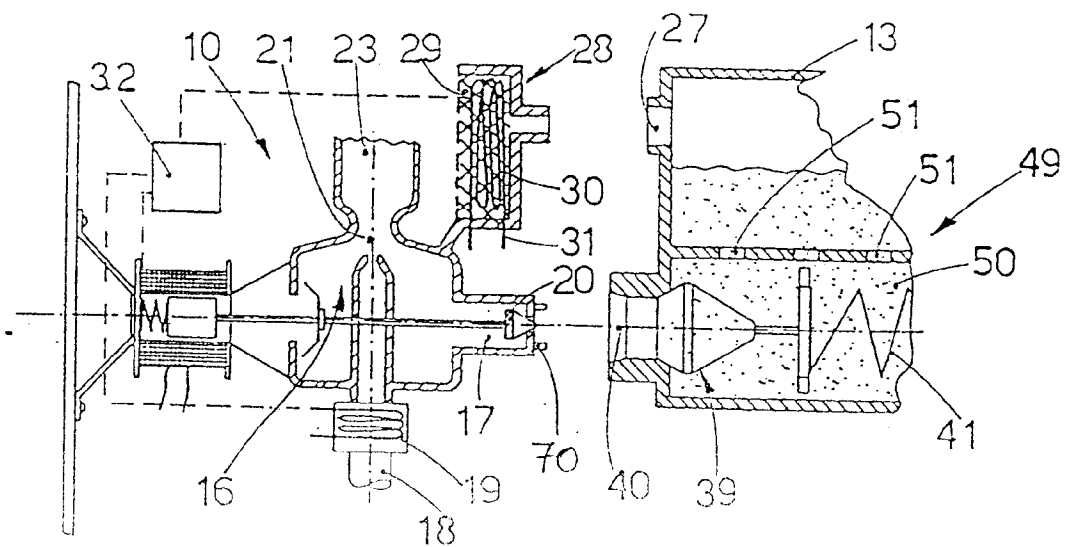
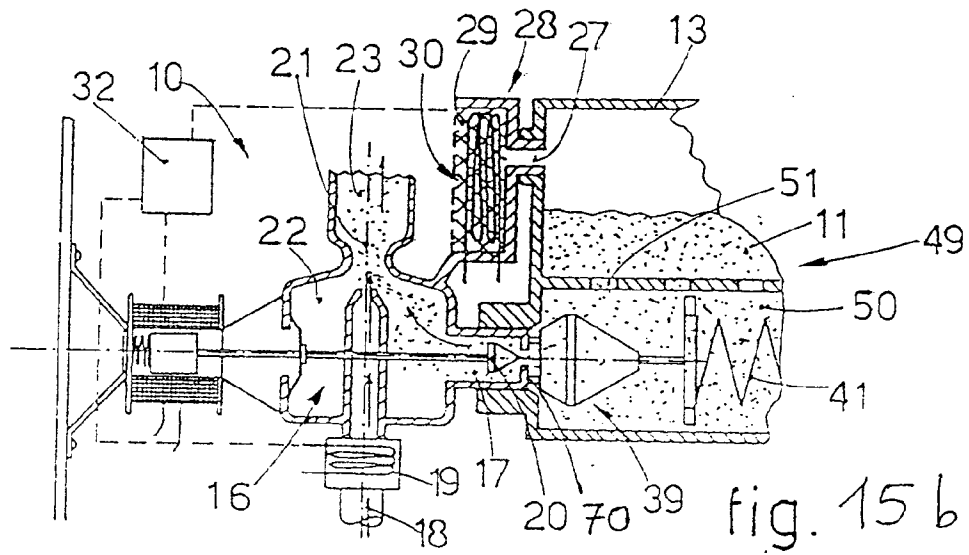
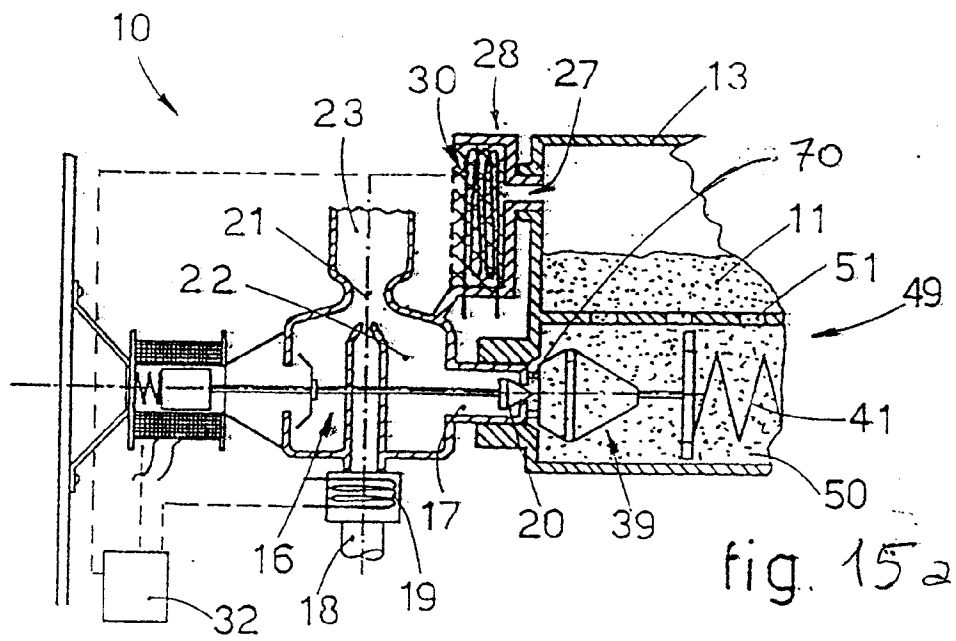


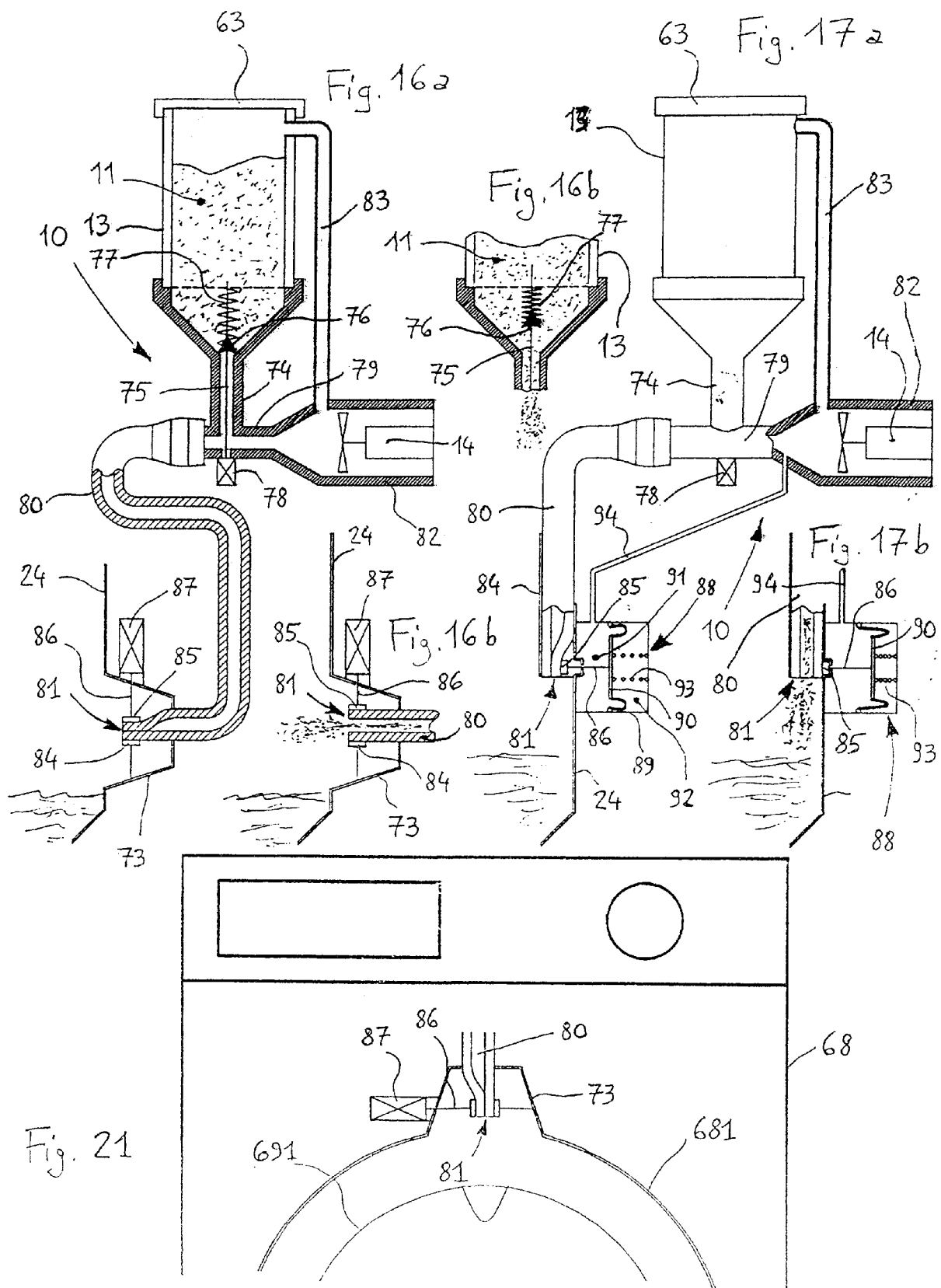
fig. 7

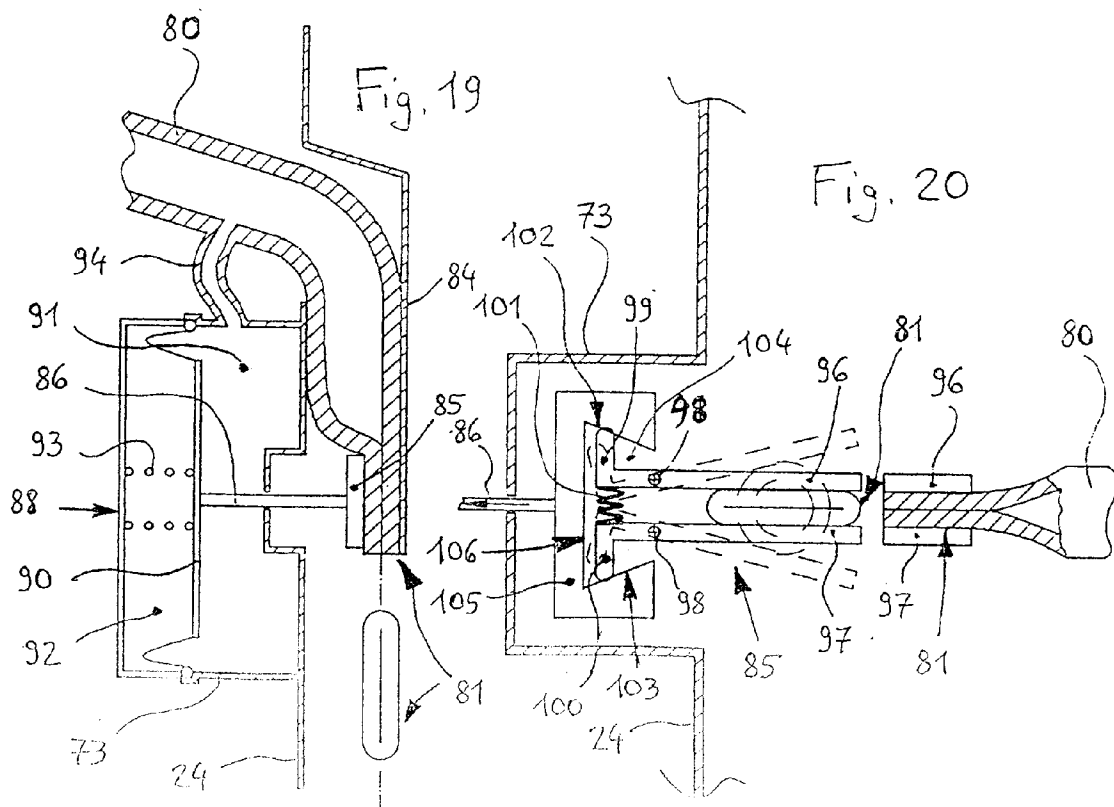
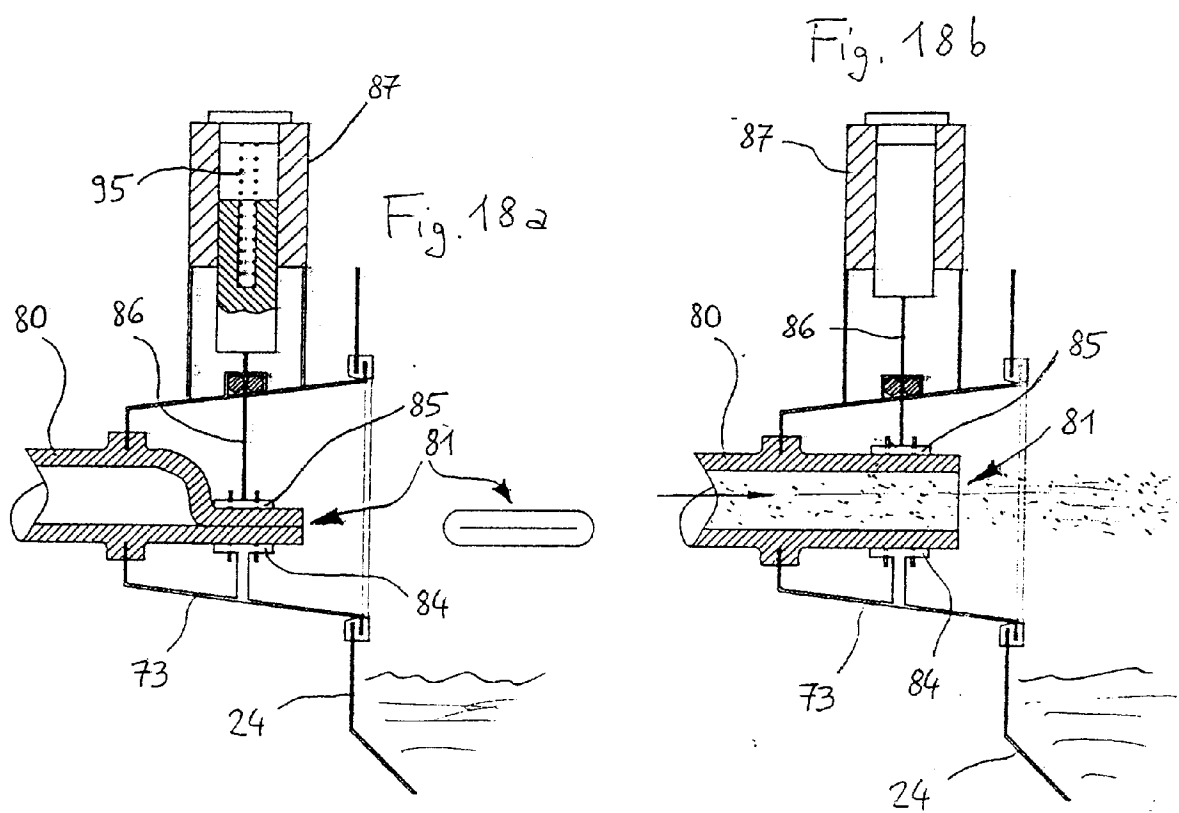
fig. 8











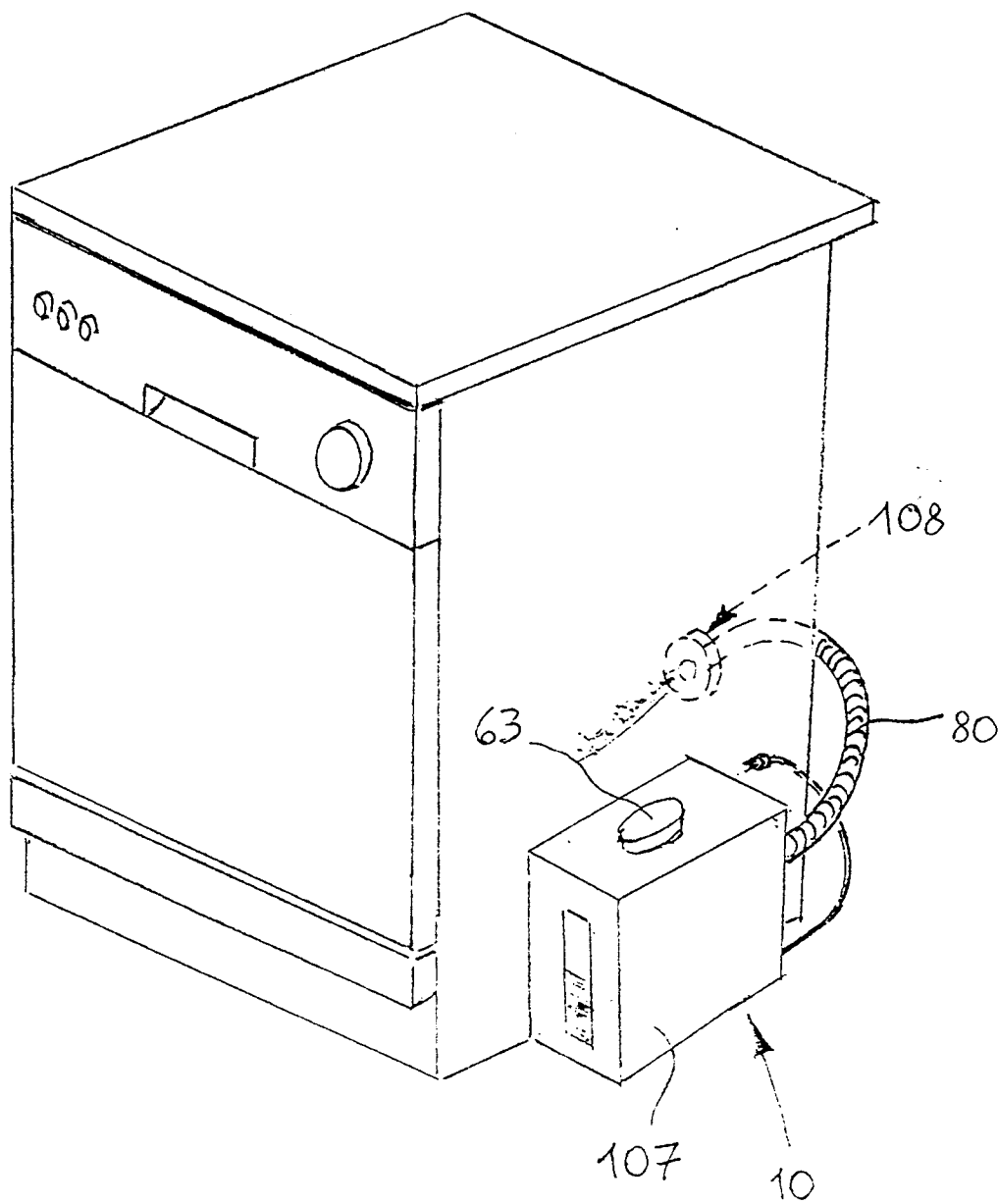


Fig. 22

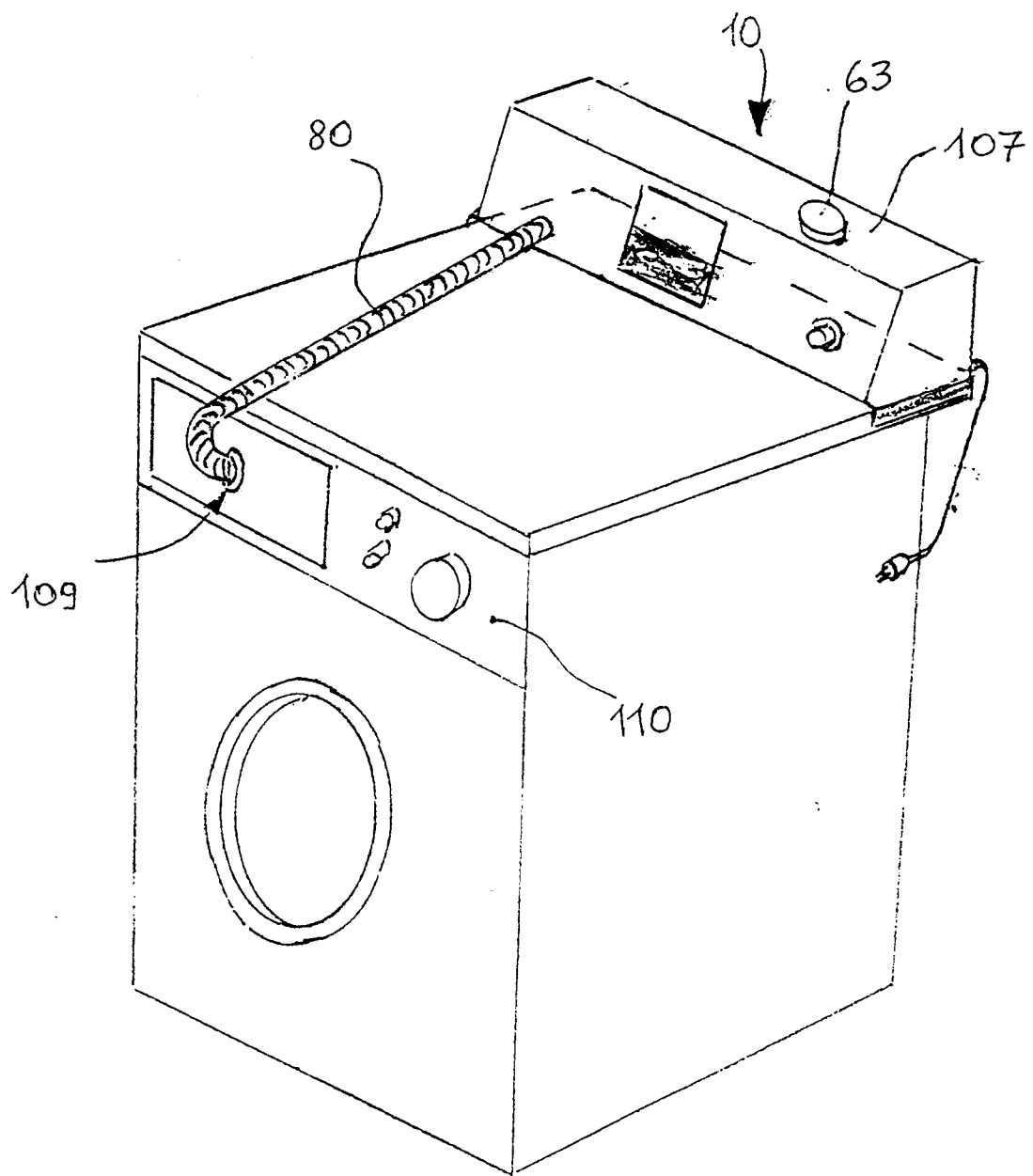


Fig. 23



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 94 10 2127

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	US-A-3 188 146 (THE PROCTER & GAMBLE COMPANY)	1,13	D06F39/02 A47L15/44
A	* the whole document * ---	2	
X	EP-A-0 386 637 (HENKEL KOMMANDITGESELLSCHAFT AUF AKTIEN)	1	
A	* claims; figure 1 * ---	2,18	
X	EP-A-0 165 690 (ECONOMICS LABORATORY INC.)	1	
A	* claims; figures 1,3 * -----	2,18	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			D06F A47L
Place of search		Date of completion of the search	Examiner
THE HAGUE		1 June 1994	Courrier, G
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