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(54) WAREWASH MACHINE WITH SOIL DETECTION AND METHOD OF DETECTING SOILING IN SUCH A WAREWASH MACHINE

GESCHIRRSPÜLMASCHINE MIT VERSCHMUTZUNGSERKENNUNG UND VERAHREN ZUR ERKENNUNG VON VERSCHMUTZUNG IN EINER DERARTIGEN GESCHIRRSPÜLMASCHINE

MACHINE POUR LAVER DES ARTICLES À DÉTECTION DE SALISSURES ET PROCÉDÉ DE DÉTECTION DE SALISSURES DANS CETTE MACHINE

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EP 2 490 582 B1

Description

TECHNICAL FIELD

[0001] The present application relates generally to warewash machines of the commercial type and, more particularly, to a commercial warewash machine with water soiling level detection.

BACKGROUND

[0002] Modern commercial warewash equipment uses internally re-circulated water during the washing process and introduces clean hot water during the rinsing and sanitization processes. The soil level of the internally re-circulated water increases as dirty ware (e.g., dishes, cutlery, pots and pans) enters the machine over the course of an operational shift. If the soil concentration reaches a critical level, the likelihood of soil re-deposition on to the ware increases.

[0003] Currently, the operator is primarily responsible to identify the issue of soil re-deposition and take corrective actions. Typical corrective actions may include re-running ware, pausing the operation to partially drain the machine tank or tanks, and pausing the operation of the machine to clean the strainer/filters.

[0004] Ideally, the warewash machine would have the capability to monitor its own soil level and take corrective actions (within a range of soil levels) without the interaction of the operator and reduction in productivity.

[0005] A known approach to sense the level of soil in liquid using optical methods is the turbidity sensor. The use of turbidity sensors in residential dishwashers is commonplace and the technology is readily available. For instance, US 2006/021637 A1 discloses a sump assembly in a dishwasher comprising a sensor for measuring the turbidity of the washing water discharged to the outside of the dishwasher. However, the migration of turbidity sensors to commercial warewash equipment has been slow due to challenges unique to their applications. For example, commercial warewash equipment operates with a much broader range of acceptable soil loads during the washing process. Existing turbidity sensors lack the dynamic range of operation for use in commercial warewash equipment. Additionally, existing turbidity control logic does not adequately optimize the performance of a commercial dishwasher due to the different nature of the machine cycles. Moreover, commercial warewash equipment operates with higher wash volumes and flow rates resulting in a significantly more turbulent environment in the wash tank(s). The placement of turbidity sensors in the prior art (e.g., in the tank or in line with wash water recirculation flow) does not allow for suitably accurate readings of soil level due to turbulence/bubbles, etc. in the wash water.

[0006] Accordingly, it would be desirable and advantageous to provide a soil sensing system that is more suited to the commercial warewash machine environment.

SUMMARY

[0007] According to the invention, a warewash machine according to independent claim 1 and a method of detecting soiling of liquid in a tank according to independent claim 12 are provided. Preferred embodiments of the invention are subject-matter of the dependent claims.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

Fig. 1 is a schematic diagram of one embodiment of a warewash machine incorporating the soil level detection system;
Fig. 2 is a schematic diagram of the soil level detection sensor arrangement;
Fig. 3 is an alternative embodiment of a warewash machine incorporating the soil level detection system; and
Fig. 4 is a timing diagram for an exemplary cycle of the machine of Fig. 3.

DETAILED DESCRIPTION

[0009] Referring to Fig. 1, in one implementation, the soil detection system is implemented in the context of a conveyor-type dishwasher 10 in which items to be washed are moved (e.g., right to left in Fig. 1 via a conveyance mechanism 12) through a housing 14 having multiple spray zones 16, 18, 20 and 22 and, in some cases, a drying zone 24. The conveyance mechanism 12 may be on suitable type, such as a continuous belt-type with ware receiving slots or a reciprocating type configured to move ware baskets containing ware.

[0010] By way of example, spray zone 16 may be a pre-wash zone, zone 18 may be a main wash zone, zone 20 may be a hot post-wash zone (also known as a power rinse zone) and zone 22 may be a final rinse zone. Additional spray zones could be included, or a lesser number of spray zones implemented. As shown, the pre-wash zone 16 includes an associated water tank 26, pump 28 and line 30 forming a recirculation path in which liquid is delivered from the tank 26 to nozzles 32 (e.g., located in upper and lower laterally extending spray arms) for spraying, and the sprayed liquid collects in the tank 26 for recirculation. Wash zone 18 includes a similar tank 34, pump 36, line 38 and spray nozzles 40 forming a recirculation flow path. Likewise, post-wash zone 20 includes a similar tank 42, pump 44, line 46 and nozzles 48 forming a recirculation flow path. Tank 42 is shown with an associated heating element 50 for heating the tank water, and one or both of tanks 34 and 26 could include a heating element as well if desired.

[0011] The final rinse zone 22 includes an associated booster heater tank 52 that receives water from a fresh

water input source 54 through a valve 56 or other feed structure (e.g., a pump). The booster tank 52 is connected to deliver water via line 58 to nozzles 60 in the final rinse zone 22, and includes a heating element 62 for heating the rinse water. The booster tank could include an associated delime system.

[0012] One or more of the tanks 26, 34 and 42 may have an associated fresh water feed line 70, 72, 74 and related valve 76, 78, 80 to control delivery of fresh water into the tank from a fresh water line 82 if desired.

[0013] The drying zone 24 includes a blower 84, which typically includes an associated heater, for blowing hot air onto the wares after final rinsing.

[0014] The final-rinse system may include an associated rinse aid supply 90 and pump 92 for delivering rinse aid to the booster 52, or alternatively to the outfeed line of the booster, in a metered manner. The main wash zone may include an associated detergent supply 96 and associated pump 98 for delivering detergent to the tank 34, or aleternatively directly into the line 38, in a metered manner. Other forms of detergent supply may be used, such as manual placement of a block/solid type detergent product. A controller 100 is provided for operating the various pumps, valves, conveyor and blower in accordance with one or more programmed cleaning sequences.

[0015] In order to address the limitations of the prior art as it applies to commercial warewash machines both the dynamic range of the turbidity sensor should be increased and the position of the sensor be arranged to accommodate the higher level of turbulence within commercial machines. In regard to sensor position, each of the tanks 26, 34, and 42 may include an associated drain system (not shown in Fig. 1) enabling the tank to be drained, either partially or fully, in a controlled manner. By way of example, reference is made to Fig. 2 in which an exemplary tank drain system 102 is shown. The drain system includes a piping, tubing or hosing line 104 that connects to an outlet 106 of the tank and extends to a sensor assembly 108 that utilizes, in one example, a clear square tubing 110 that has an associated sensor module 112 mounted thereto. The sensor module 112 includes a light emitting element 114 (e.g., one or more LEDs) on one side of the tube 110 and a light receiving element 116 (e.g,. one or more phototransistors) on the opposite side of the tube 110. The lower end of the sensor assembly is connected to drainage piping or tubing 118 that leads to a facility drain. A valve 120 may be used to control flow along the drain path, but in other embodiments a pumped drain system could be employed. While the illustrated sensor assembly 108 is shown in line with the primary drain path of the tank, the sensor assembly could, alternatively, be connected in parallel with the primary drain path (e.g., per dashed line configuration 122). Interface connectors 124 and 126 (e.g., round to square transition couplers with associated clamps) may be provided for interconnecting the sensor assembly in the drain path as shown. The sensor elements include associated leads 128 and 130 that connect back to the controller 100 and power as needed. Additional electronic control circuitry may be associated with the sensor elements as needed.

[0016] An alternative sensor arrangement could include multiple LED-phototransistor pairs arranged or spaced apart vertically from each other such that each pair is positioned for detection of soil level at a different height in the detection zone. For example, an implementation having three or more vertically spaced pairs could be beneficial in identifying floating and settling particles. Specifically, assume that the turbidity of a water sample is initially determined and that over time the turbidity indicated by the mid-height sensor pair is reflects that the water sample clears up. If the turbidity indicated by the LED-phototransistor pair below the mid-height pair increases, a conclusion can be drawn that particles are settling. The rate of settling may correspond to the size or density of such particles, enabling particle size to be used as a factor in machine control. Alternatively, if the turbidity indicated by the LED-phototransistor pair above the mid-height pair increases, a conclusion can be drawn that particles are floating.

[0017] Using the suggested sensor positioning, valve or pump cycles may be used to collect a sample of the tank water sample at predetermined intervals. By way of example, the machine controller 100 generates a tank water sample signal and a sample of the tank water is gravity fed by opening the valve 120 (or fed by a pump by operation of the pump) to the sensor assembly 108. A fresh tank sample may be obtained by momentarily opening the valve or cycling a pump. The water sample is now within the sensor assembly. A sample settling time may be applied prior to triggering the sensor components for monitoring. It is advantageous to allow the sample to settle for a short period of time to allow bubbles to escape and larger particles to settle or float. The light emitting element is energized and the output level of the light receiver monitored to determine turbidity of the water sample. An evaluation can be made by the controller 100 to determine whether any action is necessary based upon the determined turbidity or soiling level. These actions may repeated as often as desired and in sequences as determined appropriate for a given machine type.

[0018] Due to the range of soil encountered in a commercial warewash machine, a typical prior art sensor system would typically have adequate resolution at very low levels of concentration and reach saturation well before the highest acceptable levels of soil were reached for a commercial machine. If a single higher intensity turbidity sensor would be used, meaningful data would be lost at medium or low soil levels. In order to address this problem, varying the energization level of the light emitting element is employed.

[0019] In one embodiment, a stepped light intensity technique is used. In one implementation, the stepped light intensity is achieved by applying stepped energization levels for the light emitting element (e.g., applying stepped voltage levels). In an alternative implementation,

the stepped light intensity is achieved by using multiple light emitting elements (e.g., LEDs) and energizing less of the elements at lower steps and more of the elements at higher steps. In this regard, a "light emitter" may be made up of a single light element or multiple light elements and, in the latter case, the energization of the light emitter may, in certain implementations, be varied by energizing different numbers of the light elements making up the light emitter. The following is a description of an exemplary application/operation. Other configurations may be utilized to produce similar results.

[0020] The light emitting element 114 illuminates. The light travels through the water sample to the light receiver 116. The more soiled the water, the less light transmitted to the light receiver 116. The light receiver 116 (e.g., a phototransistor) outputs a voltage proportional to the light received and, therefore, proportional to the water's soil level. As the soil level increases, the voltage increases. Alternatively, the electronics could be set up so that as the soil level increases, the voltage decreases. In either case, a proportional relationship is the result.

[0021] A low light emitter intensity accurately allows the sensing of low soil levels but does not allow the accurate sensing of high soil levels. At high soil levels, the low light emitter intensity causes the sensor to saturate (reaches maximum voltage level) making it impossible to determine the higher soil levels. Conversely, a high light emitter intensity accurately allows the sensing of high soil levels but does not allow the accurate sensing of low soil levels. At lower soil levels, the high light emitter intensity causes the sensor to reach minimum voltage level (near 0 volts) thereby not being able to determine the lower soil levels. The solution is a sensor arrangement that puts out different intensities of illumination, to accurately sense different soil levels.

[0022] In one implementation of the stepped approach, 3 illumination intensities, low, medium, and high are used. Through experimentation, this has been adequate to sense required soil levels, though some applications and soil levels may require a higher or lower number of intensities.

[0023] The controller 100 may be configured to select which intensity to use for the machine. Specifically, as each intensity level (low, medium, high) is illuminated, the voltage output level of the light receiver 116 is captured and stored. These voltage output levels are compared and the intensity level that results in the light receiver voltage level closest to midrange of the light receiver is chosen for use. By way of example, and assuming use of a light receiver with a midrange voltage output of two volts, once soiled water has been delivered into the sensor assembly and, if appropriate the settling time has passed, the controller 100 effects energization of the light emitter 114 at the low intensity, and the light receiver voltage output is 3.8 volts. The light emitter is next energized at the medium intensity and the light receiver voltage output is 3.5 volts. The light emitter is next energized at the high intensity and the light receiver voltage output is 1.9 volts. Since the high intensity level results in the light receiver voltage output level that is closest to 2 volts, the controller 100 selects the high intensity level energization for use in machine control. A high intensity lookup table (e.g., stored in memory of the controller 100) may then be used determine any machine action necessary for the 1.9 volt output level of the light receiver 116.

[0024] In the above example, if the low intensity energization level resulted in the light receiver output that was closest to 2 volts, the controller would use that energization level for machine control and refer to a low intensity lookup table to determine any machine action necessary. Likewise, if the medium intensity energization level resulted in the light receiver output that was closest to 2 volts, the controller would used that energization level for machine control and refer to a medium intensity lookup table to determine any machine action necessary. The look-up tables can be established in accordance with a calibration sequence for the sensor assembly, which could be implemented prior to mounting of the sensor assembly on the machine, or afterward. In the latter case, the calibration sequence could be incorporated into the program of the controller 100.

[0025] In this manner, machine control based upon water soiling level can be more effectively maintained for low, medium and high soiling levels.

[0026] In another embodiment, varying of the light emitter energization level may be achieved by use of a ramped energization of the light emitter. For example, a complete and continuous range of light intensities from a very low level that can just produce a weak signal at the light receiver through very clear wash water to a very high intensity that can easily penetrate very heavily soiled water may be implemented. A sensor arrangement that uses the described ramped light intensity may use a light emitter 114 (e.g., LED emitter) that is driven by a voltage ramp that causes light intensity levels of a range greater than needed for the expected range of turbidity to allow for ageing and buildup on the sample tube. The light receiver 116 receives the light that has been attenuated by the fluid in the sample tube 110 and produces a signal that is compared to a predetermined reference value or set threshold value (e.g. as determined by a calibration sequence). When the ramp driven light emitter 114 reaches an intensity that causes the light receiver output to equal the reference/threshold value, a comparison circuit switches and captures the analog value of the voltage ramp at that instant. The value of the voltage ramp at that time is proportional to the turbidity level of the fluid in the sample tube. The captured turbidity value is then filtered and can be an input to the machine logic control system (e.g., used to reference a look-up table to determine responsive machine actions to be taken). The repetition rate of the turbidity sampling process can be changed for various applications. If the desire is to quantify particles suspended in the liquid sample then a high sampling rate on the order of several hundred samples per second using the appropriate filtering may be used. If the interest

is only in the average turbidity, a slower sampling rate on the order of several samples per minute with the corresponding filter would be used.

[0027] Ageing and loss of clarity of the sample tube 110 is likely to occur in most applications of the device and thus some compensation or correction scheme may be implemented for continued proper measurements to be taken. One such scheme would be to periodically allow known clean liquid to be measured by the device and note the turbidity value which will be greater than when the sample tube was new. This measured value represents the loss in light transmisitivity of the sample tube 110, and this value can be subtracted from any subsequent reading on turbid liquids until the next calibration cycle is performed and a new offset value is established.

[0028] The ramped implementation should be implemented such that the light intensity range is large enough to cover the full range of expected turbidity values and the possible loss of transmisitivity of the sample tube.

[0029] Both of the disclosed embodiments (i.e., stepped intensity and ramped intensity) will yield useful and valid data. The ramped approach will provide a stepless, non overlapping range of values and may require fewer components to manufacture. The stepped approach produces a range of values that may overlap and not be discrete, requiring more intelligence in the appliance control system to properly interpret the data and perform the appropriate action.

[0030] The stepped method may be advantageous if both average turbidity and particle data is desired. Using the stepped method, once the proper intensity step is chosen, the average turbidity level can be determined and then the light emitter intensity level could be maintained instead of switching to the next intensity in the sequence. During this extended time the variations in received signal from the light receiver 116 (e.g., due to particle settling) could be processed to provide useful information about the size and quantity of suspended particles in the liquid sample.

[0031] The stepped light intensity and ramp light intensity approaches allow for soil samples to undergo a number of complete cycle sweeps within a given time period. Useful information that characterizes the soil can be gathered during the sweeps, specifically: (1) light receiver voltage level output (i.e., V(t) - discrete voltage values at points in time indicate the turbidity level at that specific moment), useful for basic measurement and useful for setting action thresholds; (2) rate of change in light receiver voltage level output over time (i.e., dV/dt), which (i) can be calculated within a specific sample or from sample to sample, (ii) provides information related to the presence of particles in the solution (e.g., the greater the rate of change indicates the greater amount of particles that are settling, which information is useful because the presence of a significant amount of particles will increase the likelihood of soil re-deposition) and (iii) provides information related to the soil level trends; (3) variance in light receiver voltage level output (i.e., the variance of the light receiver voltage values within a given period of time (applies to stepped approach), which (i) can be calculated over a given light emitter intensity and/or from sample to sample and (ii) provides information related to the presence of particles in the solution.

[0032] Referring now to Fig. 3, an alternative warewash machine embodiment is shown, which is of the box-type (also known as batch type or door type machines). The machine 140 includes a housing 142 defining a wash chamber 144 that is accessible by a door 146. The door may be pivotally mounted (e.g., in the case of an under-counter machine) or mounted for vertical, sliding movement (e.g., in the case of a hood-type machine). Wares are manually moved into the chamber 144 for cleaning, and manually removed when the cleaning cycle has been completed. A sump tank 148 is located below the chamber 144 and a pump 150 and line 152 are provided to deliver water from the sump to nozzles 154 of upper and lower spray arms 156 (e.g., of the rotating type). A detergent supply 158 and associated pump may be provided to deliver detergent to the sump 148 in a metered manner. Other forms of detergent supply may be used, such as manual placement of a block/solid type detergent product. A booster heater 162 receives water from a fresh water supply input 164 via a valve 166 or pump and has an output line 168 that delivers water to the nozzles 154 or, in the alternative, to a set of separate rinse arms with associated nozzles (not shown). A rinse aid supply 170 and associated pump 172 is provided to deliver rinse aid to the booster tank 162 in a metered manner. The sump 148 includes an associated drain outlet 174 that leads to a sensor assembly 108 (shown in dashed line form as a box) which could be similar to that of Fig. 2. A drain valve 110 is provided to control draining, but a pumped drain line system could alternatively be provided. A controller 180 is provided to operate the various valves and pumps in accordance with one or more programmed cleaning cycles.

[0033] Machine actions based on determined turbidity/soil level will generally be determined by the type and configuration of warewash machine with the goal of reducing the potential for soil re-deposition. The basic types of machines can be divided into two categories, the conveyor-type (e.g., per Fig.l) and the box-type (e.g., per Fig. 3).

[0034] In the case of the box-type machine, variables that can be controlled based on the soil level in the sump tank 148 include, by way of example: (1) frequency and duration of wash (e.g., by controlling the duration of operation of pump 150), (2) drop down duration (i.e., the dwell time between the spraying of detergent laden wash liquid and the subsequent spraying of clean rinse liquid; e.g., by controlling when the booster water is delivered following cessation of pump 150 operation), (3) frequency and duration of draining of the sump tank 148 (e.g, via control of valve 110), (4) rinse duration and/or rinse water volume (e.g., by controlling how long valve 166 is maintained open), (5) rinse aid dosing (e.g., by controlling

operation of pump 172), (6) detergent dosing (e.g., by controlling operation of pump 160), (7) steam cycle (if available), (8) drying duration (e.g., by controlling operation of a blower and/or heating element used during drying), (9) interruption of the wash with a partial drain followed by refill and continuation of the wash and (10) implementation of a partial or full drain after wash and repetition of the wash cycle before rinse.

[0035] Referring to Fig. 4, in the case of the box-type machine an exemplary cycle Tc is delineated by a wash period W (e.g., during which detergent laden liquid is recirculated), a drop down period DD during which recirculation of wash liquid stops and the machine dwells to allow liquid to drop down off of the ware and a rinse period R during which clean rinse liquid is sprayed on the wares. Two exemplary water sample times are shown at drain times D1 and D2. Sampling at D1 could primarily be used to determine whether to modify wash duration, drop down duration, timing of drain time D2, volume drained at drain time D2, rinse duration, rinse aid dosing and detergent dosing. Sampling a D2 could primarily be used to determine whether to modify drop down duration, introduction of a third drain time for sampling and its associated volume and rinse duration.

[0036] In the case of the conveyor-type machine variables that can be controlled based on the soil level in the monitored tank or tanks include, by way of example: (1) dilution of pre-wash (e.g., by controlling valve 76), (2) dilution of main wash (e.g., by controlling valve 78), (3) dilution of post wash (e.g., by controlling valve 80), (4) conveyor speed (e.g., by controlling a motor associated with the conveyor 12), (5) drain valves or drain pumps associated with the tanks, (6) final rinse flow rate (e.g., by controlling valve 56 or a pump associated with the rinse line), (7) wash flow rate (e.g., by controlling operation of pump 36), (8) frequency and duration of tank drains, (9) rinse aid dosing (e.g., by controlling operation of pump 92) and (10) detergent dosing (e.g., by controlling operation of pump 98.

[0037] On occasion, it may be desirable to check the integrity of the soil sensor assembly 108. A method is to inject clean water into the sensor may be provided and the sensor arrangement operated. If the light receiver voltage levels are not within a set tolerance and/or if the soil sensor assembly operation stops, an error message is given (e.g., via the controller 100 to energize a visual or audible annunciator). An error offset may allow for continued operation.

[0038] Although the invention has been described and illustrated in detail it is to be clearly understood that the same is intended by way of illustration and example only and is not intended to be taken by way of limitation. It is recognized that numerous other variations.

Claims

1. A warewash machine (10), comprising:

a tank (26; 34; 42; 148) for holding liquid to be sprayed on items in a spray chamber;
a recirculation line (30; 38; 46; 152) for delivering liquid from the tank to nozzles (32; 40; 48; 154) for spraying;
a sensor arrangement (108) for monitoring condition of tank liquid, the sensor arrangement including a light emitter (114) and a light receiver (116) and being located outside of said tank; and
a control (100; 180) for monitoring output of the light receiver (116),

wherein the sensor arrangement (108) is located along a path that is one
of a drain line (104) of the tank, the drain line (104) being connected to an outlet (106) of the tank and leading to a facility drain, or a line (122) connected in parallel with the drain line (104), **characterised in that** the control (100) is configured to implement a liquid monitoring operation by means of said sensor arrangement (108) after liquid travel along the path has stopped and a settling period has occurred, wherein the settling period is applied prior to triggering the sensor arrangement (108) for monitoring.

2. The machine of claim 1, wherein:

the machine is a box-type machine and the monitoring occurs (1) during a recirculating washing operation and/or (2) during a drop down period following the recirculating washing operation.

3. The machine of one of claims 1 to 2 wherein:

the machine is a box-type machine and the control is configured to effect one or more of the following operations based upon output from the sensor arrangement (i) frequency and/or duration of the recirculating washing operation of a cleaning cycle, (ii) drop down duration, (iii) frequency and/or duration of sump drainage, (iv) rinse duration and/or rinse water volume, (v) rinse aid dosing level, (vi) detergent dosing level, (vii) steam cycle, (viii) drying duration, (ix) interruption of the recirculating washing operation of a cleaning cycle with a partial drain followed by refill and continuation of the recirculating washing operation and/or (x) implementation of a partial or full drain after the recirculating washing operation of a cleaning cycle and repetition of the recirculating washing operation of the cleaning cycle before rinse.

4. The machine of claim 1, wherein:

the machine is a conveyor-type machine and the tank (26; 34; 42) is associated with one of a

pre-wash zone (16), wash zone (18) or post-wash zone (20) of the machine.

5. The machine of claim 4, wherein:

the control (100) is configured to effect one or more of the following operations based upon output from the sensor arrangement (i) dilution of pre-wash liquid, (ii) dilution of main wash liquid, (iii) dilution of post-wash liquid, (iv) conveyance speed, (v) partial or full tank drainage, (vi) final rinse flow rate, (vii) wash flow rate, (viii) rinse aid dosing and/or (ix) detergent dosing.

6. The machine of one of the preceding claims, wherein:

the control (100; 180) evaluates one or more of (1) discrete output level of the light receiver (116) at one or more points in time, (2) a rate of change in output level of the light receiver with respect to time and/or (3) a variance in output level of the light receiver within a set period of time.

7. The machine of one of the preceding claims, wherein:

the sensor arrangement (108) includes vertically spaced light emitter-light receiver pairs at different heights in a sampling zone.

8. The machine of one of the preceding claims, wherein:

the sensor arrangement is formed by a clear tubing structure (110) with a sensor module (112) mounted thereto, the clear tubing structure forming part of the path.

9. The machine of claim 8, wherein:

the light emitter (114) is located on one side of the clear tubing structure (110) and the light receiver (116) is located at an opposite side of the clear tubing structure.

10. The machine of one of the preceding claims, wherein:

the control is configured to effect energization of the light emitter so as to produce a varying light intensity output from the light emitter.

11. The machine of claim 10, wherein:

the control (100; 180) is configured to effect energization of the light emitter so as to produce (i) a plurality of stepped light intensities or (ii) a ramped light intensity.

12. A method of detecting soiling of liquid in a tank of a warewash machine, the warewash machine comprising such a tank (26; 34; 42; 148) for holding liquid to be sprayed on items in a spray chamber, a recirculation line (30; 38; 46; 152) for delivering liquid from the tank to nozzles (32; 40; 48; 154) for spraying, a sensor arrangement (108) located outside of said tank for monitoring condition of tank liquid, the sensor arrangement including a light emitter (114) and a light receiver (116), a control (100; 180) for monitoring output of the light receiver (116) by means of said sensor arrangement, the method comprising the steps of:

locating the sensor arrangement (108) along a path that is one of a drain line (104) of the tank, the drain line (104) being connected to an outlet (106) of the tank and leading to a facility drain, or a line (122) connected in parallel with the drain line (104);

characterised in that the method comprises further:

implementing a liquid monitoring operation using the sensor arrangement (108) after liquid travel along the path has stopped and a setting period has occurred, wherein the settling period is applied prior to triggering the sensor arrangement (108) for monitoring.

13. The method of claim 12 wherein during the liquid monitoring operation the control evaluates one or more of (1) discrete output level of the light receiver at one or more points in time, (2) a rate of change in output level of the light receiver with respect to time and/or (3) a variance in output level of the light receiver within a set period of time.

Patentansprüche

1. Geschirrspülmaschine (10), die Folgendes umfasst:

einen Tank (26; 34; 42; 148) für Flüssigkeiten, die auf Gegenstände in einer Sprühkammer gesprüht werden;
eine Rückführungsleitung (30; 38; 46; 152), um Flüssigkeit von dem Tank zu Düsen (32; 40; 48; 154) zum Sprühen zu befördern;
eine Sensoranordnung (108) zum Überwachen des Zustands der Tankflüssigkeit, wobei die Sensoranordnung einen Lichtemitter (114) und einen Lichtempfänger (116) enthält und außerhalb des Tanks liegt; und
eine Steuerung (100; 180) zum Überwachen der Ausgabe des Lichtempfängers (116), wobei die

Sensoranordnung (108) entlang eines Pfades liegt, der entweder einer Ablaufleitung (104) des Tanks, wobei die Ablaufleitung (104) mit einem Auslass (106) des Tanks verbunden ist und zu einem Anlagenablauf führt, oder einer Leitung (122) entspricht, die parallel mit der Ablaufleitung (104) verbunden ist, **dadurch gekennzeichnet, dass** die Steuerung (100) konfiguriert ist, einen Flüssigkeitsüberwachungsvorgang durch die Sensoranordnung (108) zu implementieren, nachdem die Flüssigkeitsbewegung entlang des Pfades aufgehört hat und eine Absetzzeit aufgetreten ist, wobei die Absetzzeit vor dem Auslösen der Sensoranordnung (108) zum Überwachen angewendet wird.

2. Maschine nach Anspruch 1, wobei:

die Maschine eine kastenförmige Maschine ist und das Überwachen (1) während eines Umlaufspülvorgangs und/oder (2) während einer Abtropfzeit, die dem Umlaufspülvorgang folgt, auftritt.

3. Maschine nach einem der Ansprüche 1 bis 2, wobei:

die Maschine eine kastenförmige Maschine ist und die Steuerung konfiguriert ist, basierend auf der Ausgabe der Sensoranordnung einen oder mehrere der folgenden Vorgänge zu beeinflussen: (i) Häufigkeit und/oder Dauer des Umlaufspülvorgangs eines Reinigungszyklus, (ii) Abtropfdauer, (iii) Häufigkeit und/oder Dauer des Ablaufens des Sammelbehälters, (iv) Spüldauer und/oder Spülwassermenge, (v) Klarspülmitteldosierungshöhe, (vi) Reinigungsmitteldosierungshöhe, (vii) Dampfzyklus, (viii) Trocknungsdauer, (ix) Unterbrechung des Umlaufspülvorgangs eines Reinigungszyklus mit einem teilweisen Ablauf, gefolgt von Nachfüllung und Fortsetzung des Umlaufspülvorgangs und/oder (x) Implementierung eines teilweisen oder vollständigen Ablaufens nach dem Umlaufspülvorgang eines Reinigungszyklus und Wiederholung des Umlaufspülvorgangs des Reinigungszyklus vor dem Spülen.

4. Maschine nach Anspruch 1, wobei die Maschine einer Bandspülmaschine entspricht und der Tank (26; 34; 42) einem Vorspül-Bereich (16), einem Spülbereich (18) oder einem Nachspül-Bereich (20) der Maschine zugeordnet ist.

5. Maschine nach Anspruch 4, wobei:

die Steuerung (100) konfiguriert ist, basierend auf der Ausgabe von der Sensoranordnung einen oder mehrere der folgenden Vorgänge zu beeinflussen: (i) Verdünnung der Vorspülflüssigkeit, (ii) Verdünnung der Hauptspülflüssigkeit, (iii) Verdünnung der Nachspülflüssigkeit, (iv) Transportgeschwindigkeit, (v) teilweiser oder vollständiger Tankablauf, (vi) Endspül-Durchflussmenge, (vii) Spüldurchflussmenge, (viii) Klarspülmitteldosierung und/oder (ix) Reinigungsmitteldosierung.

6. Maschine nach einem der vorhergehenden Ansprüche, wobei:

die Steuerung (100; 180) (1) diskrete Ausgabeniveaus der Lichtempfänger (116) zu einem oder mehreren Zeitpunkten, (2) eine Änderungsrate des Ausgabeniveaus des Lichtempfängers bezüglich der Zeit und/oder (3) eine Schwankung des Ausgabeniveaus des Lichtempfängers innerhalb einer eingestellten Zeitspanne auswertet.

7. Maschine nach einem der vorhergehenden Ansprüche, wobei:

die Sensoranordnung (108) in einem Messbereich in unterschiedlichen Höhen vertikal voneinander beabstandete Lichtemitter-Lichtempfänger-Paare enthält.

8. Maschine nach einem der vorhergehenden Ansprüche, wobei:

die Sensoranordnung durch eine durchsichtige Rohrstruktur (110) mit einem daran montierten Sensormodul (112) gebildet ist, wobei die durchsichtige Rohrstruktur einen Teil des Pfades bildet.

9. Maschine nach Anspruch 8, wobei:

der Lichtemitter (114) auf einer Seite der durchsichtigen Rohrstruktur (110) liegt und der Lichtempfänger (116) auf einer gegenüberliegenden Seite der durchsichtigen Rohrstruktur liegt.

10. Maschine nach einem der vorhergehenden Ansprüche, wobei:

die Steuerung konfiguriert ist, eine Anregung der Lichtemitter zu beeinflussen, um eine variierende Lichtintensitätsausgabe von dem Lichtemitter zu erzeugen.

11. Maschine nach Anspruch 10, wobei:

die Steuerung (100; 180) konfiguriert ist, eine Anregung der Lichtemitter zu beeinflussen, um (i) mehrere stufenförmige Lichtintensitäten oder

(ii) eine rampenförmige Lichtintensität zu erzeugen.

12. Verfahren zum Detektieren von Verschmutzung einer Flüssigkeit in einem Tank einer Geschirrspülmaschine, wobei die Geschirrspülmaschine Folgendes umfasst: einen derartigen Tank (26; 34; 42; 148) für Flüssigkeiten, die auf Gegenstände in einer Sprühkammer gesprüht werden, eine Rückführungsleitung (30; 38; 46; 152), um Flüssigkeit von dem Tank zu Düsen (32; 40; 48; 154) zum Sprühen zu befördern, eine Sensoranordnung (108), die außerhalb des Tanks liegt, zum Überwachen des Zustands der Tankflüssigkeit, wobei die Sensoranordnung einen Lichtemitter (114) und einen Lichtempfänger (116) enthält, und eine Steuerung (100; 180) zum Überwachen der Ausgabe des Lichtempfängers (116) durch die Sensoranordnung, wobei das Verfahren die folgenden Schritte umfasst:

Lokalisieren der Sensoranordnung (108), die entlang eines Pfades liegt, der entweder einer Ablaufleitung (104) des Tanks, wobei die Ablaufleitung (104) mit einem Auslass (106) des Tanks verbunden ist und zu einem Anlagenablauf führt, oder einer Leitung (122) entspricht, die parallel mit der Ablaufleitung (104) verbunden ist;

dadurch gekennzeichnet, dass das Verfahren ferner Folgendes umfasst:

Implementieren eines Flüssigkeitsüberwachungsvorgangs unter Verwendung der Sensoranordnung (108), nachdem die Flüssigkeitsbewegung entlang des Pfades aufgehört hat und eine Absetzzeit aufgetreten ist, wobei die Absetzzeit vor dem Auslösen der Sensoranordnung (108) zum Überwachen angewendet wird.

13. Verfahren nach Anspruch 12, wobei während des Flüssigkeitsüberwachungsvorgangs die Steuerung (1) diskrete Ausgabeniveaus der Lichtempfänger zu einem oder mehreren Zeitpunkten, (2) eine Änderungsrate des Ausgabeniveaus des Lichtempfängers bezüglich der Zeit und/oder (3) eine Schwankung des Ausgabeniveaus des Lichtempfängers innerhalb einer eingestellten Zeitspanne auswertet.

Revendications

1. Machine à laver la vaisselle (10), comprenant :

un réservoir (26 ; 34 ; 42 ; 148) destiné à contenir un liquide à pulvériser sur des articles dans une chambre de pulvérisation ;
une conduite de recirculation (30 ; 38 ; 46 ; 152) destinée à distribuer le liquide du réservoir à des buses (32 ; 40 ; 48 ; 154) pour pulvérisation ;
un agencement de capteur (108) destiné à surveiller l'état du liquide du réservoir, l'agencement de capteur comportant un émetteur de lumière (114) et un récepteur de lumière (116) et étant positionné à l'extérieur dudit réservoir ; et
un dispositif de commande (100 ; 180) destiné à surveiller la sortie du récepteur de lumière (116),

dans laquelle l'agencement de capteur (108) est positionné le long d'un chemin qui est une conduite de vidange (104) du réservoir, la conduite de vidange (104) étant raccordée à une sortie (106) du réservoir et conduisant à un écoulement de l'installation, ou une conduite (122) raccordée parallèlement à la conduite de vidange (104), **caractérisée en ce que** le dispositif de commande (100) est configuré pour effectuer une opération de surveillance du liquide au moyen dudit agencement de capteur (108) après que le déplacement du liquide le long du chemin s'est arrêté et qu'une période de sédimentation s'est écoulée, la période de sédimentation étant appliquée avant de déclencher l'agencement de capteur (108) pour surveillance.

2. Machine de la revendication 1, dans laquelle :

la machine est une machine de type caisson et la surveillance se produit (1) pendant une opération de lavage avec recirculation et/ou (2) pendant une période de repos suivant l'opération de lavage avec recirculation.

3. Machine d'une des revendications 1 et 2, dans laquelle :

la machine est une machine de type caisson et le dispositif de commande est configuré pour effectuer une ou plusieurs des opérations suivantes en fonction de la sortie de l'agencement de capteur : (i) fréquence et/ou durée de l'opération de lavage avec recirculation d'un cycle de nettoyage, (ii) durée de repos, (iii) fréquence et/ou durée de vidange du collecteur, (iv) durée de rinçage et/ou volume d'eau de rinçage, (v) niveau de dosage d'adjuvant de rinçage, (vi) niveau de dosage de détergent, (vii) cycle de vapeur, (viii) durée de séchage, (ix) interruption de l'opération de lavage avec recirculation d'un cycle de nettoyage avec une vidange partielle suivie d'un remplissage et poursuite de l'opération de lavage avec recirculation, et/ou (x) réalisation d'une vidange partielle ou totale après l'opération de lavage avec recirculation d'un cycle de nettoyage et répétition de l'opération de lavage avec recirculation du cycle de nettoyage avant

rinçage.

4. Machine de la revendication 1, dans laquelle :

la machine est une machine de type convoyeur et le réservoir (26 ; 34 ; 42) est associé à une zone de prélavage (16), une zone de lavage (18) ou une zone de post-lavage (20) de la machine.

5. Machine de la revendication 4, dans laquelle :

le dispositif de commande (100) est configuré pour effectuer une ou plusieurs des opérations suivantes en fonction de la sortie de l'agencement de capteur : (i) dilution du liquide de prélavage, (ii) dilution du liquide de lavage principal, (iii) dilution du liquide de post-lavage, (iv) vitesse de transport, (v) vidange partielle ou totale du réservoir, (vi) débit de rinçage final, (vii) débit de lavage, (viii) dosage d'adjuvant de rinçage, et/ou (ix) dosage de détergent.

6. Machine d'une des revendications précédentes, dans laquelle :

le dispositif de commande (100 ; 180) évalue un ou plusieurs des paramètres suivants : (1) niveau de sortie discret du récepteur de lumière (116) à un ou plusieurs points temporels, (2) vitesse de changement du niveau de sortie du récepteur de lumière par rapport au temps, et/ou (3) variance du niveau de sortie du récepteur de lumière à l'intérieur d'un laps de temps établi.

7. Machine d'une des revendications précédentes, dans laquelle :

l'agencement de capteur (108) comporte des paires émetteur de lumière-récepteur de lumière espacées verticalement à différentes hauteurs dans une zone d'échantillonnage.

8. Machine d'une des revendications précédentes, dans laquelle :

l'agencement de capteur est constitué d'une structure de tube transparent (110) avec un module de détection (112) monté sur celle-ci, la structure de tube transparent formant une partie du chemin.

9. Machine de la revendication 8, dans laquelle :

l'émetteur de lumière (114) est positionné sur un côté de la structure de tube transparent (110) et le récepteur de lumière (116) est positionné sur un côté opposé de la structure de tube transparent.

10. Machine d'une des revendications précédentes, dans laquelle :

le dispositif de commande est configuré pour exciter l'émetteur de lumière de manière à produire une sortie d'intensité lumineuse variable depuis l'émetteur de lumière.

11. Machine de la revendication 10, dans laquelle :

le dispositif de commande (100 ; 180) est configuré pour exciter l'émetteur de lumière de manière à produire (i) une pluralité d'intensités lumineuses échelonnées ou (ii) une intensité lumineuse graduée.

12. Procédé de détection de la souillure d'un liquide dans un réservoir d'une machine à laver la vaisselle, la machine à laver la vaisselle comprenant un tel réservoir (26 ; 34 ; 42 ; 148) pour contenir un liquide à pulvériser sur des articles dans une chambre de pulvérisation, une conduite de recirculation (30 ; 38 ; 46 ; 152) destinée à distribuer le liquide du réservoir à des buses (32 ; 40 ; 48 ; 154) pour pulvérisation, un agencement de capteur (108) positionné à l'extérieur dudit réservoir pour surveiller l'état du liquide du réservoir, l'agencement de capteur comportant un émetteur de lumière (114) et un récepteur de lumière (116), un dispositif de commande (100 ; 180) destiné à surveiller la sortie du récepteur de lumière (116) au moyen dudit agencement de capteur, le procédé comprenant les étapes consistant à :

positionner l'agencement de capteur (108) le long d'un chemin qui est une conduite de vidange (104) du réservoir, la conduite de vidange (104) étant raccordée à une sortir (106) du réservoir et conduisant à un écoulement de l'installation, ou une conduite (122) raccordée parallèlement à la conduite de vidange (104) ;

caractérisé en ce que le procédé comprend en outre :

la réalisation d'une opération de surveillance du liquide à l'aide de l'agencement de capteur (108) après que le déplacement du liquide le long du chemin s'est arrêté et qu'une période de sédimentation s'est écoulée, la période de sédimentation étant appliquée avant de déclencher l'agencement de capteur (108) pour surveillance.

13. Procédé de la revendication 12 dans lequel, pendant l'opération de surveillance du liquide, le dispositif de commande évalue un ou plusieurs des paramètres suivants : (1) niveau de sortie discret du récepteur de lumière à un ou plusieurs points temporels, (2)

vitesse de changement du niveau de sortie du récepteur de lumière par rapport au temps, et/ou (3) variance du niveau de sortie du récepteur de lumière à l'intérieur d'un laps de temps établi.

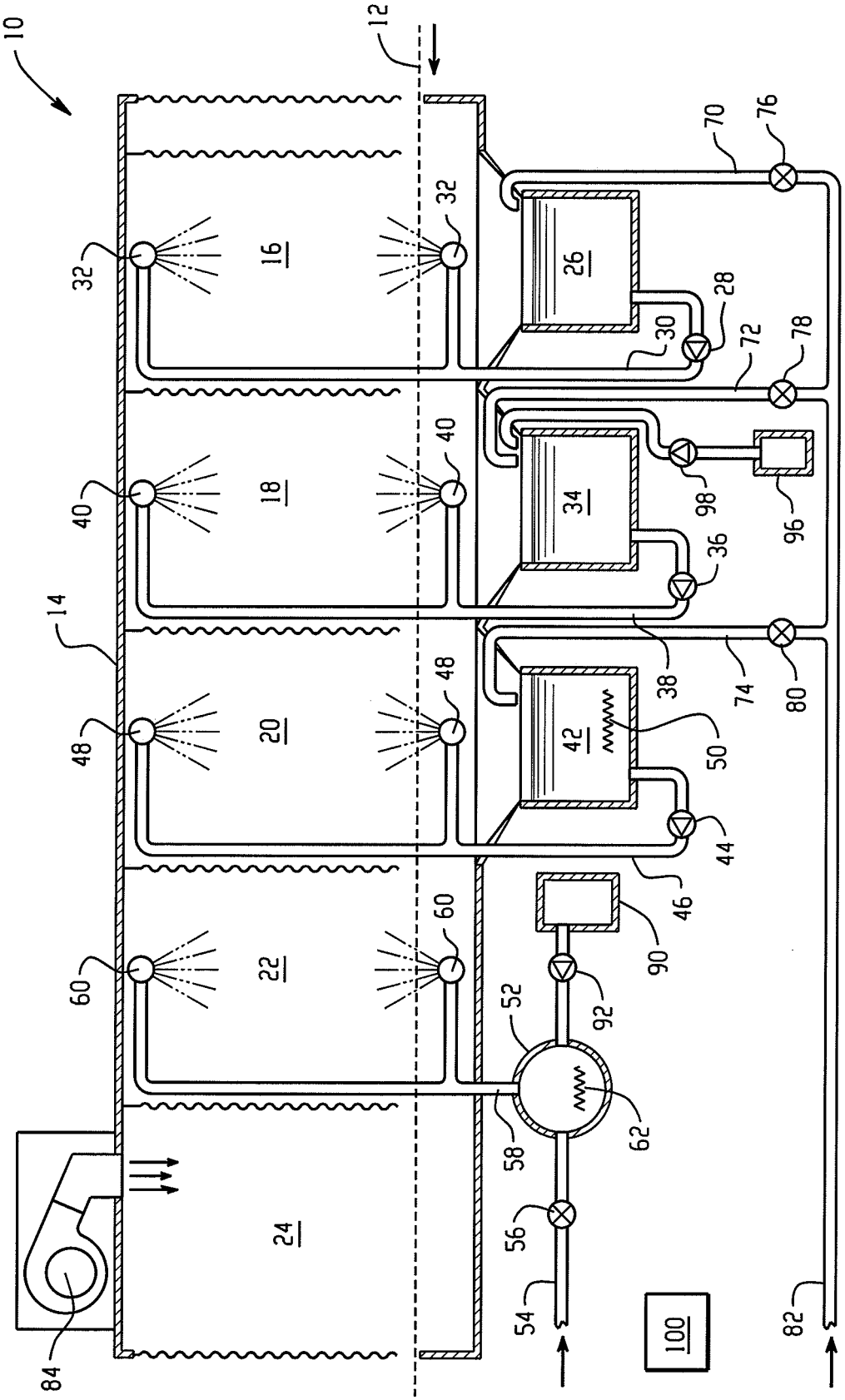

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Fig. 1

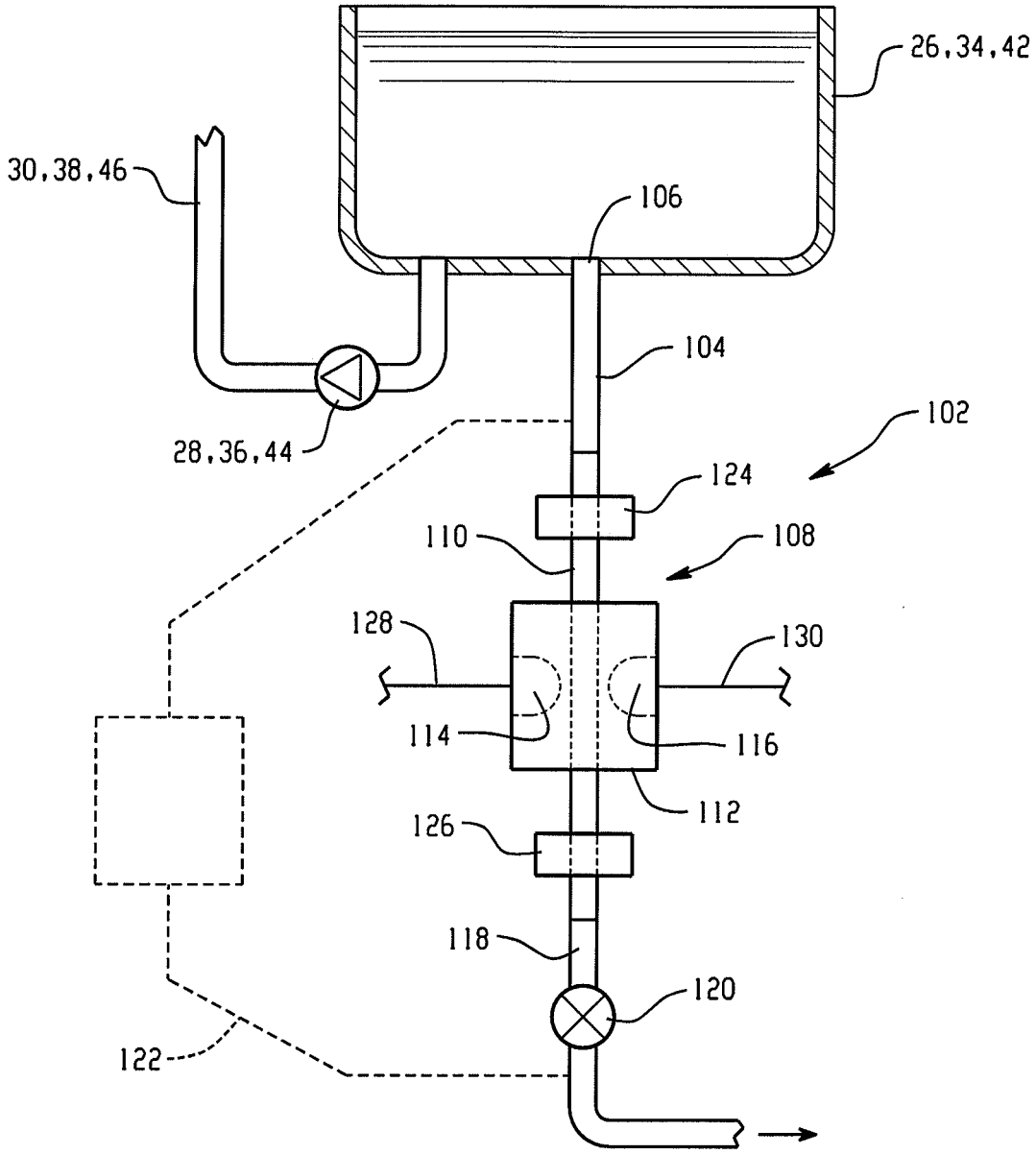

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Fig. 2

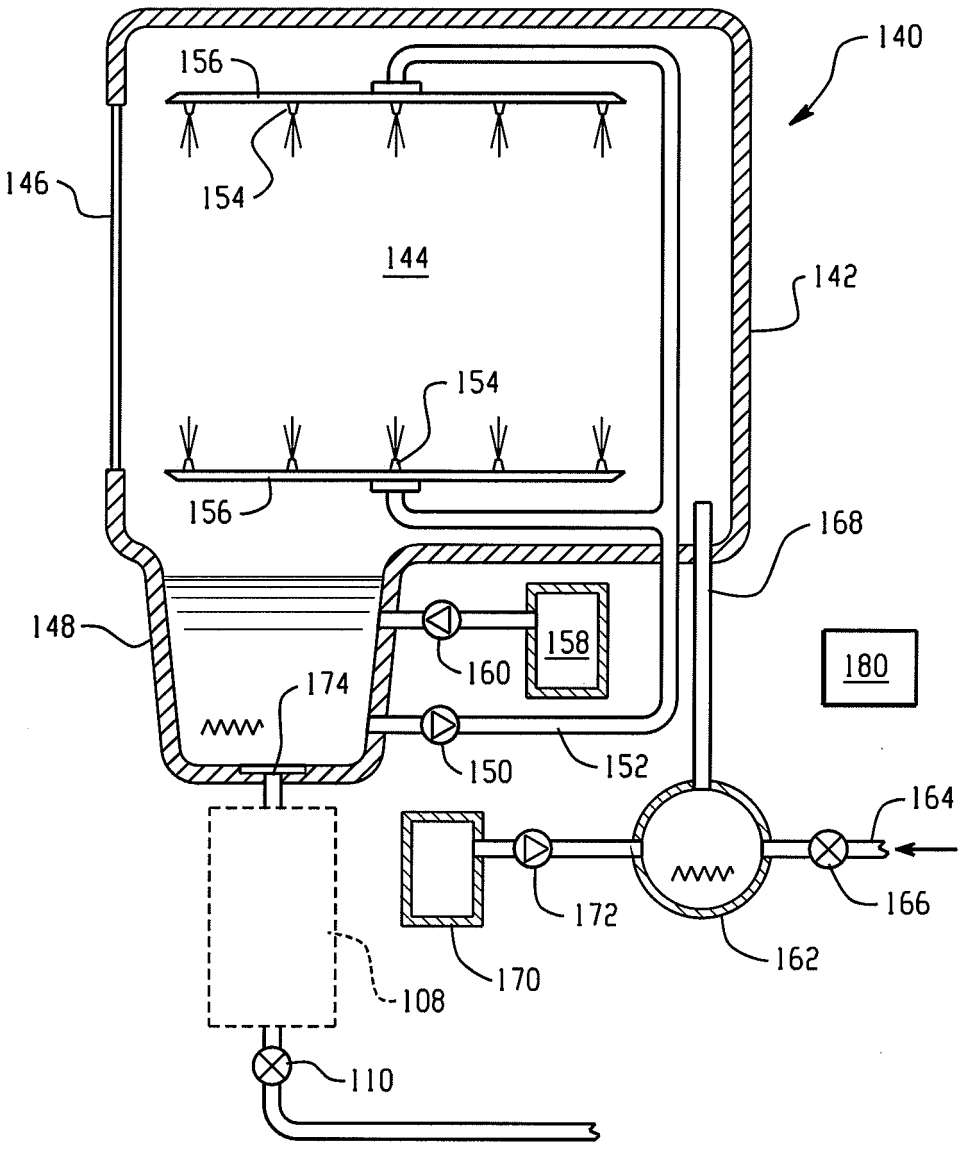

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Fig. 3

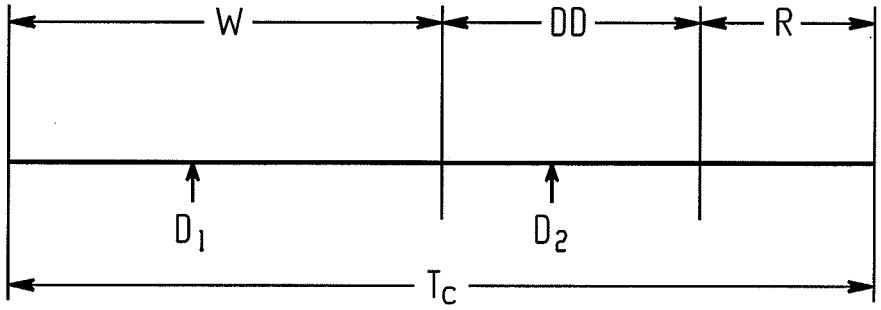

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Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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