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(54) OPERATING CYCLE FOR A DISHWASHER

BETRIEBSZYKLUS EINER GESCHIRRSPÜLMASCHINE

CYCLE DE FONCTIONNEMENT D'UN LAVE-VAISSELLE

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(73) Proprietor: **Bonferraro S.p.A.**
37060 Bonferraro (VR) (IT)

(72) Inventors:
- **AMBROSI, Andrea**
  37052 Casaleone VR (IT)
- **PINAROLI, Eros**
  37060 Castel d'Azzano VR (IT)
- **REBECCHI, Fulvio**
  46100 Mantova MN (IT)
- **ZIVIANI, Diego**
  46037 Roncoferraro MN (IT)
- **TOSI, Mauro**
  37051 Bovolone VR (IT)
- **ROSSATO, Andrea Carlo**
  37054 Nogara VR (IT)

(74) Representative: **Concone, Emanuele et al**
Società Italiana Brevetti S.p.A.
Via Carducci 8
20123 Milano (IT)

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Description

[0001] The present invention relates to dishwashers, both for domestic and professional use, and in particular to a dishwasher operating cycle for performing an intermediate cleaning of the hydraulic circuit.

[0002] It is well known that the increasingly stringent regulations concerning the energy classes of household appliances, and in particular of dishwashers, push manufacturers to reduce the operating temperatures and the volumes of water used, so that the same quantity of dishes to be treated with less wash water leads the latter to a higher concentration of dirt and detergent. As the hydraulic circuit inevitably has areas where stagnation occurs at the end of the wash water drainage phase, these stagnation areas become more polluted and it is therefore even more important to eliminate them in order to have water that is as clean as possible in the subsequent rinse phases.

[0003] To this purpose, after the wash phase and before the final rinse with hot water, an intermediate rinse is traditionally carried out with cold water, to reduce energy consumption, in order to remove the residues of polluted water that remain after the drainage of the wash water. In this way, the hydraulic circuit is cleaned in preparation for the final rinse, which must be carried out with water that is as clean as possible, but at the same time there is the disadvantage that the hydraulic circuit, the wash tank and the dishes are also cooled.

[0004] As a result, compared to a cycle without an intermediate rinse, the dishwasher is forced to heat the final rinse water more, resulting in a higher energy consumption. Obviously, it would be possible to avoid this by also using hot water for the intermediate rinse, but the overall energy consumption would not change because the heating for the intermediate rinse would compensate for the reduction in heating for the final rinse. Similarly, it would be possible to dispense with the intermediate rinse, but in that case the water for the final rinse would be polluted with not fully satisfactory washing results.

[0005] To overcome these drawbacks, it is known from EP 2759244B1 to introduce mains water into the dishwasher through the wash pump while it is turned off, so that the water fed into the wash pump flows through it and from there goes directly to the bottom sump of the wash tank through the relevant connecting pipes, from where it is discharged by activating the drain pump. In this way, an almost complete disposal of the residual wash liquid can be achieved without affecting the wash tank and dishes by moving the water inlet from the sump to the wash pump.

[0006] However, it has been found that due to the pressure of the wash pump during normal operation, the wash liquid can flow back into the mains water line with the risk of undesirable contamination.

[0007] To solve this problem, DE 102017129052A1 describes a dishwasher equipped with a mains water supply line controlled by a two-way valve with a first outlet leading to the bottom sump of the wash tank, as in conventional dishwashers, and a second outlet leading to the delivery duct of the wash pump. In the intermediate rinse phase, water can be loaded by switching the valve to the second outlet while the wash pump is off and the drain pump is running. In this way, the advantage of EP 2759244B1 of washing only the most critical areas of the hydraulic circuit, without affecting the wash tank and dishes, is maintained, but during normal operation of the wash pump there is no risk of contamination in the mains water line. In fact, in that phase the two-way valve is switched to the first outlet and thus prevents the backflow of washing liquid from the delivery duct of the wash pump.

[0008] This second solution is also not without drawbacks, as it requires an expensive and bulky two-way valve and a more complex hydraulic circuit. In addition, both of the above-mentioned prior art solutions involve a non-negligible consumption of water, since the water is immediately discharged by the drain pump as soon as it enters the sump after flowing back through the delivery duct and the wash pump.

[0009] EP 2926709A1 discloses another dishwasher that allows an intermediate rinse limited to the most critical parts of the hydraulic circuit without introducing water into the washing tank.

[0010] The object of the present invention is therefore to provide a dishwasher which overcomes said drawbacks. This object is achieved by means of a dishwasher provided with an operating cycle that allows to perform the intermediate rinse simply by reducing the rotational speed of the wash pump and/or the amount of water to be used in said phase, so that the water arrives to the lower sprayer support and, through the opening in said support that is already present to vent air, can leak down into the sump without being delivered through the lower sprayer. Other advantageous features of the present dishwasher are specified in the dependent claims.

[0011] The main advantage of the dishwasher according to the present invention is that it is possible to carry out the intermediate rinse by limiting it to the most critical areas of the hydraulic circuit, without affecting the wash tank and the dishes, and without having to make any modification/integration to the hydraulic circuit. This result in a reduction of the dishwasher cost both in terms of components and labor for its assembly, since the hydraulic circuit is simpler and less bulky with respect to the above-cited prior art dishwashers.

[0012] A further advantage of this dishwasher and its operating cycle derives from the fact that the intermediate rinse phase requires less water consumption, both due to the smaller amount of water that is loaded and because the drain pump is activated only at the end of this phase, so that the water loaded for this phase can be circulated several times for a better cleaning of the affected portion of the hydraulic circuit.

[0013] These and other advantages and features of the dishwasher and its operating cycle according to the present invention will be apparent to those skilled in the art from the following detailed description of an embodiment thereof, with reference to the accompanying drawings in which:

Fig.1 is a schematic view illustrating the connections between the main elements of the dishwasher;
Fig.2 is a top plan view of the bottom elements of the hydraulic circuit of the dishwasher;
Fig.3 is a rear top perspective view similar to Fig.2;
Fig.4 is a partial sectional view along line A-A of Fig.2;
Fig.5 is a view similar to Fig.4 with the addition of the stem of the lower sprayer; and
Fig.6 is a schematic vertical sectional view showing the circulation of water during the intermediate rinse.

[0014] Referring to Figs.1-2, it can be seen that a dishwasher according to the present invention traditionally comprises a load duct, controlled by a shut-off solenoid valve 1, for loading mains water from a tap to an air break 2, then passing through a softener 3 containing descaling resins, to be finally loaded into a sump 4 at the bottom of the wash tank through a first inlet 5. The water is then withdrawn for the wash/rinse phases, through an outlet 6, by a wash pump 7, preceded by a resistor 8 arranged on the suction duct 9. The wash pump 7 sends the water to the sprayers 10, 11 through a delivery duct 12, a second inlet 20 and a diverter valve, which controls the inflow to the various sprayers via its three outlets 16, 17, 18 (there is also a third sprayer, not shown, on the ceiling of the wash tank). The machine further comprises a drain pump 13, for sending water from sump 4 to a drain duct 14.

[0015] As shown in Figs. 3-6, the lower sprayer 10 is engaged through its stem 10a on a support 15 mounted on the first outlet 16 of the diverter valve, while the upper sprayer 11 and the sprayer on the ceiling of the wash chamber are fed through ducts extending from the second outlet 17 and the third outlet 18 of the diverter valve, respectively. Support 15 has an opening 15a in its lower region, flush with the abutment resting on top of the first outlet 16, this opening 15a being usually used for venting air from the hydraulic circuit. When the lower sprayer 10 is engaged, via its stem 10a, on the support 15, a small gap 19 remains between these two elements at the opening 15a, allowing air to be vented through the opening 15a.

[0016] It should be noted that during normal wash and rinse phases, the static water pressure at gap 19 is very low, due to the Venturi effect generated by the convergent shape of the lower part 15b of support 15 followed by the divergent shape of stem 10a; therefore, the water leakage through gap 19 and opening 15a is negligible.

[0017] The novel aspect of this dishwasher is that it is possible to reduce the dynamic water pressure at gap 19, so as to increase the static pressure and make virtually all the water leak into sump 4 through gap 19 and opening 15a.

[0018] In the light of the above description and with the help of Fig.6, the simple and effective operation of the dishwasher according to the present invention is readily understandable.

[0019] As mentioned above, in the intermediate rinsing phase, it is essential that the pressure P of the water circulated by the wash pump 7 has a value at least equal to a minimum value P1 such that the water can escape from the spray support 15 through the opening 15a, otherwise the water would not be recirculated, but less than a maximum value P2 that causes water to flow out of the lower sprayer 10, otherwise water would be sprayed on the bottom of the wash tank or even on the dishes resulting in a reduction of their temperature and energy expenditure in bringing them back to temperature for the final rinse.

[0020] In the intermediate rinse phase, only outlet 16 of the diverter valve is open, while all other outlets 17, 18 are closed. The amount of water loaded into sump 4 through inlet 5 is between 25% and 60% of the volume V of the part of the hydraulic circuit to be cleaned, that is, the part between outlet 6 of sump 4 and outlet 16 of the diverter valve.

[0021] The wash pump 7 circulates water only in the lower part of the dishwasher hydraulic circuit, drawing it in from sump 4 through the suction duct 9 and resistor 8, and then sending it back to sump 4 along the delivery duct 12 and through the second inlet 20. When the circuit cleaning is finished, the water is discharged by the drain pump 13 through the drain duct 14, leaving the wash/rinse circuit clean and ready for the final rinse.

[0022] Note that the duration of the intermediate rinse phase and the amount of water loaded for this phase (indicatively 200-300 ml) can be freely chosen depending on the specific circuit cleaning requirements. In addition, this phase could be divided into multiple sub-phases, that is, it could include multiple sequences of water loading, circuit cleaning, and water draining.

[0023] The amount of water is comprised within the above range of 25-60% of volume V when the wash pump 7 operates at a rotational speed similar to that used in the other phases of the operating cycle, indicatively with a reduction of up to 20%. In the case where the pump operates at even lower speeds, this allows for an increase in the upper limit of the range of the amount of water that is offset by the reduced pump speed (while the lower limit remains unchanged). For example, if the speed reduction of pump 7 is 40% the upper limit of the loaded water can be 80% of V, if the speed reduction reaches 60% the upper limit can be up to 120% of V (with other intermediate values basically proportional).

[0024] In this way, the energy consumption of pump 7 is reduced and there is more water available for cleaning, which can then be more thorough and faster, at the expense of higher water consumption.

[0025] Thus, the relevant operating cycle of a dishwasher according to the present invention can be summarized in the following steps:

(a) initial loading of water into sump 4;
(b) performing of the wash phase;
(c) discharge of the wash water;
(d) closing of all outlets of the diverter valve except outlet 16 towards the lower sprayer 10;
(e) loading water for the intermediate rinse into sump 4;
(f) activation of the wash pump 7;
(g) deactivation of the wash pump 7;
(h) discharge of the intermediate rinse water;
(i) opening of all outlets of the diverter valve;
(j) loading the final rinse water into sump 4;
(k) performing of the final rinse phase;
(l) discharge of the final rinse water;

in which the combination of the amount of water loaded in step (e) with the rotational speed of the wash pump 7 in step (f) generates a water pressure P equal to at least a value P1 that allows water to escape from the sprayer support 15 through the opening 15a, but less than a value P2 that causes water to be delivered from the lower sprayer 10, i.e., $P1 \leq P < P2$.

[0026] Note that, as mentioned earlier, the sequence of steps e)-h) could also be performed several times, and steps c)-d) could be swapped, as could steps i)-j).

[0027] From the above, it is easy to understand how the dishwasher according to the present invention can perform the final rinse with less energy consumption, since the wash tank and the dishes have not been cooled by the cold water loaded in the previous phase. Moreover, the quantity of water required for washing the wash/rinse circuit, which is in any case the part of the hydraulic circuit with the greatest stagnation of polluted water, is significantly less than that required for a traditional intermediate rinse. All of this without having to intervene on the dishwasher structure, but only on the mode of carrying out the intermediate rinse.

[0028] Note that softener 3 and/or air break 2 could be absent, and that in the case of an industrial dishwasher, pump 7 and sprayers 10, 11 would only be intended for washing and there would be a further pump and two further sprayers specifically intended for rinsing, but the part of the circuit illustrated in the figures would not change.

[0029] It is clear that the embodiment of the dishwasher according to the above-described and illustrated invention is only an example susceptible to numerous variations. In particular, the diverter valve could have a different number of outlets depending on the number of sprayers, and the exact shape and arrangement of ducts 9, 12, 14 and of inlets 5 and 20, as well as of the possible softener 3 and/or air break 2, may be freely varied according to specific constructional requirements, as long as their relative arrangement within the hydraulic circuit illustrated above is maintained.

Claims

1. Operating cycle for a dishwasher comprising:

- a load valve (1) controlling the inflow of water from the mains through a load duct to load water into a bottom sump (4) through an inlet (5);
- a wash pump (7) that draws water from said bottom sump (4) through a suction duct (9) and sends it to a plurality of sprayers (10, 11) through a delivery duct (12) and a diverter valve that controls the flow of water to said sprayers (10, 11) through a corresponding plurality of outlets (16, 17, 18);
- a drain pump (13) connected to a drain duct (14) so as to discharge water from the bottom sump (4);
- a support (15) mounted on the outlet (16) of the diverter valve towards a lower sprayer (10), said support (15) having an opening (15a) in its lower region and said lower sprayer (10) being engaged through a stem (10a) thereof onto the support (15) such that a small gap (19) remains between these two elements at said opening (15a);

said operating cycle comprising the following steps:

(a) initial loading of water into the bottom sump (4);
(b) performing of the wash phase;
(c) discharge of the wash water;
(d) closing of all outlets of the diverter valve except the outlet (16) towards the lower sprayer (10);
(e) loading water for the intermediate rinse into the bottom sump (4);
(f) activation of the wash pump (7);
(g) deactivation of the wash pump (7);
(h) discharge of the intermediate rinse water;
(i) opening of all outlets of the diverter valve;
(j) loading the final rinse water into the bottom sump (4);
(k) performing of the final rinse phase;
(l) discharge of the final rinse water;

characterized in that the combination of the amount of water loaded in step (e) with the rotational speed of the wash pump (7) in step (f) generates a water pressure P equal to at least a value P1 that allows water to escape from the support (15) through the opening (15a), but less than a value P2 that causes water to be delivered from the lower sprayer (10);
and **in that** steps (c)-(d) could be swapped, as could steps (i)-(j).

2. Operating cycle according to claim 1, **characterized in that** the sequence of steps (e)-(h) is performed several times

3. Operating cycle according to claim 1 or 2, **characterized in that** in step (e) there is loaded an amount of water comprised between 25% and 60% of the volume of the portion of the hydraulic circuit comprised between the outlet (6) of the sump (4) to which the suction duct (9) is connected and the outlet (16) of the diverter valve towards the lower sprayer (10).

4. Operating cycle according to claim 1 or 2, **characterized in that** in step (e) there is loaded an amount of water comprised between 25% and 80% of the volume of the portion of the hydraulic circuit comprised between the outlet (6) of the sump (4) to which the suction duct (9) is connected and the outlet (16) of the diverter valve towards the lower sprayer (10), and in step (f) the wash pump (7) operates at a rotational speed reduced by about 40% with respect to the rotational speed used in the other steps of the operating cycle.

5. Operating cycle according to claim 1 or 2, **characterized in that** in step (e) there is loaded an amount of water comprised between 25% and 120% of the volume of the portion of the hydraulic circuit comprised between the outlet (6) of the sump (4) to which the suction duct (9) is connected and the outlet (16) of the diverter valve towards the lower sprayer (10), and in step (f) the wash pump (7) operates at a rotational speed reduced by about 60% with respect to the rotational speed used in the other steps of the operating cycle.

Patentansprüche

1. Betriebszyklus für eine Geschirrspülmaschine, umfassend:

   - ein Einbringungsventil (1), das den Wasserzufluss von der Hauptleitung durch einen Einbringungskanal steuert, um Wasser durch einen Einlass (5) in eine Bodenwanne (4) einzubringen;
   - eine Waschpumpe (7), die Wasser aus dem unteren Sumpf (4) durch einen Saugkanal (9) ansaugt und es durch einen Abgabekanal (12) an eine Vielzahl von Sprühvorrichtungen (10, 11) sendet, und ein Ablenkerventil, das den Wasserfluss zu den Sprühvorrichtungen (10, 11) durch eine entsprechende Vielzahl von Auslässen (16, 17, 18) steuert;
   - eine Ablaufpumpe (13), die an einen Ablaufkanal (14) angeschlossen ist, um Wasser aus der Bodenwanne (4) abzulassen;
   - eine Halterung (15), die an dem Auslass (16) des Ablenkerventils zu einer unteren Sprühvorrichtung (10) hin angebracht ist, wobei die Halterung (15) in ihrem unteren Bereich eine Öffnung (15a) aufweist und die untere Sprühvorrichtung (10) durch einen Schaft (10a) davon auf der Halterung (15) derart in Eingriff genommen ist, dass zwischen diesen zwei Elementen an der Öffnung (15a) ein kleiner Spalt (19) verbleibt;

   der Betriebszyklus umfassend die folgenden Schritte:

   (a) anfängliches Einbringen von Wasser in die Bodenwanne (4);
   (b) Durchführen der Waschphase;
   (c) Ablassen des Waschwassers;
   (d) Schließen aller Auslässe des Ablenkerventils mit Ausnahme des Auslasses (16) zu der unteren Sprühvorrichtung (10) hin;
   (e) Einbringen von Wasser für die Zwischenspülung in die Bodenwanne (4);
   (f) Aktivierung der Waschpumpe (7);
   (g) Deaktivierung der Waschpumpe (7);
   (h) Ablassen des Zwischenspülwassers;
   (i) Öffnen aller Auslässe des Ablenkerventils;
   (j) Einbringen des letzten Spülwassers in die Bodenwanne (4);
   (k) Durchführen der letzten Spülphase;
   (l) Ablassen des letzten Spülwassers;

   dadurch gekennzeichnet, dass die Kombination der in Schritt (e) eingebrachten Wassermenge mit der Rotationsgeschwindigkeit der Waschpumpe (7) in Schritt (f) einen Wasserdruck P erzeugt, der mindestens gleich einem Wert P1 ist, der es ermöglicht, dass Wasser aus der Halterung (15) durch die Öffnung (15a) entweicht, jedoch kleiner als ein Wert P2 ist, der dazu führt, dass Wasser aus der unteren Sprühvorrichtung (10) abgegeben wird;
   und **dadurch, dass** die Schritte (c) - (d) sowie die Schritte (i) - (j) ausgetauscht werden könnten.

2. Betriebszyklus nach Anspruch 1, **dadurch gekennzeichnet, dass** die Abfolge der Schritte (e)-(h) mehrmals durchgeführt wird.

3. Betriebszyklus nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** in Schritt (e) eine Wassermenge eingebracht wird, die zwischen 25 % und 60

% des Volumens des Abschnitts des Hydraulikkreislaufs beträgt, der zwischen dem Auslass (6) der Wanne (4), an den der Saugkanal (9) angeschlossen ist, und dem Auslass (16) des Ablenkerventils zu der unteren Sprühvorrichtung (10) hin liegt.

4. Betriebszyklus nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** in Schritt (e) eine Wassermenge eingebracht wird, die zwischen 25 % und 80 % des Volumens des Abschnitts des Hydraulikkreislaufs beträgt, der zwischen dem Auslass (6) der Wanne (4), an den der Saugkanal (9) angeschlossen ist, und dem Auslass (16) des Ablenkerventils zu der unteren Sprühvorrichtung (10) hin liegt, und in Schritt (f) die Waschpumpe (7) mit einer um etwa 40 % geringeren Rotationsgeschwindigkeit als die in den anderen Schritten des Betriebszyklus verwendete Rotationsgeschwindigkeit in Betrieb ist.

5. Betriebszyklus nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** in Schritt (e) eine Wassermenge eingebracht wird, die zwischen 25 % und 120 % des Volumens des Abschnitts des Hydraulikkreislaufs beträgt, der zwischen dem Auslass (6) der Wanne (4), an den der Saugkanal (9) angeschlossen ist, und dem Auslass (16) des Ablenkerventils zu der unteren Sprühvorrichtung (10) hin liegt, und in Schritt (f) die Waschpumpe (7) mit einer um etwa 60 % geringeren Rotationsgeschwindigkeit als die in den anderen Schritten des Betriebszyklus verwendete Rotationsgeschwindigkeit in Betrieb ist.

Revendications

1. Cycle de fonctionnement d'un lave-vaisselle comprenant :

- une vanne de charge (1) régulant l'arrivée d'eau en provenant des réseaux principaux par le biais d'un conduit de charge pour charger l'eau dans un puisard de fond (4) par le biais d'une entrée (5) ;
- une pompe de lavage (7) qui aspire l'eau dudit puisard de fond (4) par le biais d'un conduit d'aspiration (9) et l'envoie à une pluralité pulvérisateurs (10, 11) par un conduit de refoulement (12) et une vanne de dérivation qui régule le flux d'eau vers lesdits pulvérisateurs (10, 11) par le biais d'une pluralité correspondante de sorties (16, 17, 18) ;
- une pompe de vidange (13) raccordée à un conduit de vidange (14) afin de vidanger l'eau du puisard de fond (4) ;
- un support (15) monté sur la sortie (16) de la vanne de dérivation vers un pulvérisateur inférieur (10), ledit support (15) ayant une ouverture (15a) dans sa région inférieure et ledit pulvérisateur inférieur (10) étant mis en prise par une tige (10a) de celui-ci sur le support (15) de telle sorte qu'un petit espace (19) demeure entre ces deux éléments au niveau de ladite ouverture (15a) ;

ledit cycle de fonctionnement comprend les étapes suivantes consistant à :

(a) charger de manière initiale l'eau dans le puisard de fond (4) ;
(b) réaliser la phase de lavage ;
(c) évacuer l'eau de lavage ;
(d) fermer toutes les sorties de la vanne de dérivation à l'exception de la sortie (16) vers le pulvérisateur inférieur (10) ;
(e) charger l'eau pour le rinçage intermédiaire dans le puisard de fond (4) ;
(f) activer la pompe de lavage (7) ;
(g) désactiver la pompe de lavage (7) ;
(h) évacuer l'eau de rinçage intermédiaire ;
(i) ouvrir toutes les sorties de la vanne de dérivation ;
(j) charger l'eau de rinçage final dans le puisard de fond (4) ;
(k) réaliser la phase de rinçage final ;
(l) évacuer l'eau de rinçage final ;

caractérisé en ce que la combinaison de la quantité d'eau chargée à l'étape (e) avec la vitesse de rotation de la pompe de lavage (7) à l'étape (f) génère une pression d'eau P égale au moins à une valeur P1 qui permet à l'eau de s'échapper du support (15) par le biais de l'ouverture (15a), mais inférieure à une valeur P2 qui amène l'eau à être refoulée par le pulvérisateur inférieur (10) ;
et **en ce que** les étapes (c) à (d) pourraient être interverties, de même que les étapes (i) à (j).

2. Cycle de fonctionnement selon la revendication 1, **caractérisé en ce que** la séquence d'étapes (e) à (h) est réalisée plusieurs fois.

3. Cycle de fonctionnement selon la revendication 1 ou 2, **caractérisé en ce que,** à l'étape (e), une quantité d'eau est chargée comprise entre 25 % et 60 % du volume de la partie du circuit hydraulique comprise entre la sortie (6) du puisard (4) auquel est raccordé le conduit d'aspiration (9) et la sortie (16) de la vanne de dérivation vers le pulvérisateur inférieur (10).

4. Cycle de fonctionnement selon la revendication 1 ou 2, **caractérisé en ce que,** à l'étape (e), une quantité d'eau est chargée comprise entre 25 % et 80 % du volume de la partie du circuit hydraulique comprise entre la sortie (6) du puisard (4) auquel est raccordé le conduit d'aspiration (9) et la sortie (16) de la vanne de dérivation vers le pulvérisateur inférieur (10), et **en ce que**, à l'étape (f), la pompe de lavage (7) fonctionne à une vitesse de rotation réduite d'environ 40 % par rapport à la vitesse de rotation utilisée dans les autres étapes du cycle de fonctionnement.

5. Cycle de fonctionnement selon la revendication 1 ou 2, **caractérisé en ce que,** à l'étape (e), une quantité d'eau est chargée comprise entre 25 % et 120 % du volume de la partie du circuit hydraulique comprise entre la sortie (6) du puisard (4) auquel est raccordé le conduit d'aspiration (9) et la sortie (16) de la vanne de dérivation vers le pulvérisateur inférieur (10), et **en ce que**, à l'étape (f), la pompe de lavage (7) fonctionne à une vitesse de rotation réduite d'environ 60 % par rapport à la vitesse de rotation utilisée dans les autres étapes du cycle de fonctionnement.

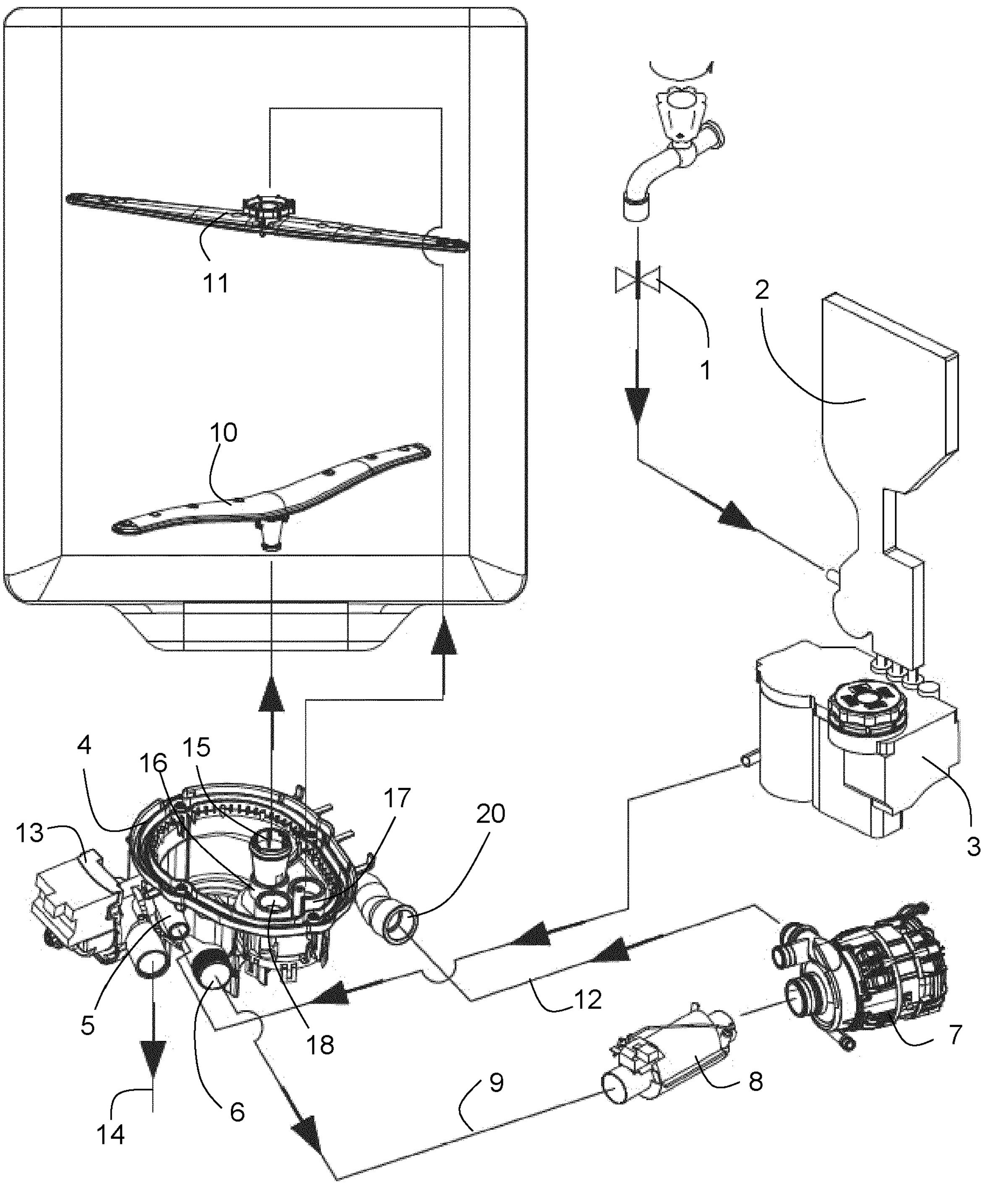

FIG.1

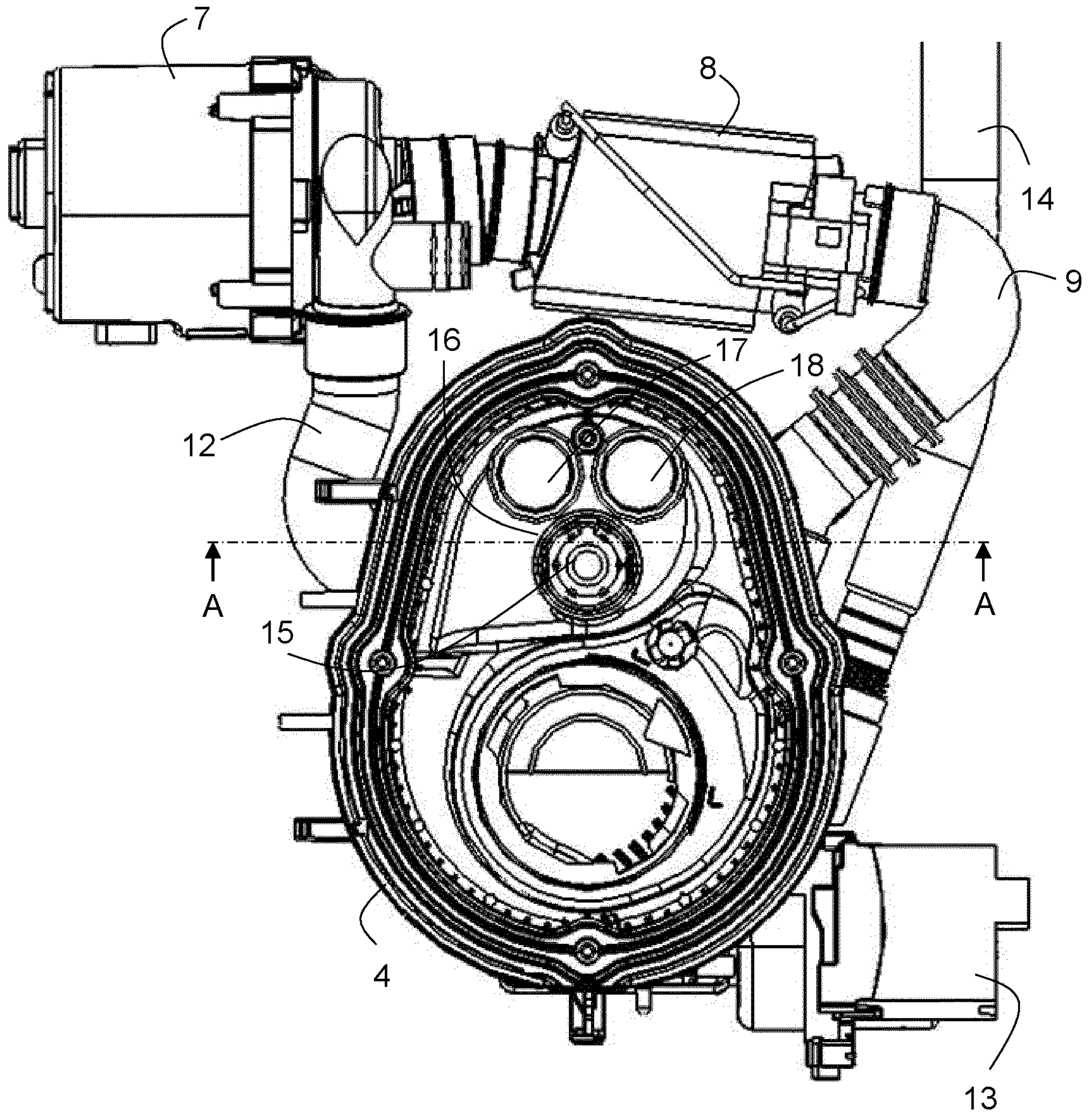

FIG.2

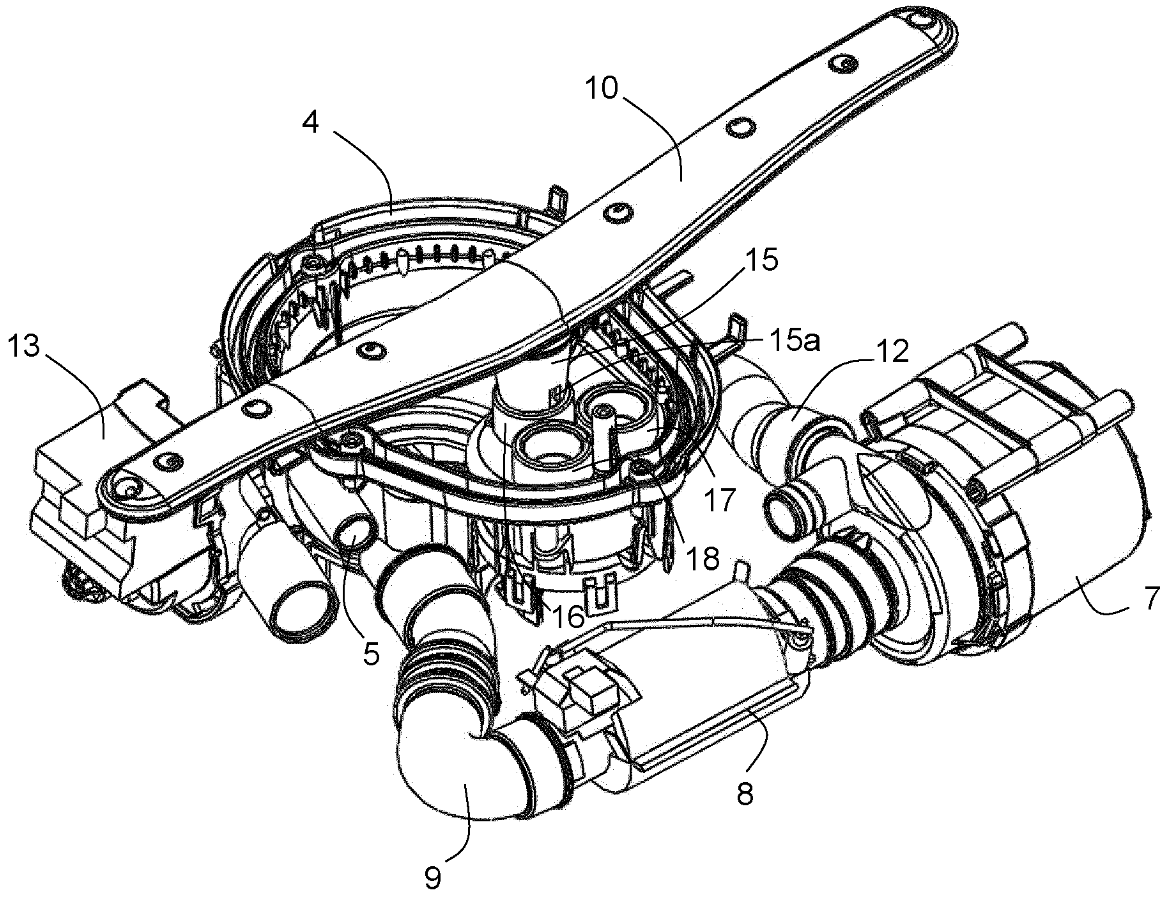

FIG.3

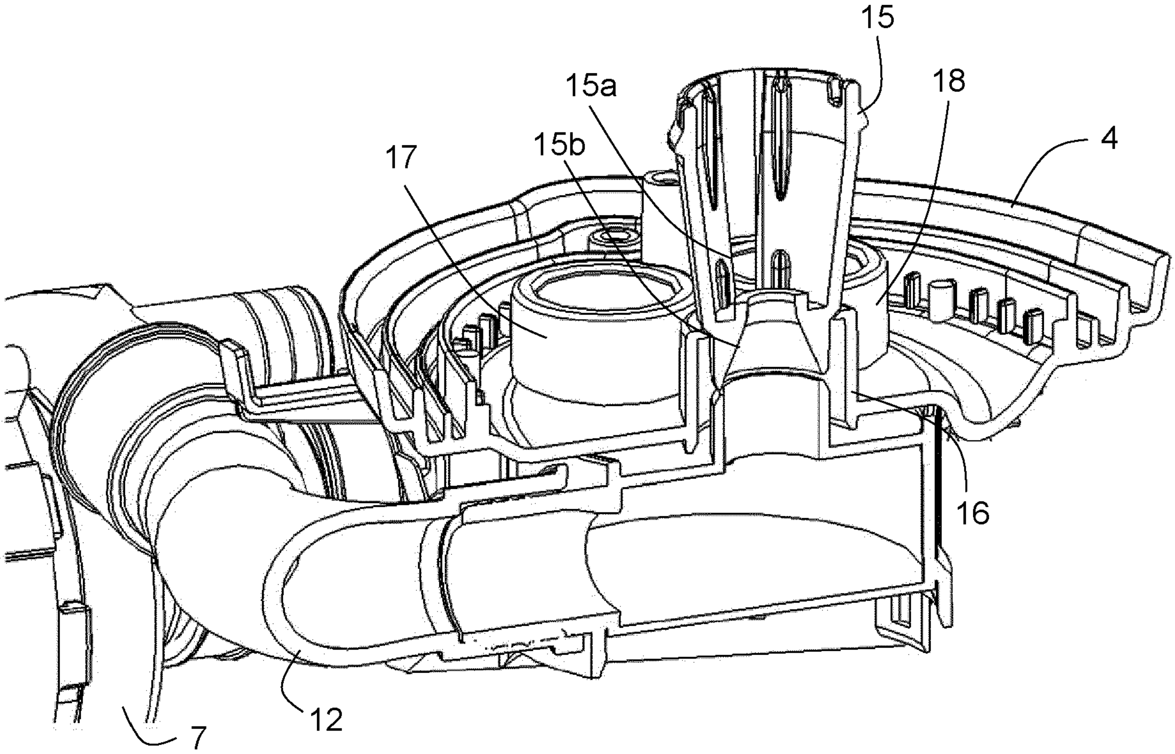

FIG.4

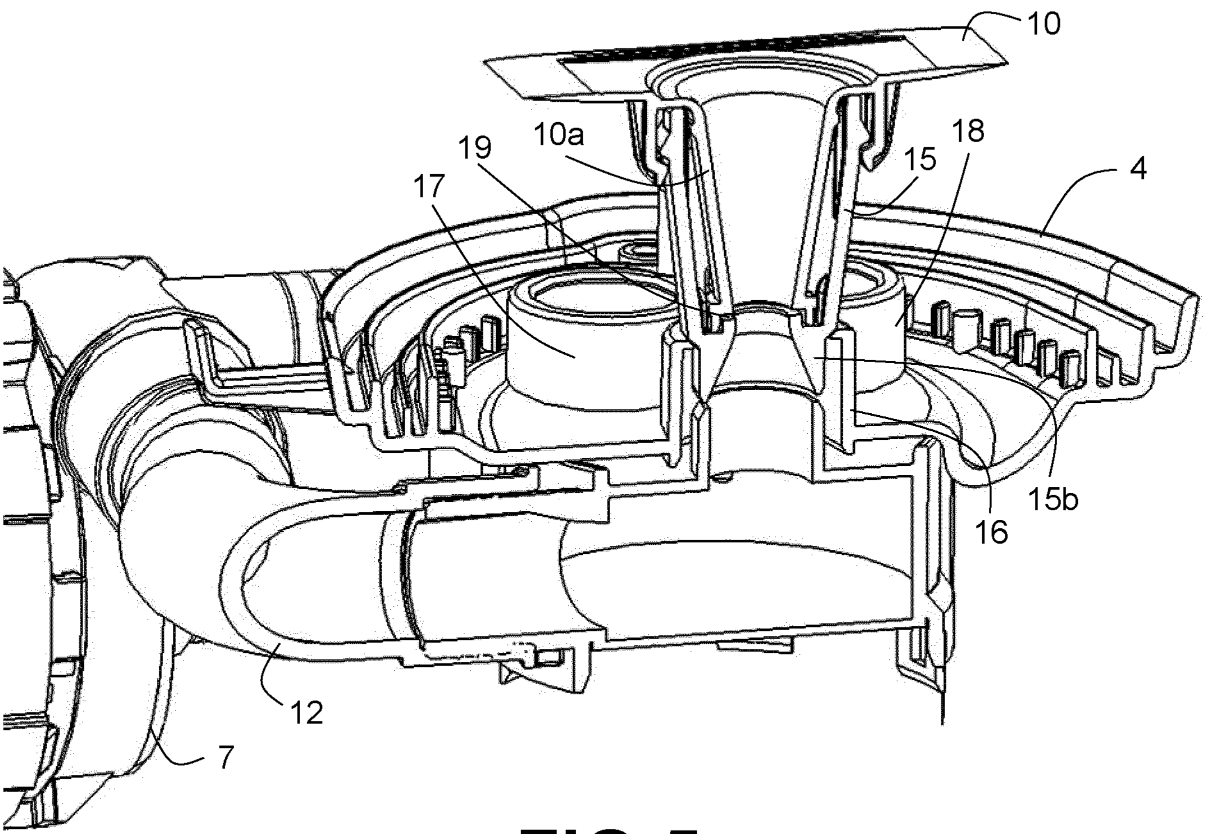

FIG.5

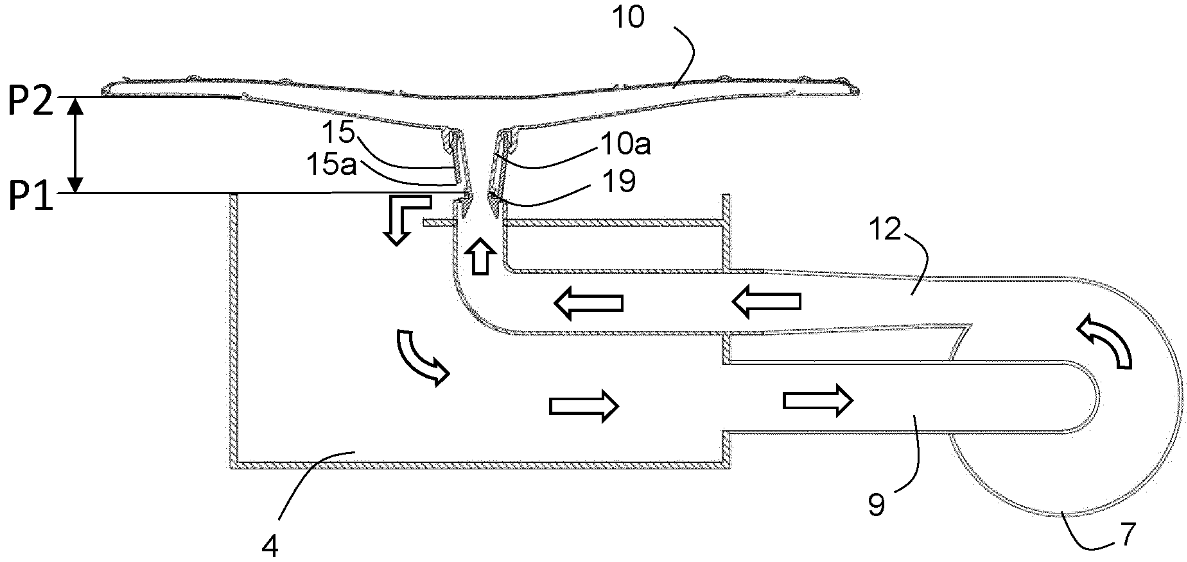

FIG.6

REFERENCES CITED IN THE DESCRIPTION

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