US 20120006355A1

(19) **United States**

(12) **Patent Application Publication**

Heidel et al.

(10) **Pub. No.: US 2012/0006355 A1**

(43) **Pub. Date: Jan. 12, 2012**

(54) **DISHWASHER**

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(21) Appl. No.: **13/165,818**

(22) Filed: **Jun. 22, 2011**

(30) **Foreign Application Priority Data**

Jul. 12, 2010 (DE) 10 2010 031 234.7

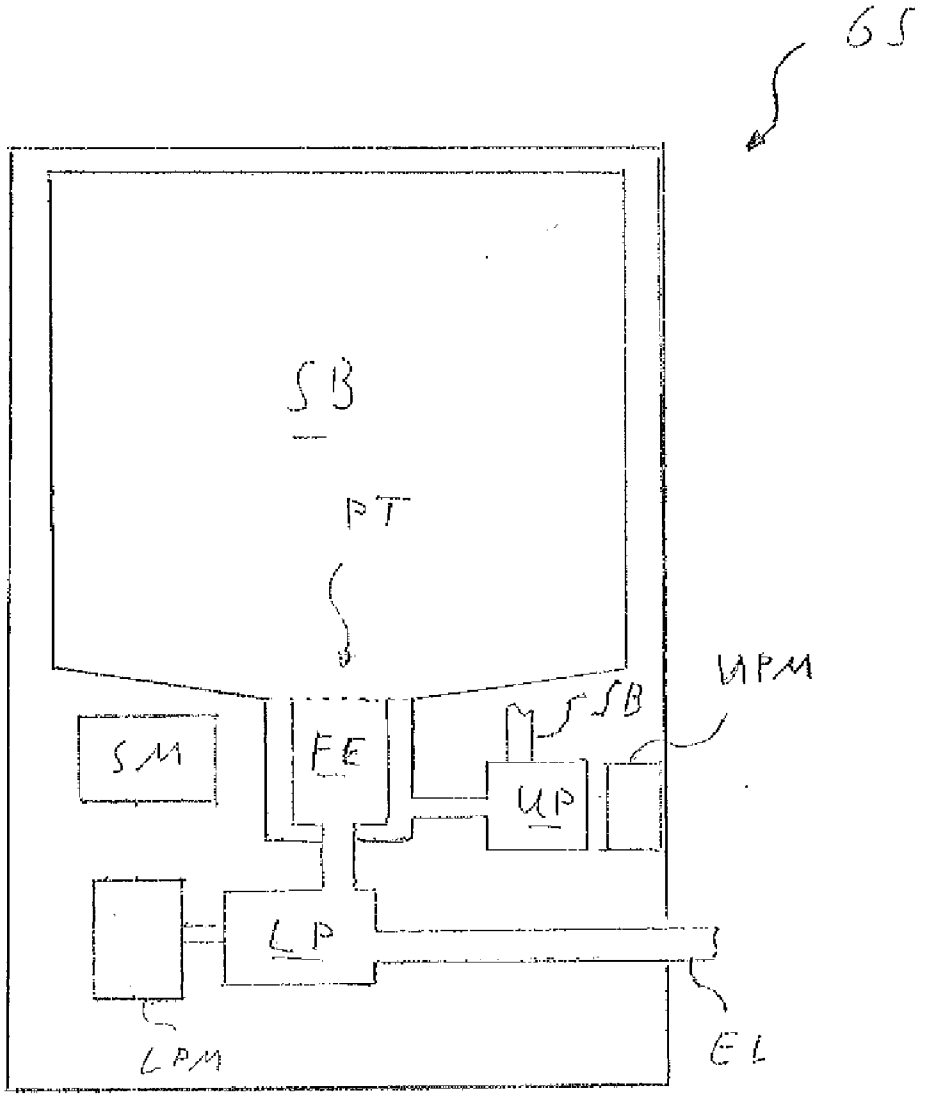
Publication Classification

(51) **Int. Cl.**
A47L 15/42 (2006.01)

(52) **U.S. Cl.** ..... **134/10**; 134/56 D

(57) **ABSTRACT**

A dishwasher, in particular a domestic dishwasher, includes at least one activatable circulating pump for directing liquid against food-soiled items to be cleaned, at least one activatable drain pump for discharging a minimum liquid volume of an operating liquid volume from a pump well of the dishwasher, and a filter unit for preventing soil particles contained in the liquid from reaching the circulating pump. After the drain pump has been activated for discharging the minimum liquid volume and then deactivated, the circulating pump can be activated and an operating parameter evaluated to determine whether there is a residual liquid volume remaining in the dishwasher.



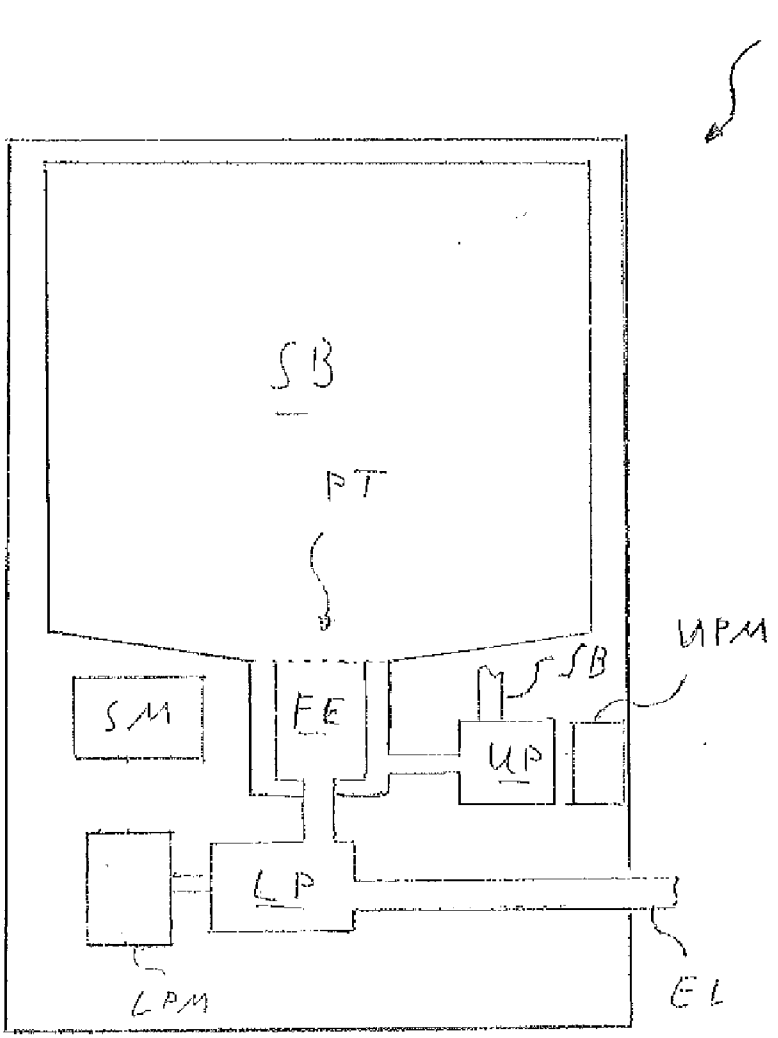


Fig. 1

DISHWASHER

BACKGROUND OF THE INVENTION

[0001] The invention relates to a dishwasher, in particular a domestic dishwasher, having at least one activatable circulating pump for directing liquid against food-soiled items requiring to be cleaned, at least one activatable drain pump for discharging a minimum liquid volume of an operating liquid volume from a pump well of the dishwasher, and a filter unit for preventing soil particles contained in the liquid from reaching the circulating pump.

[0002] Dishwashers have a filter unit which can be constructed from a multistage filter, such as for example a coarse strainer, a fine strainer and a microfilter and by means of which soil particles detached as a result of liquid being directed against food-soiled items to be cleaned can be separated from the circulated liquid in order in this way to prevent soil from being redeposited on the items to be cleaned. As a consequence of heavy use a filter cake can form on individual strainers of the filter unit, resulting in the filter unit becoming blocked. Furthermore, frequent operation of a dishwasher at low temperatures, i.e. the circulated liquid is heated in the individual subprogram steps of a wash program to e.g. max. 45° C., can lead to the formation of grease deposits on water-conducting parts of the dishwasher, such as e.g. the filter unit with its filters, with the result that the filter unit is likewise blocked by the grease deposits. With a filter unit blocked in this way it is not possible to continue a wash program, because due to the blocked filter unit the dishwasher cannot be pumped completely empty by putting the drain pump into operation, the consequence being that when the dishwasher is put into operation next time the soil-laden liquid remaining in the dishwasher is mixed with the newly introduced liquid and as a result the cleaning performance of the dishwasher is affected in a negative manner.

BRIEF SUMMARY OF THE INVENTION

[0003] It is an object of the invention to provide a remedy for this problem.

[0004] It is provided according to the invention that after the drain pump has been activated in order to discharge the minimum liquid volume and then deactivated, the circulating pump can be activated and its operating parameters evaluated to determine whether there is a residual liquid volume remaining in the dishwasher. It is thus possible to establish in a surprisingly simple manner, without additional components such as e.g. sensors or impeller meters, whether or not the liquid circulated during the operation of the circulating pump and directed against food-soiled items to be cleaned has, following termination of a subprogram step of a wash program, essentially been completely or else only partially discharged as a result of putting the drain pump into operation. In this case use is made of the fact that by starting up the circulating pump and evaluating its operating parameters it is possible to establish whether a residual liquid volume has remained in the dishwasher or not. The residual liquid volume is a volume of liquid remaining in the dishwasher when e.g. a blocked filter prevents it from being pumped out. In this case, if all the liquid is pumped out, the quantity of the minimum liquid volume to be pumped out can substantially correspond to the quantity of an operating liquid volume that is required in order to clean food-soiled items. However, the minimum liquid volume to be pumped out has a minimum quantity, e.g. 0.1 to 1 litre, such as e.g. approx. 0.5 litre, so that it is ensured that the resulting minimum liquid volume can be reliably measured by evaluating the operating parameters. In this case part of the liquid is pumped out, with the dishwasher not being emptied completely. Thus, the residual liquid volume is substantially equivalent to the operating liquid volume reduced by the minimum liquid volume to be pumped out, with account being taken of liquid residues adhering in the washing compartment or residual water volumes remaining in the dishwasher's pipeline system due to its layout, as well as of deviations attributable to component tolerances. Discharging a liquid volume from a pump well of a dishwasher is understood to mean that said liquid is pumped into a domestic wastewater disposal system or at least part thereof is stored in a liquid reservoir, such as e.g. a tank, for subsequent reuse; in the latter case the liquid reservoir can be associated with the dishwasher and arranged within the housing of the dishwasher.

[0005] Preferably it is provided that the electricity consumption of a circulating pump motor driving the circulating pump can be measured and evaluated as operating parameters of the circulating pump. Use is therefore made of the fact that the electricity consumption of a circulating pump motor is increased due to a quantity of liquid being circulated in the dishwasher, whereas if the dishwasher has been pumped completely empty the circulating pump motor has a reduced electricity consumption since only air can be circulated. Accordingly it can be established in a surprisingly simple manner by comparing the electricity consumption measured during the operation of the circulating pump following a pumping-out operation by means of the drain pump with a stored reference value whether an undesirable residual liquid volume has remained in the dishwasher.

[0006] In a preferred embodiment variant it is provided that the circulating pump motor is embodied as a BLAC or BLDC motor, i.e. as a brushless alternating-current or direct-current motor having electronic commutation. In this case it is particularly easily possible, on account of the electronic commutation, to establish a correlation between the electricity consumption and the pumped liquid volume.

[0007] It is furthermore preferably provided that the circulating pump can be activated for a predetermined period of time. For example, there is provided in a control electronics module of the dishwasher a sub-step of a wash program according to which, following completion of a pumping-out operation, the circulating pump is put into operation for a predetermined time period, for example 0.3 to 10 seconds in order to check whether a residual liquid volume is contained in the dishwasher or not. By this means the noise nuisance caused as a result of putting the circulating pump into operation is reduced owing to its short-lived nature.

[0008] Because a filter cake clogging the filter unit or equivalent grease deposits build up slowly there is no necessity to check every time the dishwasher is put into operation whether the filter unit is blocked. It is, however, preferably provided that each time after liquid has been discharged, i.e. following completion of each pumping-out operation, the circulating pump can be activated and each time the operating parameters of the circulating pump can be evaluated in respect of a circulated residual liquid volume. This permits a developing blockage of the filter unit by a filter cake or grease deposits to be detected at any early stage and countermeasures to be provided as necessary.

[0009] In a further embodiment variant it is provided that a visual and/or audible error signal can be generated in response to the residual liquid volume being exceeded. This permits an operator to be alerted in a simple manner to the fact that the filter unit is blocked and/or a residual quantity of dirty liquid has remained behind in the dishwasher. A visual error

signal can be indicated for example by means of an appropriate indicator lamp on a control panel of the dishwasher.

[0010] Finally the possibility is provided in a preferred embodiment variant for a cleaning program for cleaning the filter unit to be performed in response to the residual liquid volume being exceeded. In this case a cleaning program of said type can be initiated manually by an operator in response to a visual or audible signal, e.g. by means of an appropriate selection button on the control panel of the dishwasher, or a cleaning program of said type is automatically inserted into a wash program sequence comprising a plurality of subprogram steps, without the necessity for action on the part of an operator. In this case provision can be made for the cleaning program to put the circulating pump and/or drain pump into operation for the purpose of cleaning the filter unit, with pressure surges being generated by means of variations in speed in order to clean the filter unit, and/or to operate the pumps with reversal of the direction of rotation insofar as the drain pump or circulating pump is embodied for doing this. The cleaning program for cleaning the filter unit can furthermore make provision for example to refill the dishwasher and to remove grease deposits on the filter unit by heating the liquid to temperatures of 60-80° C. for example. In this case provision can additionally be made to operate the circulating pump motor at a reduced speed so as to avoid heating items to be cleaned as a result of being impinged upon by heated liquid, since because of the low speed and the low pressure the heated liquid emerges from the spray devices for spraying the items to be cleaned in such a way that it does not come into contact with the items to be cleaned. Finally provision can also possibly be made for cleaning agent to be added for the purpose of cleaning the filter unit.

[0011] Also included within the scope of the invention is a method for operating a dishwasher, in particular a domestic dishwasher, during which food-soiled items to be cleaned are impinged upon by liquid at least temporarily by means of an activated circulating pump, and during which a minimum liquid volume of an operating liquid volume is to be discharged from a pump well of the dishwasher at least temporarily by means of an activated drain pump, with soil particles contained in the liquid being kept away from the circulating pump by means of a filter unit, wherein it is provided according to the invention that after activation of the drain pump for the purpose of discharging the minimum liquid volume and its subsequent deactivation, the circulating pump is activated and its operating parameters are evaluated to determine whether there is a residual liquid volume remaining in the dishwasher.

[0012] Advantageous developments of the method are disclosed in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The invention is explained below with reference to a drawing, in which:

[0014] FIG. **1** shows a schematic representation of an exemplary embodiment of a dishwasher according to the invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS OF THE PRESENT INVENTION

[0015] Depicted in the figure as an exemplary embodiment of a dishwasher is a domestic dishwasher GS which has a washing compartment SB in which food-soiled items to be cleaned (not shown) can be placed on extractable dish racks (not shown). Spray arms (not shown) are provided in the washing compartment SB for the purpose of directing liquid against the food-soiled items placed in the dish racks for cleaning. Said spray arms are connected in a liquid-conducting manner via a spray arm supply line SZ to a circulating pump UP. During the operation of the domestic dishwasher GS, i.e. while a wash program comprising a plurality of subprogram steps is performed, the circulating pump UP is driven by a circulating pump motor UPM, with the liquid dripping from the items to be cleaned collecting in a pump well PT in the base region of the washing compartment SB in order to be fed back again to the circulating pump UP, which for this purpose is connected in a liquid-conducting manner to the pump well PT. In order to separate out from the liquid soil particles contained in the liquid that have been detached for example from the items to be cleaned and prevent them from reaching the circulating pump UP, there is provided in the pump well PT a filter unit FE which can be formed for example from a coarse strainer, a fine strainer and a microfilter.

[0016] Also provided is a heating device (not shown) for heating the liquid circulated by means of the circulating pump UP in order for example to increase the cleaning effect of the water mixed with detergents and/or rinsing agent.

[0017] In order to empty the domestic dishwasher GS following termination of a subprogram step of a wash program during which the food-soiled items to be cleaned are impinged upon by liquid which is circulated by means of the circulating pump and to which detergent and/or rinsing agent may have been added, a drain pump LP is additionally provided which is driven by a drain pump motor LPM and which permits liquid to be pumped out of the pump well PT of the domestic dishwasher GS by means of a drain conduit EL into a domestic wastewater disposal system. For this purpose the pump well PT is connected in a liquid-conducting manner to the drain pump LP. In order to control the circulating pump UP and the drain pump LP or, more precisely, the circulating pump motor UPM and the drain pump motor LPM, a control electronics module SM is provided which is connected to the said motors via control lines (not shown). In the present exemplary embodiment the circulating pump motor UPM and the drain pump motor LPM are electronically commutated brushless alternating-current motors (BLACs) with which measuring the electricity consumption by means of the control electronics module SM is particularly simply by virtue of the electronic commutation.

[0018] In this case, during the operation of the circulating pump UP with the circulating pump motor UPM running, wash liquor passes through a straining area, e.g. a peripheral surface of an e.g. cylindrically embodied strainer of the filter unit FE in order then to be drawn in by the circulating pump UP, whereas during operation of the drain pump LP the liquid does not pass through the peripheral surface of the strainer of the filter unit FE. This permits a filter cake forming on the inner surface of the filter unit FE to be removed during a pumping-out operation through activation of the drain pump LP and thus to effect a cleaning of the straining area of the filter unit FE.

[0019] A blockage of the filter unit FE can nonetheless occur, for example due to formation of grease deposits on the filter unit FE as a result of the dishwasher being operated at low operating temperatures, in the range of 45° C. for example, to which the circulated liquid is heated at a maximum during the wash program step.

[0020] If the filter unit FE is blocked and the domestic dishwasher GS is to be emptied by putting the drain pump LP into operation, the domestic dishwasher GS cannot be drained completely, because due to the blocked filter unit FE a

residual liquid volume remains in the pipeline system, to which for example the spray arm supply line SZ also belongs, between the filter unit FE and the circulating pump UP. Because of the soil particles entrained in it said residual liquid volume can have a negative impact on cleaning performance when the domestic dishwasher GS is next used, since said soil particles in the residual liquid volume are mixed with the introduced fresh water. Thus, normal use of the domestic dishwasher GS in the intended manner is not possible on account of the blocked filter unit FE.

[0021] In order to establish whether the filter unit FE is blocked for example by grease deposits, it is therefore provided to put the circulating pump UP into operation, for example for a time period of 0.3-10 seconds, by activating the circulating pump motor UPM following a pumping-out operation during which, as a result of the drain pump motor LPM being started up, the drain pump LP pumps a liquid volume, i.e. a minimum liquid volume having a detectable minimum quantity, through the drain conduit EL into a domestic wastewater disposal system. The liquid volume can be a pumping-out volume which is less than an operating liquid volume in the case of a partial pumping-out, or the pumping-out volume is equivalent to the operating liquid volume in the case of complete pumping-out. An activation sequence of said kind can be stored for example in the control electronics module SM, in which a plurality of wash programs comprising a plurality of subprogram steps are stored. With the aid of the measured electricity consumption of the circulating pump motor UPM during this time period it can be established on the basis of the correlation between electricity consumption of the circulating pump motor UPM and the pumped liquid volume whether in spite of the drain pump LP having been put into operation there remains a residual liquid volume in the domestic dishwasher GS due to a blocked filter unit FE. For this purpose the electricity consumption summed during the time period is compared in the control electronics module SM with a stored reference value.

[0022] This check as to whether the filter unit FE is blocked or not can be carried out every time the liquid has been discharged by putting the drain pump LP into operation or at specific, alternative intervals with a longer interval duration.

[0023] If it has been established by means of the control electronics module SM that the electricity consumption of the circulating pump motor UPM is exceeding a limit value, a visual and/or audible error signal are/is generated upon confirmation that a minimum liquid volume remains in the domestic dishwasher GS, in which case the visual error signal can be indicated for example by means of an indicator lamp (not shown) on a control panel (not shown) of the domestic dishwasher GS.

[0024] An operator can thereupon clean the filter unit FE manually in order thus to remove the blockage of the filter unit FE. Alternatively the domestic dishwasher GS may also have a button on the control panel for selecting a cleaning program for cleaning the filter unit. In said cleaning program for cleaning the filter unit FE it can be provided e.g. for the purpose of removing grease deposits in the filter unit FE to circulate the residual liquid volume remaining in the domestic dishwasher GS as far as possible through the blocked filter unit FE by activating the circulating pump UP and to heat up said residual liquid volume by means of a heating device to temperatures of at least 60° C. in order to dissolve the grease deposits on the filter unit FE and subsequently, by activating the drain pump LP, to pump the liquid containing the dissolved greases through the drain conduit EL into a domestic wastewater disposal system. At the same time the process of degreasing the filter unit FE can be improved by adding detergents. Furthermore the cleaning program for cleaning the filter unit FE can provide an operating mode of the circulating pump UP and the drain pump LP in which, by appropriate activation of the circulating pump motor UPM and the drain pump motor LPM, pressure peaks are generated in order to release the blockage of the filter unit FE, as well as possibly also a mode of operation reversing the normal operating direction.

[0025] Alternatively, upon the presence of a residual liquid volume in the dishwasher being detected following a pumping-out operation by means of the drain pump LP, it can be provided that in a wash program sequence comprising a plurality of subprogram steps the control electronics module SM automatically inserts such a cleaning program for cleaning the filter unit FE, thereby removing the need for intervention on the part of an operator.

What is claimed is:

1. A dishwasher, comprising:
- at least one circulating pump for directing liquid against food-soiled items to be cleaned;
- at least one drain pump for discharging a minimum liquid volume of an operating liquid volume from a pump well of the dishwasher; and
- a filter unit for preventing soil particles contained in the liquid from reaching the circulating pump,
- wherein after activation and deactivation of the drain pump, the circulating pump is activatable and an operating parameter of the circulation pump is evaluated to determine whether there is a residual liquid volume remaining in the dishwasher.

2. The dishwasher of claim **1**, constructed in the form of a domestic dishwasher.

3. The dishwasher of claim **1**, further comprising a circulating pump motor driving the circulating pump, wherein the operating parameter of the circulating pump is a measured electricity consumption of the circulating pump motor.

4. The dishwasher of claim **1**, wherein the circulating pump motor is embodied as a BLAC or BLDC motor.

5. The dishwasher of claim **1**, wherein the circulating pump is activated for a predetermined time period.

6. The dishwasher of claim **1**, wherein after each discharge of liquid by the drain pump the circulating pump is activatable and each time the operating parameter of the circulating pump is evaluated for determining a presence of residual liquid volume.

7. The dishwasher of claim **1**, further comprising a visual and/or audible error signal generated when the residual liquid volume exceeds a limit value.

8. The dishwasher of claim **1**, further comprising a cleaning program for cleaning the filter unit when the minimum liquid volume is exceeded.

9. A method for operating a dishwasher, comprising the steps of:
- activating a circulating pump to direct liquid at least temporarily upon food-soiled items to be cleaned;
- activating a drain pump to discharge a minimum liquid volume of an operating liquid volume from a pump well of the dishwasher at least temporarily;
- keeping soil particles contained in the liquid away from the circulating pump by a filter unit, and
- determining a residual liquid volume remaining in the dishwasher after activation and deactivation of the drain pump and subsequent activation of the circulating pump and evaluation of an operating parameter of the circulating pump.

10. The method of claim **9**, for operating a domestic dishwasher.

11. The method of claim **9**, wherein the operating parameter is a measured electricity consumption of a circulating pump motor driving the circulating pump.

12. The method of claim **9**, wherein the circulating pump motor is embodied as a BLAC or BLDC motor.

13. The method of claim **9**, wherein the circulating pump is operated for a predetermined time period.

14. The method of claim **9**, wherein after discharge of liquid by the drain pump the circulating pump is activated and the operating parameter of the circulating pump is evaluated for determining a presence of residual liquid volume.

15. The method of claim **9**, further comprising the step of generating a visual and/or audible error signal when the residual liquid volume exceeds a limit value.

16. The method of claim **9**, further comprising the step of executing a cleaning program for cleaning the filter unit when the minimum liquid volume is exceeded.

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