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(54) **SYSTEM FOR WATER REUSE IN A HOUSEHOLD APPLIANCE, AND HOUSEHOLD APLIANCE
EQUIPPED WITH SAID SYSTEM**

SYSTEM ZUR WASSERWIEDERVERWENDUNG IN EINEM HAUSHALTSGERÄT UND MIT
BESAGTEM SYSTEM AUSGESTATTETES HAUSHALTSGERÄT

SYSTÈME POUR LA RÉUTILISATION DE L'EAU DANS UN APPAREIL MÉNAGER ET UN TEL
APPAREIL ÉQUIPÉ DUDIT SYSTÈME

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EP 3 034 673 B1

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Description

Field of the invention

[0001] The present invention relates to a system for water reuse in a household appliance, as well as to a household appliance equipped with said system. For example, document EP0396515A1 relates to a system for water reuse in a household appliance of a similar type.

Background art

[0002] In the household appliances known in the art, in particular washing machines, washing/drying machines and dishwashers, during the various stages of the wash cycle a washing liquid, typically water, needs to be fed into the wash tub. Typically, this water is taken from the domestic water mains, and the intake water flow is controlled by an electrovalve. The water intake stage is called "supply stage".

[0003] At certain stages it is also necessary to drain the wash liquid into a domestic drain system, typically by means of a drain pump included in the appliance. This wash liquid outflow stage is called "drain stage".

[0004] The total quantity of water necessary for completing a work cycle of the household appliance is quite large and will then be completely lost, since it will be drained out. For example, a washing machine may use approx. 50 l of water per wash cycle. Of course, if we consider the total number of existing household appliances and the number of work cycles carried out by each one of them, the total quantity of consumed water is huge. Moreover, the water drained out contains detergents that are harmful for the environment.

[0005] Water is becoming more and more precious and must be used sparingly and with the utmost attention, also because of population increase and improved life conditions in an increasing number of countries, including developing ones, contributing to increased demand.

[0006] On the other hand, we are witnessing a phenomenon according to which electric energy will be more and more available, cheap and ecological in the future and, thanks to advanced technologies, the various forms of generation and use of renewable energy, e.g. solar, aeolian, will improve the global energetic efficiency.

[0007] Therefore, a need is felt for household appliances with reduced or even null water consumption, even at the cost of higher power consumption.

Summary of the invention

[0008] The present invention therefore aims at providing a system for water reuse in a household appliance, as well as a household appliance equipped with said system, which can overcome the above-mentioned problems.

[0009] The present invention relates to a system for water reuse configured for use in a household appliance

comprising a washing assembly with a water containment tub, characterized in that it comprises:

- a first tank adapted to contain water to be supplied into said tub;
- a second tank adapted to contain water coming from said tub;
- distilling and condensing means adapted to purify the water in said second tank and to supply purified water into said first tank;
- means for controlling the water supply into said first tank, so that any water coming from outside said household appliance will only be fed into said first tank.

[0010] The present invention also relates to a household appliance comprising said system for water reuse.

[0011] It is a particular object of the present invention to provide a system for water reuse in a household appliance, and a household appliance equipped with said system, as set out in the claims, which are an integral part of the present description.

Brief description of the drawings

[0012] Further objects and advantages of the present invention will become apparent from the following detailed description of a preferred embodiment (and variants) thereof referring to the annexed drawings, which are only supplied by way of non-limiting example, wherein:

Figure 1 shows a block diagram of the main components of a first variant of the system for water reuse of the present invention;

Figure 2 shows a block diagram of the main components of a second variant of the system;

Figure 3 shows a block diagram of the main components of a third variant of the system.

[0013] In the drawings, the same reference numerals and letters identify the same items or components.

Detailed description of some embodiments of the invention

[0014] In the non-limiting examples described below, a household washing machine will be taken into account, the main components of which, for the purposes of the present invention, are located in a raised compartment at the bottom of the appliance, which is normally equipped with a washing assembly GL of a *per se* known type.

[0015] With reference to Figure 1, inside the raised compartment two washing liquid tanks are accommodated: a tank S1 adapted to contain clean water, taken in a *per se* known manner, e.g. from the water main by an electrovalve EV1, having a capacity of, for example, 50

1, and a tank S2 adapted to contain the water drained during the operation of the appliance, having dimensions similar to those of S 1.

[0016] Both tanks are preferably provided with a level sensor, respectively PR1, PR2, which may be a pressure switch or the like, and which, as is *per se* known, controls the filling condition and can stop the water supply.

[0017] For taking the water from the tank S1 a peristaltic pump PP1 is preferably employed (e.g. having a flow rate of approx. 7 l/min.); the water taken in is then supplied to the washing assembly GL, preferably through a detergent dispenser drawer D1.

[0018] Preferably, for draining the water a pump will not be necessary, since a simple valve V2 (e.g. a thermally actuated valve) at the inlet of the tank S2 will suffice, due to the fact that the water resulting from the wash can enter the tank S2 by gravity, S2 being located at a lower level than the tub of the washing assembly GL.

[0019] An electrovalve EV1 performs the function of initially filling the main tank S1 and subsequently topping it up.

[0020] Associated with the tank S2 (e.g. inside of it), a distilling device RD, e.g. containing heating resistors, is used for boiling the water in S2 so that it can be distilled.

[0021] Distillation may occur, for example, by letting the steam flow through a coil made by using roll-bond technology, e.g. positioned in the rear part of the household appliance. A fan may be associated therewith for better cooling, thus improving the distillation process.

[0022] Preferably, there is also an extractable drawer C 1 for containing the dry residue, which allows cleaning the tank S2 after the distillation stage, when dry residue may remain inside that needs to be removed.

[0023] When the washing machine is started, it supplies to the tank S1 the quantity of water necessary for filling it up.

[0024] At the beginning of the cycle, water is supplied into the tub of the washing assembly GL through the peristaltic pump PP1.

[0025] The water level in the tub of the washing assembly GL depends, as is known, on a preset value, and is controlled by means of a pressure switch PRL.

[0026] Once the wash stage is over, the valve V2 opens to allow the water in the tub to flow out into the tank S2, preferably through an impurity filter of a known type (not shown in the drawing), which can be inspected and cleaned. This filter may be the filter of the drain pump normally included in the washing machine. Its presence is important to trap objects such as coins, buttons or the like, which might cause problems to the distillation device.

[0027] At this point, while more water is supplied from S 1 to the tub of the washing assembly for the rinse stages, a first distillation stage can be started by boiling the water in the tank S2. At this stage it is also possible to exploit the residual heat of the washing water to shorten the distillation time.

[0028] Through the effect of distillation, the steam

reaches an exchanger/condenser GC, which generates condensed water.

[0029] Preferably, the exchanger/condenser GC is positioned higher than S1, e.g. behind or under the top of the washing machine, so that the condensed water will return by gravity into the tank S 1. It may also be positioned in the back part of the washing machine.

[0030] As the wash cycle continues, the rinse water and the final spin water will be drained into the tank S2, and the distillation process will go on until the water contained in the tank S2, which flows back into S1, will be evaporated.

[0031] When the distillation process is complete, one can access the tank S2 in order to clean it, after releasing the drawer C1, preferably under control of a temperature sensor T1 because during or at the end of the distillation stage the temperature of the tank S2 will be high, thus requiring a safety lock.

[0032] Cleaning of the drawer C1 is preferably effected only as necessary; an audible or visual warning may be provided to inform the user that the drawer is full and needs cleaning. In order to activate the warning signal it is conceivable, for example, to count the cycles carried out or to use an optical sensor.

[0033] The drawer C1 is preferably enveloped in a disposable bag, in which the dry residue stays confined.

[0034] Of course, the material of the extractable drawer and of the bag is heat resistant.

[0035] Access to the tank S2 is preferably allowed by a door that, in addition to being protected by a safety lock, is also equipped with a known waterproof system to prevent leakage of the steam that is formed inside the tank during the distillation process.

[0036] The tank S2 is preferably provided with a vent valve VS, which intervenes in case of overpressure caused by the increased temperature of the boiling water.

[0037] At the end of the entire washing process, in the load there will remain a given quantity of water (e.g. 1 to 10 l), depending on the quantity of load and the spin speed. If this quantity of water cannot be recovered and supplied again into the tank S1, e.g. because it has remained in humid laundry, it will have to be restored and, based on the information sent by the pressure switch PR1, fed into the tank S 1 through the supply electrovalve EV1.

[0038] If a drying cycle is carried out at the end of the wash cycle, then the water extracted from the load during the drying process can be fed again into the tank S1, whether directly or after having been conveyed into the tank S2, so that it will be recovered by means of the above-described process; in such a case, the water level in S1 will need topping up less often.

[0039] In accordance with a second variant of the above-described example of the system, with reference to Figure 2, a measuring device ST1 is included for measuring the degree of impurity of the water in the tub of the washing assembly GL.

[0040] The measuring device ST1 is designed in a *per*

se known manner, e.g. for measuring the degree of dirt, turbidity, alkalinity, conductivity, transparency of the water, and hence of the detergent residue contained therein.

[0041] When determining the destination of the water exiting the tub of the washing assembly GL based on the wash program, the water will be fed into either the tank S 1 or the tank S2 depending on the impurity level detected. Water having a high impurity level, over a certain threshold, will be drained into the tank S2 through a valve V2 to be subjected to distillation as previously described, whereas water having an impurity level under the threshold, e.g. rinse water, will be fed again directly into the tank S1 through the valve V1 and reused without undergoing distillation, e.g. for a subsequent wash cycle or an intermediate rinse cycle.

[0042] The other elements of the second variant comply with the above description relating to the first variant.

[0043] In accordance with a third variant of the above-described example of embodiment of the system, with reference to Figure 3, in addition to the tank S2 there is also a third tank S3: based on the detections made by the measuring device ST1, relating to the degree of impurity of the water in the tub of the washing assembly GL, which device is of the above-described type, the water exiting the tub of the washing assembly GL is fed into the tank S3, if the quantity of residues therein is minimal or null, e.g. as a result of rinse operations, and can be directly reused for the next cycles without having to undergo distillation. In this case, the water is preferably brought from the tank S3 to the tub of the washing assembly GL, for reuse, by means of a peristaltic pump PP2.

[0044] The water exiting the tub of the washing assembly GL, on the other hand, is fed into the tank S2, if it has a high impurity level, and is subjected to distillation prior to being reused, i.e. supplied again into the tank S1 as described.

[0045] The tanks S2 and S3 are equipped with respective pressure switches PR2 and PR3 of the above-described type.

[0046] Preferably, the sum of the capacities of the tanks S2 and S3 equals the capacity of the tank S2 of the previous variant.

[0047] The other elements of the third variant comply with the above description relating to the first variant.

[0048] In any case, it is preferable to include components for draining the water outside the household appliance, e.g. to allow cleaning/maintenance/transportation operations. For this purpose, screw plugs at the tanks will suffice.

[0049] Water consumption is much reduced or even eliminated, with important benefits in terms of water supply cost and, most importantly, a drastic reduction of water bed pollution. At every wash cycle, demineralized water will be used which will allow using a smaller quantity of detergent.

[0050] The wash cycle can use more water than is currently used, because reuse will ensure reduced water

bed consumption.

[0051] The distillation stage can start immediately at the end of the wash stage, with clean water always available in the main tank.

[0052] From the above description, those skilled in the art will be able to produce the object of the invention without introducing any further construction details.

10 Claims

1. System for water reuse, configured for use in a household appliance comprising a washing assembly (GL) with a water containment tub, said system comprising:

- a first tank (S1) adapted to contain water to be supplied into said tub;
- a second tank (S2, S2B) adapted to contain water coming from said tub;
- distilling and condensing means (RD, GC) adapted to purify the water in said second tank (S2) and to supply purified water into said first tank (S1);
- means for controlling the water supply into said first tank (S1), so that water coming from outside said household appliance will only be fed into said first tank,

characterized in that it comprises:

- a third tank (S3) adapted to contain water coming from said tub;
- measuring means (ST1) for measuring the degree of impurity of the water in said tub, said measuring means (ST1) being adapted to cause the water coming from said tub to be fed either into said third tank (S3), if said degree of impurity is lower than a second impurity threshold, or into said second tank (S2), if said degree of impurity is higher than said impurity threshold;
- means for controlling the water output from said third tank (S3), so that said water will only be fed into said tub.

2. System according to claim 1, comprising measuring means (ST1) for measuring the degree of impurity of the water in said tub, said measuring means (ST1) being adapted to cause the water coming from said tub to be fed either into said first tank (S1), if said degree of impurity is lower than a first impurity threshold, or into said second tank (S2), if said degree of impurity is higher than said impurity threshold.

3. System according to any one of the preceding claims, wherein said purifying means comprise distilling means (RD) followed by condensing means (GC), said distilling means producing water vapor,

which is conveyed towards said condensing means, and dry residue, said condensing means (GC) producing said water to be fed again into the first tank (S1).

4. System according to claim 3, comprising means for removing said dry residue.
5. System according to claim 3, wherein said condensing means (GC) are positioned higher than said first tank (S1) in said household appliance, so that said water to be fed again into the first tank (S1) will be fed into it by gravity.
6. System according to claim 1, comprising an impurity filter (FL) between the outlet of said tub and the inlet of said second tank (S2).
7. Household appliance comprising a system for water reuse according to any one of the preceding claims.

Patentansprüche

1. System zur Wiederverwendung von Wasser, welches zur Verwendung in einem Haushaltsgerät mit einer Waschanordnung (GL) mit einer Wasserbehälterwanne konfiguriert ist, wobei das System umfasst:

- einen ersten Tank (S 1), der dazu eingerichtet ist, dass er Wasser enthält, das in die Wanne zugeführt wird;
- einen zweiten Tank (S2, S2B), der dazu eingerichtet ist, dass er Wasser enthält, das aus der Wanne kommt;
- Destillations- und Kondensationsmittel (RD, GC), die dazu eingerichtet sind, um das Wasser in dem zweiten Tank (S2) zu reinigen und um dem ersten Tank (S1) gereinigtes Wasser zuzuführen;
- Mittel zum Steuern der Wasserzufuhr in den ersten Tank (S1) so dass Wasser, das von außerhalb des Haushaltsgeräts kommt, nur in den ersten Tank eingespeist wird, **dadurch gekennzeichnet, dass** es umfasst:

- einen dritten Tank (S3), der dazu eingerichtet ist, dass er Wasser enthält, das aus der Wanne kommt;
- Messmittel (ST1) zum Messen des Verunreinigungsgrades des Wassers in der Wanne, wobei die Messeinrichtung (S1) dazu eingerichtet ist, dass das aus der Wanne kommende Wasser entweder dem dritten Tank (S3) zugeführt wird, wenn dessen Verunreinigungsgrad niedriger ist als ein erster Verunreinigungsschwellenwert oder einem zweiten Tank (S2), wenn der Verunrei-

nungsgrad höher ist als der Verunreinigungsschwellenwert;

- Mittel zum Steuern des Wasserabgangs von dem dritten Tank (S3), so dass das Wasser nur der Wanne zugeführt wird.

2. System nach Anspruch 1, umfassend eine Messeinrichtung (ST1) zum Messen des Verunreinigungsgrades des Wassers in der Wanne, wobei die Messeinrichtung (ST1) dazu eingerichtet ist, das aus der Wanne kommende Wasser entweder dem ersten Tank (S1) zuzuführen, wenn der Verunreinigungsgrad niedriger als ein erster Verunreinigungsschwellenwert ist, oder einem zweiten Tank (S2), wenn der Verunreinigungsgrad höher ist als der Verunreinigungsschwellenwert.
3. System nach einem der vorhergehenden Ansprüche, wobei die Reinigungsmittel eine Destillationseinrichtung (RD) umfassen, gefolgt von einer Kondensationseinrichtung (GC), wo bei die Destillationseinrichtung Wasserdampf erzeugt, der zu der Kondensationseinrichtung transportiert wird, und Trockenrückstand, wobei die Kondensationseinrichtung (GC) das Wasser erzeugt, das dem ersten Tank (S1) wieder zugeführt wird,
4. System nach Anspruch 3, umfassend Mittel zum Entfernen des Trockenrückstandes.
5. System nach Anspruch 3, wobei die Kondensationseinrichtung (GC) höher als der erste Tank (S1) in dem Haushaltsgerät angeordnet ist, so dass das Wasser, das wieder dem ersten Tank (S1) zugeführt werden soll, durch Schwerkraft zugeführt wird.
6. System nach Anspruch 1, umfassend einen Verunreinigungsfilter (FL) zwischen dem Auslass der Wanne und dem Einlass des zweiten Tanks (S2).
7. Haushaltsgerät, umfassend ein System zur Wasserwiederverwendung nach einem der vorhergehenden Ansprüche,

Revendications

1. Système de réutilisation d'eau, configuré pour être utilisé dans un appareil électroménager comprenant un ensemble de lavage (GL) avec une cuve de retenue d'eau, ledit système comprenant :

- un premier réservoir (S1) adapté pour contenir de l'eau à fournir dans ladite cuve ;
- un deuxième réservoir (S2, S2B) adapté pour contenir de l'eau provenant de ladite cuve ;
- des moyens de distillation et de condensation (RD, GC) adaptés pour purifier l'eau dans ledit

deuxième réservoir (S2) et pour fournir de l'eau purifiée dans ledit premier réservoir (S1) ;
 - des moyens pour commander la fourniture d'eau dans ledit premier réservoir (S1), de sorte que l'eau provenant de l'extérieur dudit appareil électroménager soit uniquement apportée dans ledit premier réservoir,

cuve et l'orifice d'entrée dudit deuxième réservoir (S2).

- 5 7. Appareil électroménager comprenant un système de réutilisation d'eau selon l'une quelconque des revendications précédentes.

caractérisé en ce qu'il comprend :

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 - un troisième réservoir (S3) adapté pour contenir de l'eau provenant de ladite cuve ;
 - des moyens de mesure (ST1) pour mesurer le degré d'impureté de l'eau dans ladite cuve, lesdits moyens de mesure (ST1) étant adaptés pour que l'apport de l'eau provenant de ladite cuve soit dans ledit troisième réservoir (S3), si ledit degré d'impureté est inférieur à un second seuil d'impureté, ou soit dans ledit deuxième réservoir (S2), si ledit degré d'impureté est supérieur audit seuil d'impureté ;
 - des moyens pour commander l'eau fournie en sortie par ledit troisième réservoir (S3), de sorte que ladite eau soit uniquement apportée dans ladite cuve.
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2. Système selon la revendication 1, comprenant des moyens de mesure (ST1) pour mesurer le degré d'impureté de l'eau dans ladite cuve, lesdits moyens de mesure (ST1) étant adaptés pour que l'apport de l'eau provenant de ladite cuve soit dans ledit premier réservoir (S1), si ledit degré d'impureté est inférieur à un premier seuil d'impureté, ou soit dans ledit deuxième réservoir (S2), si ledit degré d'impureté est supérieur audit seuil d'impureté.
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3. Système selon l'une quelconque des revendications précédentes, dans lequel lesdits moyens de purification comprennent des moyens de distillation (RD) suivis des moyens de condensation (GC), lesdits moyens de distillation produisant de la vapeur d'eau, qui est transportée vers lesdits moyens de condensation, et un résidu sec, lesdits moyens de condensation (GC) produisant ladite eau à apporter à nouveau dans le premier réservoir (S1) .
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4. Système selon la revendication 3, comprenant des moyens pour éliminer ledit résidu sec.
5. Système selon la revendication 3, dans lequel lesdits moyens de condensation (GC) sont positionnés plus haut que ledit premier réservoir (S1) dans ledit appareil électroménager, de sorte que ladite eau à apporter à nouveau dans le premier réservoir (S1) sera apportée dans celui-ci par gravité.
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6. Système selon la revendication 1, comprenant un filtre d'impureté (FL) entre l'orifice de sortie de ladite

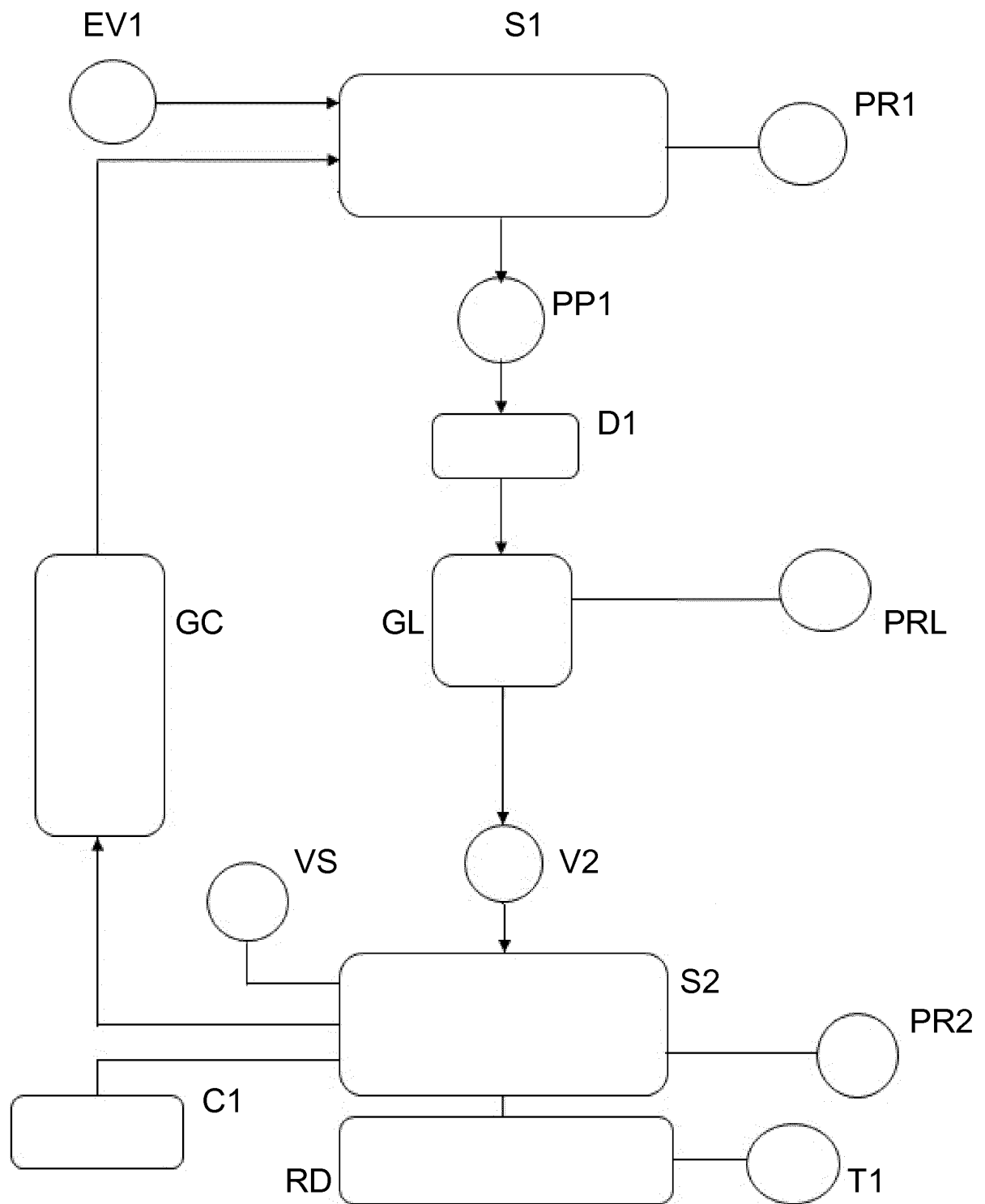
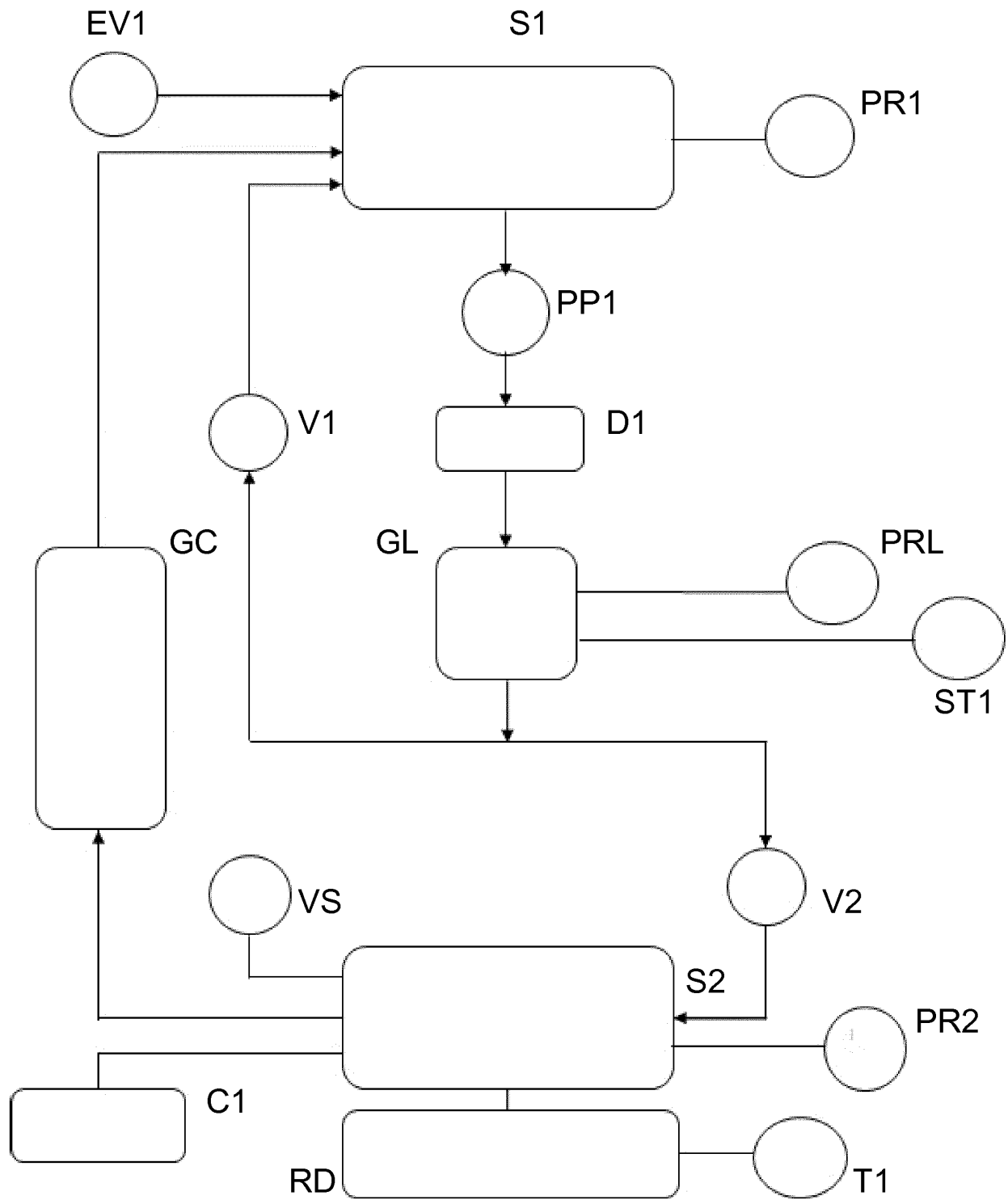


FIG. 1

**FIG. 2**

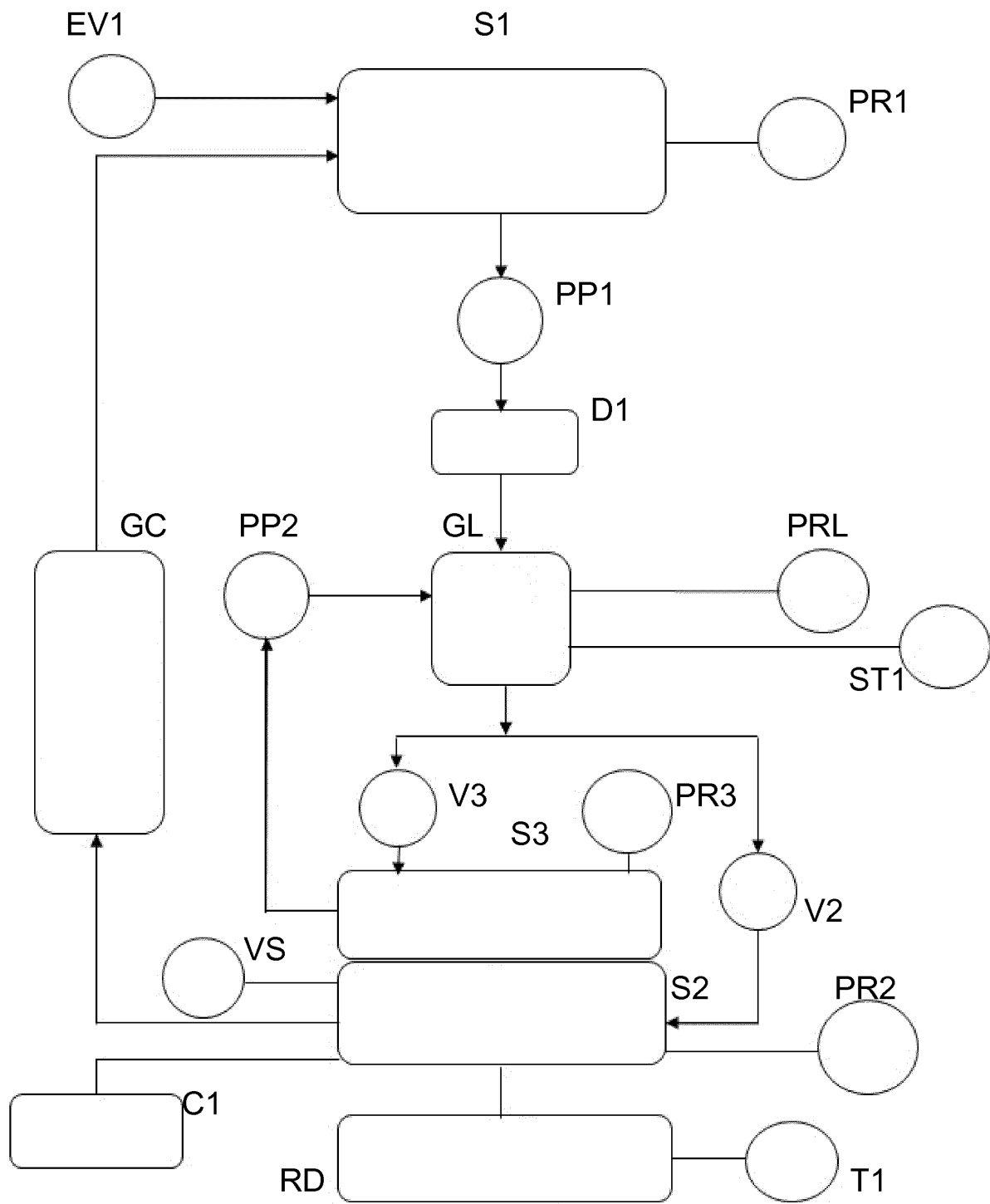


FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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