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

(57) A system for water reuse is described, configured for use in a household appliance comprising a washing assembly (GL) with a water containment tub, characterized in that it comprises:

- a first tank (S1) adapted to contain water to be supplied into said tub;
- a second tank (S2) 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 any water coming from outside said household appliance will only be fed into said first tank.

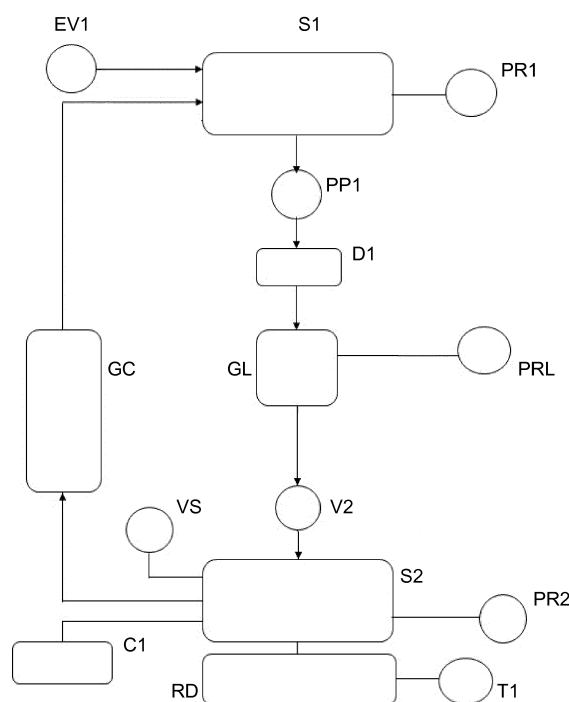


FIG. 1

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.

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 of embodiment 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 l, 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. Preferably, there is also an extractable drawer C1 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.

[0022] When the washing machine is started, it supplies to the tank S1 the quantity of water necessary for filling it up.

[0023] At the beginning of the cycle, water is supplied into the tub of the washing assembly GL through the peristaltic pump PP1.

[0024] 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.

[0025] 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.

[0026] At this point, while more water is supplied from S1 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.

[0027] Through the effect of distillation, the steam reaches an exchanger/condenser GC, which generates condensed water.

[0028] Preferably, the exchanger/condenser GC is po-

sitioned 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 S1. It may also be positioned in the back part of the washing machine.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] The drawer C1 is preferably enveloped in a disposable bag, in which the dry residue stays confined.

[0033] Of course, the material of the extractable drawer and of the bag is heat resistant.

[0034] 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.

[0035] 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.

[0036] 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 S1 through the supply electrovalve EV1.

[0037] 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.

[0038] In accordance with a second variant of the above-described example of embodiment 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.

[0039] 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.

[0040] 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 S1 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.

[0041] The other elements of the second variant comply with the above description relating to the first variant.

[0042] 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.

[0043] 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.

[0044] The tanks S2 and S3 are equipped with respective pressure switches PR2 and PR3 of the above-described type.

[0045] Preferably, the sum of the capacities of the tanks S2 and S3 equals the capacity of the tank S2 of the previous variant.

[0046] The other elements of the third variant comply with the above description relating to the first variant.

[0047] 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.

[0048] The above-described example of embodiment may be subject to variations without departing from the protection scope of the present invention, including all equivalent designs known to a man skilled in the art.

[0049] The elements and features shown in the various preferred embodiments may be combined together without however departing from the protection scope of the present invention. The advantages deriving from the application of the present invention are apparent.

[0050] Water consumption is much reduced or even eliminated, with important benefits in terms of water sup-

ply 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.

5 [0051] The wash cycle can use more water than is currently used, because reuse will ensure reduced water bed consumption.

[0052] The distillation stage can start immediately at the end of the wash stage, with clean water always available in the main tank.

10 [0053] 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.

15 Claims

1. System for water reuse, configured for use in a household appliance comprising a washing assembly (GL) with a water containment tub, **characterized in that** it comprises:

- 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.

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 claim 1, comprising:

- 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.

4. 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).
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5. System according to claim 4, comprising means for removing said dry residue.
6. System according to claim 4, 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.
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7. System according to claim 1, comprising an impurity filter (FL) between the outlet of said tub and the inlet of said second tank (S2).
8. Household appliance comprising a system for water reuse according to any one of the preceding claims.
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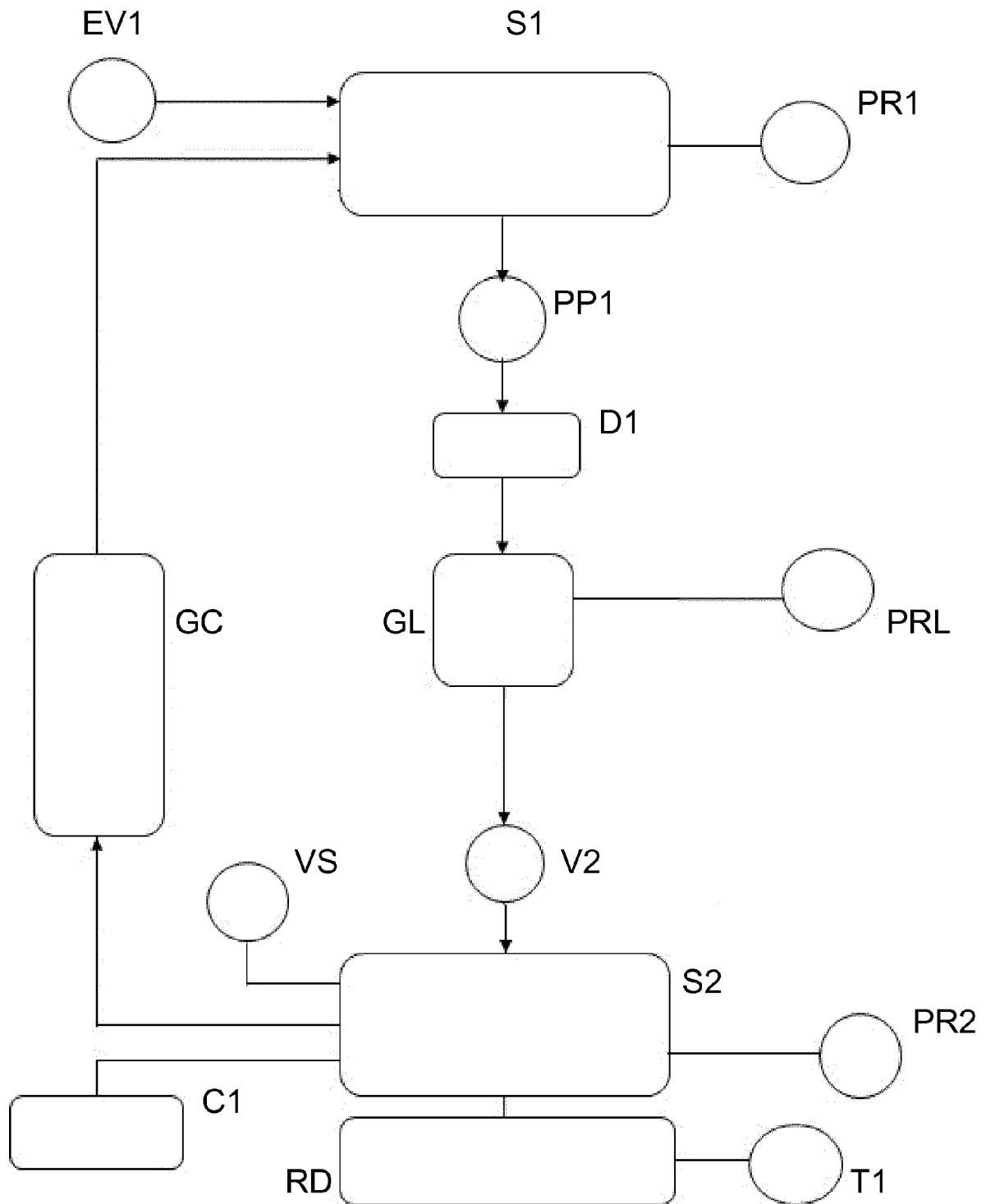


FIG. 1

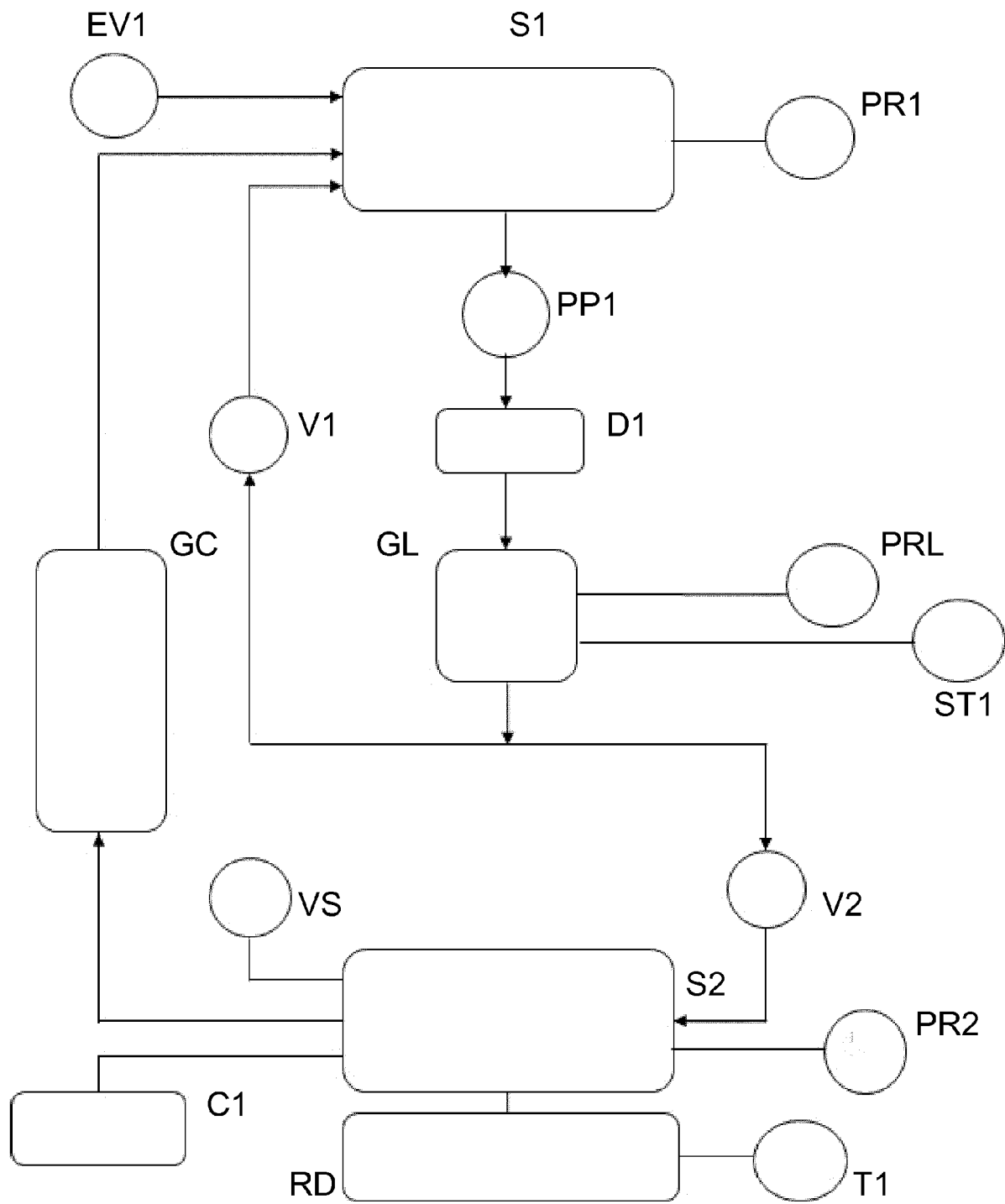


FIG. 2

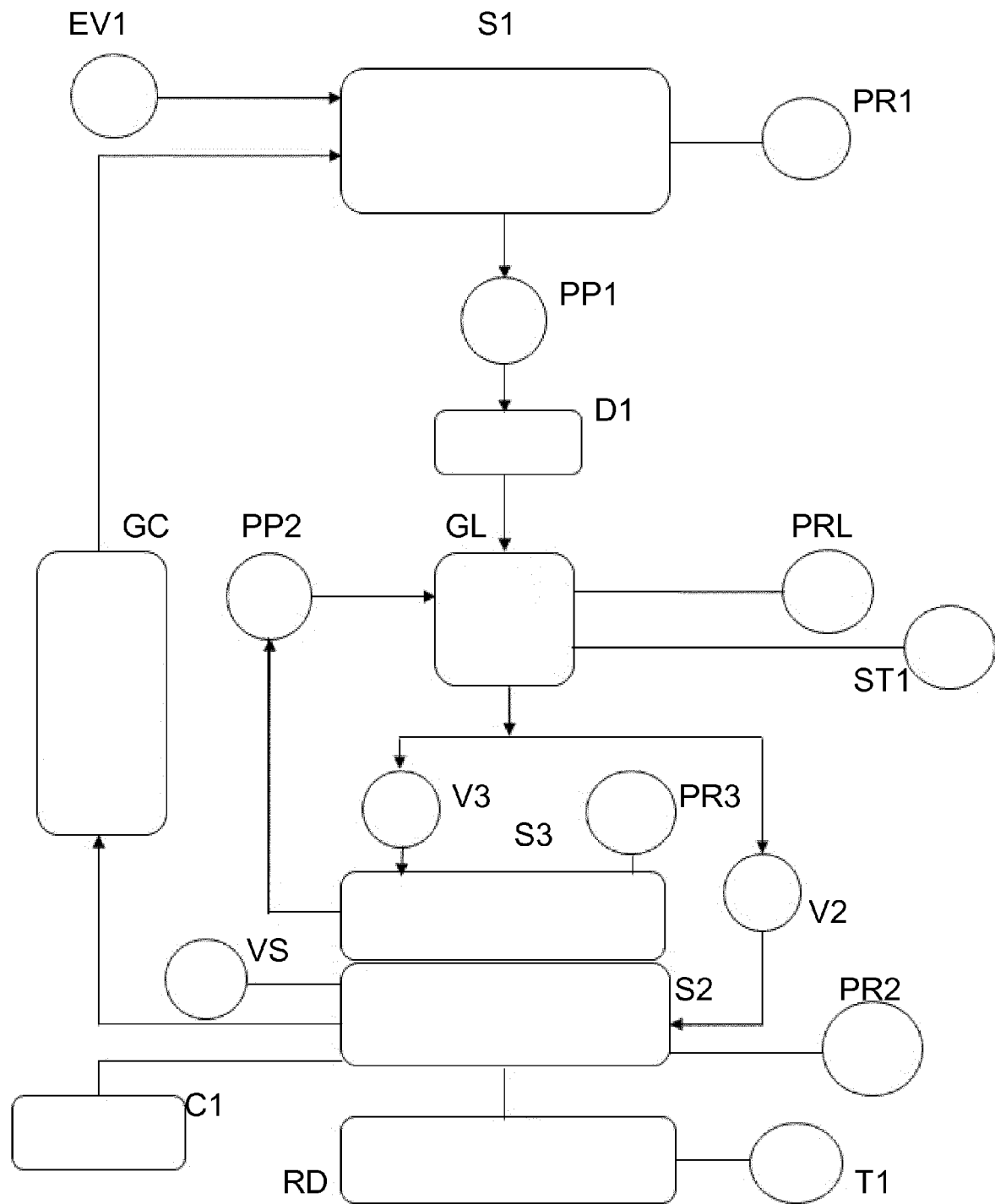


FIG. 3



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Application Number
EP 15 20 0070

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 2 May 2016	Examiner Diaz y Diaz-Caneja
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82