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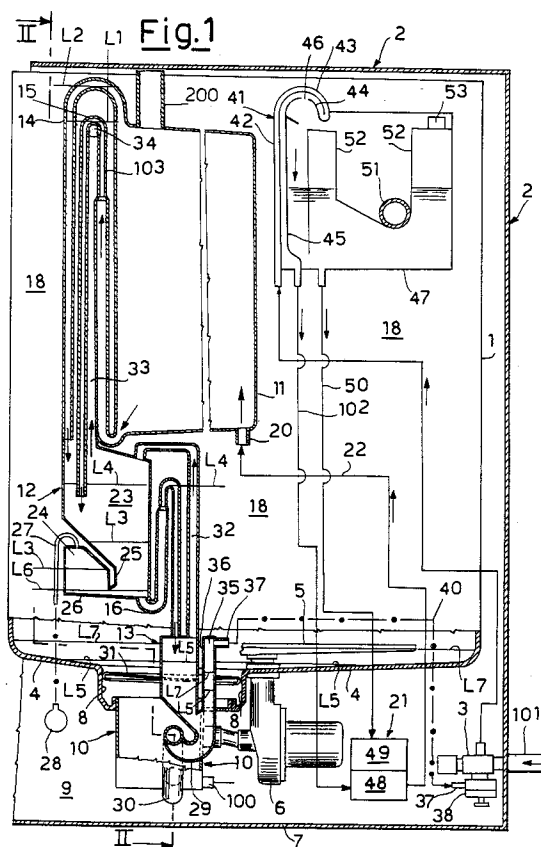
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I-20131 Milano (IT)(54) **Device for controlling the level of washing liquid in a dishwasher.**

(57) A device for the control of the level of washing liquid in a dishwasher comprises a tank (11) with capacity equal to a fraction of the quantity of liquid to be loaded into a washing drum (1) of the dishwasher and fed through a feed solenoid valve (3), first means (14,15) for transferring the liquid from said tank (11) into a transfer recipient with a smaller capacity than the tank (11), which first means are actuated when the tank (11) has been filled and de-actuated when all the liquid contained in the tank (11) has been transferred, a pressure chamber (24) connected to said transfer recipient (12) whereto pressure detection means (27,28) are associated and which are actuated when the level of the liquid transferred into said recipient (12) exceeds a first preset level (L3) to cause the closure of said feed solenoid valve (3), and second means (16,13,30) for transferring the liquid from said transfer recipient (12) to the washing drum (1), which second means are actuated when the level of the liquid transferred into said transfer recipient (12) exceeds a second preset level (L4), higher than the first level (L3).

**EP 0 669 099 A2**

The present invention relates to a device for controlling the level of washing liquid in a dishwasher.

Dishwashers comprise a washing drum on the base whereof the water used for washing dishes is collected, and wherefrom it is then pumped to appropriate rotor diffusers. Since the drum is relatively shallow, it is important to control the quantity of water loaded by the dishwasher for washing, both at the start of the cycle and for subsequent rinsing operations, to avoid overflows.

In many existing dishwashers the device for controlling the level of the water is represented by a solenoid valve placed at the inlet of the pipe for feeding the flow of water, controlled by an electric pressure switch. The switch detects, by means of a sensitive diaphragm, the air pressure in a compression chamber (pressure chamber) located at the top of a column of liquid connected to the washing drum of the dishwasher, a pressure which is proportional to the level of liquid in the drum. The electric contacts of the switch are made to commute by the sensitive diaphragm, so as to cause the closure of the solenoid valve when the pressure of the air in the chamber reaches a certain value corresponding to the maximum water level required in the washing drum. Systems of this type can be defined as "direct control in drum".

The pressure switch must be calibrated beforehand with high precision, above all since, the drum having a somewhat extensive surface, a few millimetres of variation in the level of the water in the drum correspond to several litres of water. A quantity of water greater than is required, in addition to making overflows from the drum more likely, means greater consumption of electricity required to heat it, in contrast with the current tendency of manufacturers to reduce consumption rates further. It is in fact known that the approximately 40 litres once required for a complete washing cycle have now dropped to 18-20 litres.

A further problem which affects systems for direct control in the drum is represented by the fact that during washing the water incorporates dirt and fatty deposits, which may clog the pipe which leads to the compression chamber wherein the pressure switch is located. In these cases the pressure in the chamber is no longer proportional to the level of water in the drum, and the control system is less efficient, even leading to an overflow.

In order to avoid these problems, the systems for direct control in drum have been gradually abandoned.

A simple yet inaccurate system consists of controlling the time of opening of the feed solenoid valve by the programming device (timer). In this way however account is not taken of the possible variations in the flow rate and/or flow pressure of

water fed to the solenoid valve.

Italian patent application no. MI92A000597, in the name of the same Applicant, describes a control device substantially comprising a measuring tank branching off from the feed pipe which leads from the solenoid valve to the drum. The water flowing into the dishwasher is divided between the washing drum and the measuring tank. A pressure switch measures the level of water in the measuring tank (a level which is proportional to that in the drum and which is converted into air pressure inside the tank) and interrupts the inflow of water, closing the solenoid valve, when this level reaches the required value. In this way the control device no longer works on the whole quantity of water fed to the drum, but on a small fraction thereof, and in a constantly clean environment.

This device, although more accurate than the previous one, is subject to errors caused by differences in water flow rate or pressure in the branch pipe which feeds the measuring tank in relation to the pipe which feeds the drum.

European patent application no. 0351564 describes a control device which exploits the principle of filling the drum with water due to successive transfers from a smaller capacity recipient, for example equal to a third of the volume of water to be loaded into the drum.

In this device the feed solenoid valve is not controlled by a pressure switch but instead by a microswitch in turn controlled by a float and rocker arm assembly located in the smaller capacity recipient, and which may be subject to problems of mechanical seizure.

In view of the state of the art described, the object of the present invention is that of providing a device for controlling the level of washing liquid in a dishwasher which is not subject to the problems which characterise the control systems described.

In accordance with the present invention, this object is achieved thanks to a device for controlling the level of washing liquid in a dishwasher, comprising a tank of capacity equal to a fraction of the quantity of liquid to be loaded into a washing drum of the dishwasher and fed via a feed solenoid valve, characterised in that it comprises first means for transferring liquid from said tank to a transfer recipient of smaller capacity compared to the tank, which first means are actuated when the tank has been filled and de-actuated when all the liquid contained in the tank has been transferred, a pressure chamber connected to said transfer recipient where to pressure detector means are related which are actuated when the level of the liquid transferred in said recipient exceeds a first preset level to cause the closure of said feed solenoid valve, and second means for transferring liquid from said transfer recipient to the washing drum, which sec-

ond means are actuated when the level of the liquid transferred into said transfer recipient exceeds a second preset level, greater than the first level.

Thanks to the present invention, it is possible to provide a device for controlling the level of liquid outside of the washing drum, which is therefore not accessible to the dirt produced during washing and therefore not subject to clogging. Due to the fact that the principle of transfer from a tank to a recipient with a much smaller capacity and connected with a pressure chamber is exploited, the system has a much higher trigger speed, allowing a highly accurate control. Using moreover as detectors standard pressure switches, widely available and economical, the device is not subject to problems of mechanical seizure.

The features of the present invention shall be made clearer from the following detailed description of its embodiment, illustrated by way of a non-limiting example in the accompanying drawings, in which:

Figure 1 shows a partially sectioned side view of a dishwasher provided with a control device according to the invention;

Figure 2 is a view sectioned along line II-II of Figure 1;

Figure 3 is a view similar to that of Figure 1, showing a different embodiment of the control device according to the invention.

1 in Figure 1 denotes a washing drum for dishwasher machines. This drum 1 is enclosed in a manner in itself known inside a framework 2 forming the external casing of the dishwasher. Mounted on said framework 2 is a feed solenoid valve 3 whereto a pipe 101 for feeding clean water is connected externally.

Mounted on the base 4 of the washing drum 1, in an approximately central position, is a diffusion rotor 5 which is fed by an electric pump 6 placed below the drum 1, in a cavity 9 between the base 4 of the drum 1 and base 7 of the framework 2. The base 4 of the washing drum 1 converges towards a substantially square opening 8, below which, again in the cavity 9, is a collection basin or sump 10. The opening 8 is covered by a perforated plate 31 having filter functions, to prevent washing residue from penetrating the basin 10. Moreover, connected to the collection basin 10 is a drain pipe 100, connected to a drain pump (not shown).

The control device according to the invention essentially comprises a tank 11, a first transfer recipient 12 and a second transfer recipient 13, connected by siphon pipes 14, 15 and 16. The whole can also be usefully housed in a cavity 17 between a lateral wall 18 of the washing drum 1 and a lateral wall 19 of the framework 2 (Fig. 2). In a preferred embodiment the tank 11, the two trans-

fer recipients 12 and 13 and the siphon pipes 14, 15 and 16 are produced by the blow moulding technique and form a single part. This does not mean that the device according to the invention cannot be made in several separate parts, connected by pipes.

More precisely, the tank 11 has a capacity equal to a fraction of the volume of water (typically 5 litres) required by the dishwasher in a single load phase. It will later be assumed that the tank 11 has a capacity equal to half of this volume of water, i.e. 2.5 litres. The tank 11 is provided on the base with an inlet mouth 20 through which the tank 11 is fed with decalcified water from a decalcification assembly 21 which is to be described hereinbelow. The connection between the decalcification assembly 21 and the tank 11 is schematically indicated in Figure 1 by line 22. The siphon pipe 15 is also connected to the base of the tank 11, and leads into the first transfer recipient 12, positioned at a height from the base 7 of the framework 2 lower than the height of the tank 11. The siphon pipe 14, also leading into the first transfer recipient 13, is instead connected to the top of the tank 11. Also connected at the top of the tank 11 a breather pipe 200, whose upper opening is located at a greater height in relation to the elbow of the siphon pipe 16. The first transfer recipient 13 has a much smaller capacity than the tank 11 and is composed of two chambers 23 and 24 of different capacities and divided by a baffle 25 and connected only on the common base 26. Connected at the top of the chamber 24, with a smaller capacity and forming a pressure chamber, is a capillary tube 27, which leads at the other end to a pressure switch 28, which is connected to a programming device or timer (not shown) which regulates the working of the dishwasher. On the base 26 of the first transfer recipient 12, at the chamber 23, the siphon pipe 16 is connected, which leads into the second transfer recipient 13. The latter is shaped so as to form below a siphon 29 and leads, via a hose 30, to the collection basin 10. The end of the hose 30, connected to the second transfer recipient 13, is located at a greater height than the end connected to the basin 10 to avoid backflows of water from the basin into the transfer recipient 13. For the same reason the hose 30 is bent to form a siphon too (Fig. 2). A pipe 32 connects the top of the second transfer recipient 13 to the top of the chamber 23 of the first transfer recipient 12 to ensure that inside thereof there is the same pressure. Furthermore a pipe 33, formed between the bend of the siphon pipe 15, connects the top of the chamber 23 to the outside, via a hole 34. In this way the pressure in the chamber 23 and in the second transfer recipient 13 is always equal to atmospheric pressure.

Like the first transfer recipient 12, the second recipient 13 is also provided with a chamber 35 of small capacity and separated from a main chamber by means of a baffle 36 and forming a pressure chamber. At the top of the chamber 35 a capillary tube 37 leads off and is connected at the opposite end to a pressure switch 38 for pneumatic locking of the solenoid valve 3. This connection is schematically indicated in Figure 1 by means of the dot and dash line 40.

In outlet from the solenoid valve 3, the clean water from the water supply system is sent, in observance of legislation, to a so-called "air jump" assembly, having the function of preventing the water present in the circuit of the dishwasher from being sucked into the piping of the water supply system should vacuums be created in the latter. This is substantially piping 41 comprising a vertical outward section 42, an upturned "U" outward section 43, an upturned "U" return section 44 and a vertical return section 45. In the pipe section 44 a hole 46 is formed, below which a container 47 is located, with volume of approximately 350 cc and wherein the small quantity of water which falls from the hole 46 is collected for subsequent use by the decalcification unit 21 in the phase of so-called recycling of decalcifying residues. The decalcification unit 21 comprises a segment 48 containing decalcifying resins, and a segment 49 containing salts for regenerating the decalcifying resins. During a normal phase of loading water into the drum 1, the water from the section 45 of the piping 41 passes through the resins (connection schematically indicated by line 102) and from here is sent decalcified, as mentioned previously, via a pipe represented by line 22 to the tank 11. During the phase of regeneration of the resins, however, the water which is collected in the container 47 is sent, by means of a pipe, represented in the figure by line 50, to the segment 49 containing the salts, to form a mixture of salty water used to regenerate the decalcifying resins.

Figure 1 also shows in section a pipe 51 connected to the interior of the washing drum 1 for releasing the steam partially condensated on the walls 52 of the container 47 before leaving the dishwasher via a breather hole 53.

The functioning of the control device described above will now be illustrated with reference to a typical washing cycle of a dishwasher.

At the start of such a cycle, the programming device (timer) will cause the opening of the solenoid valve 3. The water flows along the piping 41 of the "air jump" assembly, into the segment 48 of the decalcifier 21, and is sent, decalcified, into the tank 11. The latter is gradually filled, together with the rising section 103 of the siphon pipe 15, until the level of water inside said section 103 reaches

the triggering level of the siphon 15, a level denoted in Figure 1 by L1. At this point, a further flowing of water into the tank 11 causes the triggering of the siphon 15, which quickly transfers water from the tank 11, drawing from the base thereof, into the first transfer recipient 12. If the rate of flow of water entering the tank 11 is greater than the flow rate of the siphon 15, even after triggering of the latter, the quantity of water entering the tank 11 is greater than that transferred by the siphon 15 into the first transfer recipient 12. When the level of the water reaches the level L2, the siphon 14 is also triggered, which causes an increase in the flow rate which serves to transfer water to the first transfer recipient 12. In this way the control device is ensured a high response speed.

Inside the first transfer recipient 12, the water is distributed in the two chambers 23 and 24. In the pressure chamber 24 the increase in the level of the water causes a gradual increase in the pressure of the air, and when this pressure exceeds a predefined level (corresponding to a level of water L3) the pressure switch 28 is actuated to send to the programming device the command for closure of the solenoid valve 3. Given the small dimensions of the first transfer recipient 12 in relation to the tank 11, it is sufficient for a small quantity of water to be transferred from the latter to actuate the pressure switch 28. This means that the delay between the triggering instant of the siphon 15, corresponding to the filling of the tank 11, and the closure instant of the solenoid valve 3, corresponding to the interruption in the flow of the water into the tank 11, is very short, and that consequently the control of the quantity of water loaded is very precise. When the level of water in the chamber 23 of the transfer recipient 12 exceeds level L4, the siphon 16 is triggered and transfers water into the second transfer recipient 13. The siphon 14 detriggers as soon as the level of water in the tank 11 drops below L2, while the siphon 15, drawing off from the bottom of the tank 11, remains triggered until the latter has been completely emptied. The siphon 16 remains triggered until the first pressure chamber 12 has been emptied: the two siphons 15 and 16 therefore remain triggered until the tank 11 has been completely emptied. The existence of the breather pipes 32 and 33 and the hole 34 allows, as mentioned previously, the same air pressure to be maintained inside the second transfer recipient 13 and the chamber 23 of the first transfer recipient 12. In this way the siphons 15 and 16 can effectively remain in a triggered condition until the tank 11 and the first transfer recipient 12 have been emptied.

The siphon 29 having been triggered, the water is transferred into the collection basin 10 from the second transfer recipient 13, via the pipe 30.

When the tank 11 has been totally emptied, the siphon 15 is dettriggered. The level of water in the first transfer recipient 12 starts to fall, under the transfer action of the siphon 16. When this level falls below a recovery level L6, the pressure switch 28 signals this condition to the programming device, and the programming device reopens the solenoid valve 3. The tank 11 begins to fill once again, and thus a new cycle, identical to the previous one, begins.

Since, as mentioned previously, the tank 11 is dimensioned so as to have a capacity equal to half of the quantity of water required for total loading of the dishwasher, at the end of the second cycle the level of water in the washing drum 1 of the dishwasher reaches the required level L5 (static level). As before, when the tank 11 has been totally emptied, and the level of water in the first transfer recipient 12 has again dropped below L6, the pressure switch 28 indicates this condition to the programming device, which causes the advance to a subsequent phase of the washing cycle, maintaining the solenoid valve 3 closed. When the pump 6 is switched on, the level of water in the tank 1 falls in relation to L5, dropping below the perforated plate 31. This allows, among other things, elimination of additional nozzles for cleaning the plate 31.

There is also a safety control of the level of water in the drum, to prevent overflows as a result of excessive loads of water in the washing drum 1, caused for example by a fault in the programming device, or by manual intervention thereon which alters the predefined sequence of operations, for example bringing the programming device to a load start position. This safety control is actuated through the chamber 35 of the second transfer recipient 13: when the level of water in the drum 1 exceeds a maximum safety level, which is translated into a level L7 in the pressure chamber 35, the pressure of air in the chamber 35 exceeds a predetermined value, and causes actuation of the lock pressure switch 38, which causes closure of the solenoid valve 3. The presence of this safety control allows, among other things, the user to deliberately adjust the programming device, altering the predefined sequence to perform additional loads of water. This takes place in complete safety, since on exceeding the predefined safety level the flow of water is automatically interrupted.

It is also possible to perform a washing cycle with loading of more water than the usual 5 litres, for example 6 litres. It is in fact sufficient for the programming device to inhibit the command from the pressure switch 28, and actuate a time control of the opening of the solenoid valve 3. During emptying of the tank 11 by the siphon 15, an additional quantity of water is fed to the tank 11 to top up the 2.5 litre capacity of the tank. The

additional quantity of water is determined by the time of opening of the solenoid valve 3 after the pressure switch 28 has been actuated.

During a washing cycle of the dishwasher, a phase of regeneration and rinsing of the decalcifying resins is normally carried out. As already mentioned, regeneration provides for flowing of water from the collection recipient 47, with capacity of around 350 cm², to the segment 49 of the decalcifier 21 to form a mixture of water and salts, and from the segment 49 to the segment 48 containing resins, which are thus regenerated. For subsequent rinsing of the resins, it is sufficient to perform a partial load of 2.5 litres of water, corresponding to filling the tank 11. The clean water entering the decalcifier in this way rinses the resins.

The control device described is particularly insensitive to the changes in flow rate and/or pressure of the water supply system. Experimental tests have shown that, by using as a feed solenoid valve a standard solenoid valve calibrated to 6.5 l/min., a variation from 0.8 atm to 3.5 atm in the pressure of the incoming flow of water means a variation of 0.2 l in the quantity of water at complete load (that is to say a variation of between 4.9 l and 5.1 l), which represents an extremely satisfactory tolerance.

The passage of the water from the second transfer recipient 13 to the collection basin 10 (through the pipe 30 and the siphon end 29 of the chamber 13 itself) is never made difficult by possible deposits of residue or dirt, in that this passage is cleaned by the flow of water at each load. Moreover, when the pump 6 is in motion, a pulsating movement of water is caused in the basin 10 to prevent adherence of dirt to the walls of the chamber 10 and inside the pipe 30.

Figure 3 shows a particularly convenient embodiment of an assembly of control devices according to the invention and of an "air jump" assembly. The control device remains substantially unchanged compared to the previous embodiment, but the "air jump" assembly is also inserted in the cavity 17 between the wall 18 of the washing drum 1 and the wall 19 of the framework 2 of the dishwasher. Moreover, this solution is suitable for production as a single part, using the aforementioned technique of blow moulding. In this way the overall dimensions and the assembly times are reduced, factors which both affect production costs.

A conduit 55, connected to the solenoid valve 3, develops within the cavity 17 and is connected to the decalcification assembly 21. The conduit 55 has at the top an opening 58, for performing the "air jump" function, which leads into a collection recipient 56 below, with a capacity of approximately 350 cm³, wherein the water flowing from the opening is collected, and which has similar func-

tions to the container 47 of Figure 1. From here, the water flows through a conduit 57 and is conveyed to the segment 49 of the decalcification assembly 21 containing the regeneration salts.

A condensation conduit 54 is also formed into which the conduit 51, leading to the washing drum 1, outflows, as does the breather pipe 32 which leads to the second transfer recipient 13. This condensation conduit is considerably effective, having a much more extensive condensation surface than that represented by the walls 52 of Figure 1. The condensation conduit 54 is also shaped so as to provide tilted attachments 201 which define, with the walls of the conduit 54 itself, micro containers of water coming from the condensation of the steam leaving the basin of the conduit 51, or from the overflowing of the connection recipient 56, or again from the opening 58. In this way efficiency during the drying phase is increased.

Even if the device according to the invention has been described by making reference to the need to fill the dishwasher with a quantity of water of 5 litres, it is possible to alter the device in order to alter this quantity of water. For this purpose it is possible to vary both the volume of the tank 11, and to vary the heights of the various siphon pipes, so as to vary their drawing-off level: if for example a quantity of water of less than 5 litres is to be loaded, at the same time retaining a tank 11 of 2.5 litres, it is sufficient to lower the elbow of the siphon pipe 15, so as to lower the level L1 of its drawing-off. Transfer of the tank 11 will start therefore when the volume of water contained therein is less than 2.5 litres, and the pressure switch 28 will cause closure of the solenoid valve 3 before the tank 11 has been filled.

Claims

1. Device for controlling the level of the washing liquid in a dishwasher, comprising a tank (11) with capacity equal to a fraction of the quantity of liquid to be loaded into a washing drum (1) of the dishwasher and fed via a feed solenoid valve (3), characterised in that it comprises first means (14,15) for transferring liquid from said tank (11) to a transfer recipient (12) of smaller capacity than the tank (11), which first means are actuated when the tank (11) has been filled and de-actuated when all the liquid contained in the tank (11) has been transferred, a pressure chamber (24) leading into said transfer recipient (12) where to pressure detector means (27,28) are associated and which are actuated when the level of the liquid transferred into said recipient (12) exceeds a first preset level (L3) to cause the closure of said feed solenoid valve (3), and second

means (16,13,30) for transferring liquid from said transfer recipient (12) to the washing drum (1), which second means are actuated when the level of the liquid transferred into said transfer recipient (12) exceeds a second preset level (L4), greater than the first level (L3).

2. Control device according to claim 1, characterised in that said first means (14,15) comprise a first siphon pipe (15) with a mouth on the base of the tank (11) and ending in said transfer recipient (12) which is positioned at a lower height from the ground compared to the tank (11), said first siphon (15) automatically triggering when the tank (11) has been completely filled and remaining triggered until the tank (11) has been completely emptied.
3. Control device according to claim 2, characterised in that said first means (14,15) comprise a second siphon pipe (14), with a mouth at the top of the tank (11) and ending in the transfer recipient (12), which is automatically triggered when the tank (11) has been filled and the flow rate of liquid of the first siphon pipe (15) is less than the flow rate of liquid fed by said feed solenoid valve (3).
4. Control device according to claim 1, 2 or 3, characterised in that said second means (16,13,30) comprise a third siphon pipe (16) with a mouth on the base of said transfer recipient (12), which automatically triggers when the level of the liquid in said transfer recipient (12) exceeds said second predefined level (L4), and ending in an additional transfer recipient (13) positioned at a lower height from the ground compared to said transfer recipient (12) and leading into the washing drum (1).
5. Control device according to claim 4, characterised in that said additional transfer recipient (13) is connected via a fourth siphon pipe (29,30) to a collection basin (10) positioned below the washing drum (1) and connected thereto.
6. Control device according to claim 5, characterised in that said collection basin (10) feeds liquid to a pump (6) which in turn feeds liquid diffusers (5) located inside the washing drum (1).
7. Washing device according to claim 5 or 6, characterised in that said collection basin (10) is connected to a pump for draining the washing liquid from the dishwasher.

8. Control device according to claim 5, characterised in that said additional transfer recipient (13) is connected to a respective additional pressure chamber (35) where to relative pressure detector means (37,38) are related for causing the closure of the feed solenoid valve (3) when the level of liquid in the washing drum (1) exceeds a predefined safety level. 5
9. Control device according to claim 4, characterised in that vent pipes (32,33) are provided for maintaining the air pressure inside said transfer recipients (12,13) constantly at the value of atmospheric pressure. 10
10. Control device according to one of the previous claims, characterised in that it is housed in a cavity (17) between a lateral wall (18) of the washing drum (1) and a lateral wall (19) of an external framework (2) of the dishwasher. 15 20
11. Control device according to claim 10, characterised in that said cavity also houses an air jump assembly (55,58), a recipient (56) for collecting liquid for regenerating decalcifying resins of a decalcification assembly (21) and a condensation conduit (54) leading into the inside of the washing drum (1) and to the outside of the dishwasher for condensation and release of the steam generated in the drum (1) during washing. 25 30
12. Control device according to any one of the previous claims, characterised in that said tank (11) has a capacity equal to half of the volume of liquid to be loaded into the drum of the dishwasher. 35

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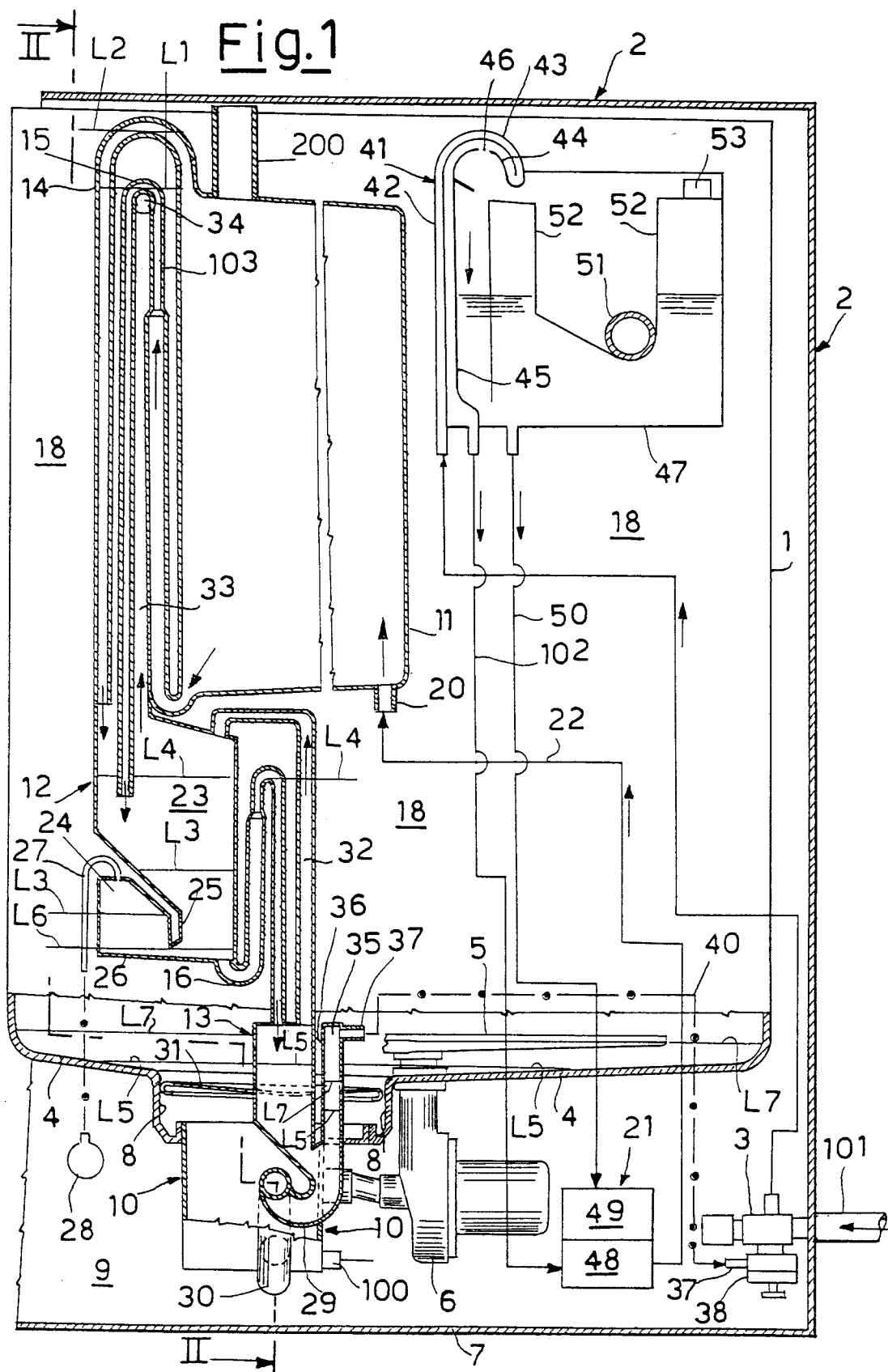


Fig. 2

