April 30, 1963 H. W. GESCHKA 3,087,504

DISHWASHER

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FIG. 1

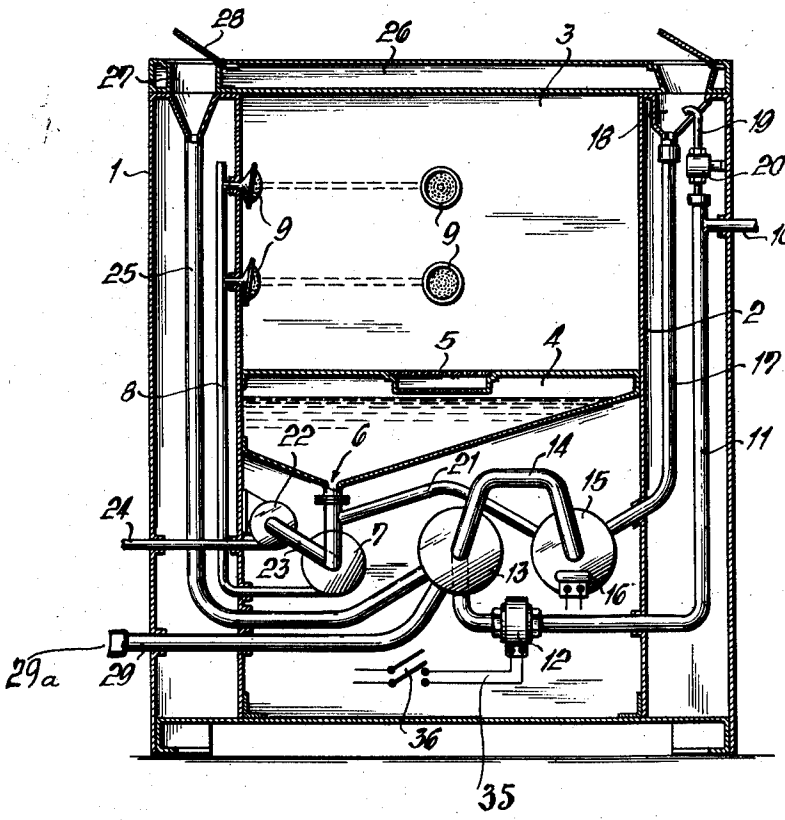

FIG. 2

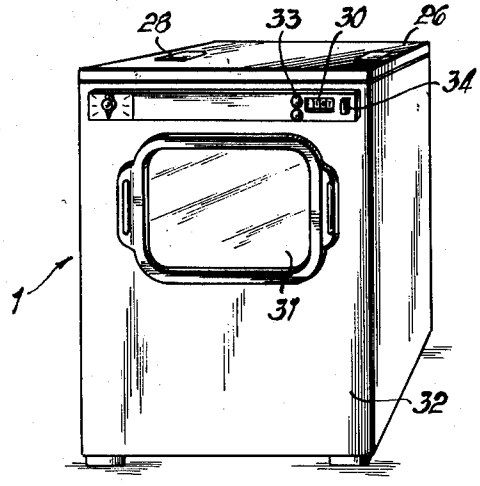

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FIG. 3

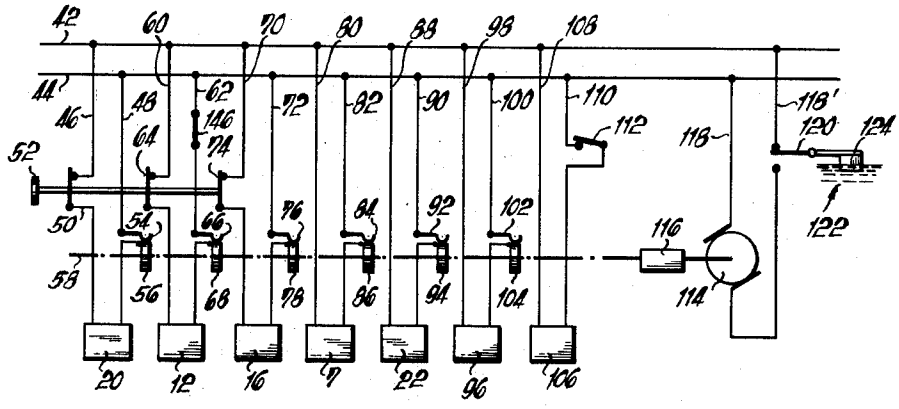
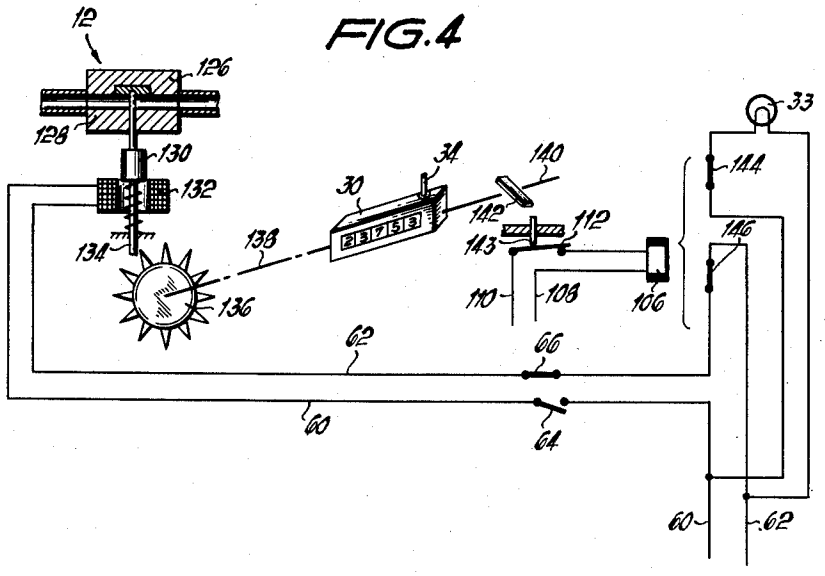


FIG. 4



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DISHWASHER

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11 Claims. (Cl. 134—57)

The present invention relates to automatic or semi-automatic dishwashers.

In conventional dishwashers, the dishes are placed on a grid or in a basket in a washing space. Usually, a sump is provided below the washing space to receive fresh wash water and a chemical cleansing medium to prepare the water for the washing cycle. If the water is to be heated, means may also be provided to heat the sump. A whirlpool wheel may be provided at the bottom of the washing space to throw the prepared wash water continuously against the dishes during the washing cycle whereby dirt is removed from their surfaces. The dirty water runs off the dishes back into a bottom chamber of the washing space and if this chamber is separated from the space by a sieve retaining the dirt particles and if the water is then returned from this chamber to the washing space by a pump, the dishes will constantly be washed with clean water rather than having the dirty water be thrown against the dishes over and over again. If desired, the pump delivers the clean water from the bottom chamber to shower heads so as to spray the water into the washing space.

It is also known to mount a special sump in the bottom chamber for preparing the wash water chemically and/or thermally before it is pumped into the washing space and to recirculate the prepared water from the washing space into the bottom chamber and back into the washing space. Finally, the spent wash water is removed and the washing cycle may be followed by a rinsing cycle with fresh water. The complete dish washing cycle usually includes a pre-washing cycle, a main washing cycle, a rinsing cycle and a drying cycle, all of which may be controlled by an automatic programming means or by hand.

While conventional dishwashers of the above type are generally satisfactory, the washed dishes are often found to be coated with a grayish, hard calcareous layer. This coating is due to the calcium content in hard water used for washing the dishes.

It is the primary object of the present invention to prevent calcareous deposits on dishes washed in dishwashers.

This object is accomplished by mounting a water softening ion exchanger in the water inlet conduit means leading to the washing space of the dishwasher. Known water softening cation exchangers bind the calcium in hard water and release sodium chloride in solution in the water.

In accordance with a preferred embodiment of this invention, the ion exchanger is mounted within the casing of the dishwasher.

According to another preferred embodiment, means is provided for indicating the exhaustion of the ion exchange capacity of the ion exchanger and the indicating means operates a programming means designed to cut off further water supply to the dishwasher and thus to stop its operation upon exhaustion of the ion exchange capacity of the ion exchanger. The indicating means may include a counter indicating the number of washing cycles or a means analysing the chemical composition of the ion exchanger, and the programming means may include a switch responsive to the indicating means and operating a solenoid valve in the water inlet conduit means to shut off water supply upon exhaustion of the ion exchanger.

The above and other objects, advantages and features of the present invention will become more apparent in the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawings wherein

FIG. 1 is a sectional side view of the dishwasher according to this invention;

FIG. 2 is a perspective view thereof;

FIG. 3 is a circuit diagram of an electrical control system of the dishwasher according to this invention; and

FIG. 4 is a control unit for controlling the ion exchange capacity of the water softener.

Referring now to the drawings, there is shown an automatic dishwasher with a casing **1** holding the dish container **2**. The container **2** defines the dish washing space **3** and the wash water chamber **4**. Space **3** and chamber **4** are separated by sieve **5** which retains solid particles removed from the dishes by the wash water. A drain outlet pipe **6** is mounted on the bottom of the wash water chamber and communicates with the input of wash water circulation pump **7** the output of which is connected to conduit **8**. The conduit or pipe **8** carries one or several shower heads **9** through which the wash water from chamber **4** is forcefully pressed into the washing space **3** during the washing and rinsing cycles.

The machine is supplied with water from a water supply source (not shown) through inlet pipe **10** leading to the water inlet conduit **11** which may be opened and closed by solenoid valve **12** in any suitably programmed manner. The inlet conduit leads from the valve **12** to a container **13** holding a water softening ion exchange material. The ion exchange material may be any of the well known cation exchange materials used in water-softening processes. Such materials include, by way of example, ion exchange resins with active sulfonic groups which may be converted to the sodium form and will then exchange its sodium ions with the calcium ions present in hard water. Polystyrene type resins sold by Rohm and Haas Co. under the trademark "Amberlite IR–120" are useful for this purpose. Other useful cation exchangers include the zeolites which are a class of hydrated silicates of aluminum and sodium compounds of the type

$$Na_2O \cdot Al_2O_3 \cdot nSiO_2 \cdot xH_2O$$

Natural zeolites include analcite, chabazite, heulandite, natrolite, stilbite and thompsonite. Artificial zeolites are made in a variety of forms ranging from gelatinous to porous and sandlike. The mineral glauconite has also been found suitable for water softening. Generally speaking, any of the known water softening ion exchangers may be used, including natural and synthetic cation exchange minerals as well as organic cation exchangers, such as sulfonated phenol-formaldehyde resins and carboxylic acid resins. All of these water softeners being well known, the present invention is not concerned with any such specific material but with its use in a dishwasher, as herein described.

The ion exchange water softener placed in container **13** should have an activity sufficient to soften about 8 to 10 liters of water per minute.

A conduit **14** connects the container **13** with sump **15** which receives the softened water from container **13**. A feed pipe **17** leads from funnel **18** to the sump whereby a liquid or solid cleansing medium, such as a detergent or the like, may be fed to the softened water in sump **15**. If cold water is supplied to the machine through inlet pipe **10**, the sump may also serve for heating the wash water, for which purpose the sump is shown provided with an electric heating element **16**. This, of course, may be eliminated if hot water is supplied to the machine.

At the beginning of the washing cycle, the cleansing

medium is fed through funnel 18 into pipe 17 which received a stream of water from inlet pipe 10 through the branch pipe 19 which may be opened or closed by valve 20. The sump 15 is connected with the input of circulating pump 7 by conduit 21. At the beginning of the washing cycle, fresh wash water is circulated from sump 15 into conduit 8 and through shower heads 9 into the washing space 3 where the wash water is impinged upon the dishes in space 3 and runs off through sieve 5 into the wash water chamber 4. The drain outlet pipe 6 in the chamber 4 returns the wash water to the circulating pump which operates continuously during the main washing cycle to recirculate the water constantly through the washing space 3.

After the completion of the washing cycle, pump 22, which is connected with drain outlet pipe 6 by conduit 23, is actuated to remove the dirty wash water through outlet pipe 24 from the wash water chamber 4. The circulating pump 7 remains inoperative, of course, while pump 22 operates.

The container 13, which holds the water softening ion exchanger, is connected with funnel 27 by conduit 25, a pivotal lid 28 being mounted in the cover plate 26 of the casing 1 to open and close access to funnel 27. After a certain number of washing cycles, the ion exchanger requires regeneration and, for this purpose, a sodium chloride solution is fed through funnel 27 and flushed under pressure into container 13 whence calcium-rich water is removed through outlet pipe 29 leading from container 13 and being closable by a valve 29*a*.

The operation of the dishwasher may be programmed in any conventional manner. As shown in FIG. 2, the programming means may include a counter 30 indicating the number of times wash water has been recirculated through space 3. A suitable signaling means, giving a visfble or audible signal to indicate that the ion exchange capacity of the water softener has been exhausted, is provided, as indicated by signal lamp 33. This signal means is operated by counter 30 after a set number of washing cycles predetermined on the basis of the known capacity of the particular ion exchanger used and when it gives a signal, the ion exchanger is regenerated by flushing a common salt solution through pipe 25 and container 13, the outlet pipe 29 being opened at the outlet valve 29*a* to remove the resultant calcium-rich water. After regeneration, the counter is returned to its zero setting, for instance manually, by setting element 34.

As shown, the exhaustion of the ion exchanger also automatically closes off any further water supply to the machine from inlet pipe 10. For this purpose, the signal means 33 is connected with a relay operating switch 36 which actuates via lines 35 the solenoid valve 12 in inlet pipe 11 so that the valve is closed upon actuation of signal lamp 33, i.e. when the ion exchange capacity of the water softener in container 13 is exhausted.

As shown in FIG. 2, the dishwasher casing 1 has a front wall 32 with a door 31 through which the dishes are placed in washing space 3 of the machine.

FIG. 3 shows the circuit diagram of an electrical control system for an automatic dishwasher according to the invention.

Electric power is fed to the dishwasher by power supply lines 42, 44. Valve 20 is connected to power supply lines 42, 44 by lines 46, 48 resp. Line 46 comprises contact 50 of a start button 52. Line 48 comprises a contact 54 actuated by a cam 56 on a shaft 58.

The solenoid valve 12 is also connected to power supply lines 42, 44 by connectors 60, 62. Connector 60 comprises a contact 64 of the starting button 52, connector 62 a contact 66 actuated by a cam 68 on the shaft 58.

Further connected to the power supply lines 42, 44 is the electrical heating element 16 by connectors 70, 72. Connector 70 comprises a contact 74 of the starting button 52, connector 72 comprises a contact 76 actuated by a cam 78 on the shaft 58.

Further connected to power supply lines 42, 44 is the circulating pump 7 by connectors 80, 82. Connector 82 comprises a contact 84 actuated by a cam 86 on the shaft 58.

Further connected to power supply lines 42 in the pump 22 by connectors 88, 90. Connector 90 comprises a contact 92 actuated by a cam 94 on the shaft 58.

Further connected to power supply lines 42, 44 is a combined air heater and compressor unit 96 by connectors 98, 100. Connector 100 comprises a contact 102 actuated by a cam 104 on the shaft 58.

Finally a relay 106 is connected to the power supply lines 42, 44 by connectors 108, 110. Connector 110 comprises a contact 112, actuated by a control unit further to be described. The shaft with the cams 56, 68, 78, 86, 94, 104 is connected to a reduction gear 116 driven by an electric motor 114. The electric motor 114 is connected by connectors 118', 118 to power supply lines 42, 44. Connector 118' comprises a contact 120. This contact 120 is actuated by a level control unit 122. The level control unit 122 comprises a floating body 124 mounted in the wash water chamber 4 (FIG. 1).

When the operation of the dishwasher is to be started, the starting button 52 is moved to the right in the illustration of FIG. 3. By moving the starting button 52 to the right, contacts 50, 64, 74 are closed. Closing of contact 50 causes opening of the valve 20 as contact 54 is closed. Closing of contact 64 causes energization of solenoid valve 12 as contact 66 is also closed. When the solenoid valve 12 is energized fresh water is admitted to the dishwasher. Closing of the contact 74 causes power supply to the heating element 16 as contact 76 is also closed. Under these conditions fresh water is admitted into the dishwasher in the way described above. The heating element 16 supplied with electric power heats the water entering into the dishwasher. As soon as a predetermined level in the water chamber 4 is obtained, floating body 124 is raised so as to close contact 120. When contact 120 is closed, the motor 114 starts and drives the cam shaft 58 via the reduction gear box 116.

When cam shaft 58 begins to turn, cam 56 opens contact 54, so that no further water flow takes place through valve 20 and pipe 17. Simultaneously, contact 66 is opened by cam 68, so as to deenergize solenoid valve 12 and to stop water flow through this valve. Cam 86 is so adjusted as to close contact 84 before simultaneously with or after opening of contact 66. When contact 84 is closed, the circulating pump begins to circulate washing water in the dish washer continuously, as already described. During the circulation by the circulating pump 7, cam 78 may continue to keep contact 76 closed, so as to further heat the circulated water by the heating element 16.

As cam shaft 58 is continuously driven by motor 114 and reduction gear box 116, contacts 84 and 76 are opened again by the cams 86 and 78 resp. so as to stop operation of the heating element 16 and circulating pump 7. Contact 92 is now closed by cam 94 so as to start pump 22 for conveying the dirty wash water through outlet pipe 24, as already described.

When the dirty wash water has been removed from the dishwasher, contact 92 is opened again, so that pump 22 stops. At the same time contact 102 is closed by cam 104, so as to supply power to a motor and a heating element (not shown) of the air heating and compressor unit 96. After some time when the clean dishes have been dried by the air stream coming from the air heating and compressor unit 96, contact 102 is opened again so as to interrupt power supply to the air heating and compressor unit. In order to keep closed contact 120 when floating body 124 has once been raised by the wash water, there may be a relay, which keeps contact 120 closed, when it has once been closed by floating body 124 and which opens contact 120 again, when the drying action is finished, so as to stop the motor 114.

In FIG. 4 a control unit for controlling the exhaustion of the water softener is illustrated.

Solenoid valve **12** comprises a valve housing **126** and a valve piston **128**. The valve piston **128** is supported by a magnetic core **130** movable within a magnetic coil **132**. The magnetic core **130** comprises an extension **134**, which co-operates with a sprocket **136** on an input shaft **138** of the counter **30**. An output shaft **140** of the counter **30** bears a lever **142** cooperating with a push rod **143**. The push rod **143** acts on a contact **112** of the connector **110** (FIG. 4). The relay **106** (FIGS. 3 and 4) comprises two contacts **144**, **146**. Contact **144** is normally open and contact **146** is normally closed, when the relay **106** is energized by the normally closed contact **112**. When the normally closed contact **112** is opened by the lever **142** and the push rod **143** the relay **106** is deenergized, so that contact **144** is closed and contact **146** is opened. Closing of contact **144** causes illumination of a signal lamp **33**. Opening of contact **146** prevents further energization of solenoid valve **12**.

While a specific embodiment of an automatic dishwasher constructed in accordance with this invention has been described, it will be clearly understood that many modifications and variations may occur to the skilled in the art, particularly after benefiting from the present teaching, without departing from the spirit and scope of the invention as defined in the appended claims.

The output shaft **140** of the counter **30** actuates contact **112** after a predetermined number of counting steps transmitted by input shaft **138**. Said predetermined number can be varied by adjusting counter **30**. After actuation of contact **112**, counter **30** can be reset by reset switch **34**.

I claim:

1. A dishwasher comprising
(*a*) a casing; and mounted within said casing:
(*b*) a dish container defining a dish washing space and a wash water chamber below said space;
(*c*) a wash water drain outlet means in said wash water chamber;
(*d*) a wash water distributing means mounted in said dish washing space;
(*e*) a conduit means connecting the water drain outlet means with the water distributing means;
(*f*) a water circulation pump in said conduit means for supplying water from the wash water chamber to the dish washing space, the pump having an input connected to the drain outlet means and an output connected to the distributing means; and
(*g*) a fresh water supply and conduit system connected to the input of the water circulation pump, said system including
(*h*) a first branch,
(*i*) a second branch,
(*j*) a water sump selectively receiving fresh water from either of said branches,
(*k*) a water softening ion exchanger in one of said branches,
(*l*) a counter indicating the number of washing cycles of the dishwasher, and
(*m*) a signaling means responsive to a number of washing cycles set in accordance with the predetermined activity of the water softening ion exchanger.

2. The dishwasher of claim 1, wherein the first and second branches of the fresh water supply and conduit system lead to said water sump.

3. The dishwasher of claim 1, further comprising
(*o*) a valve in each of said branches for selectively opening and closing said branches.

4. The dishwasher of claim 3, further comprising
(*p*) electromagnetic means for opening and closing said valves.

5. The dishwasher of claim 3, further comprising
(*r*) programming means for opening and closing the valves.

6. The dishwasher of claim 1, further comprising
(*s*) an inlet means connected to the other one of said branches for introducing a cleansing medium into the fresh water in said other branch.

7. The dishwasher of claim 6, wherein said inlet means is a funnel.

8. The dishwasher of claim 1, further comprising
(*t*) an ion exchange medium inlet means and
(*u*) a conduit connecting the ion exchange medium inlet means with the ion exchanger.

9. A dishwasher comprising
(*a*) a casing; and mounted within said casing;
(*b*) a dish container defining a dish washing space and a wash water chamber below said space;
(*c*) a wash water drain outlet means in said wash water chamber;
(*d*) a wash water distributing means mounted in said dish washing space;
(*e*) a conduit means connecting the water drain outlet means with the water distributing means;
(*f*) a water circulation pump in said conduit means for supplying water from the wash water chamber to the dish washing space, the pump having an input connected to the drain outlet means and an output connected to the distributing means;
(*g*) a fresh water supply and conduit system connected to the input of the water circulation pump, said system including
(*h*) a first branch,
(*i*) a second branch,
(*j*) a water sump selectively receiving fresh water from either of said branches,
(*k*) a water softening ion exchanger in one of said branches,
(*l*) a counter indicating the number of washing cycles of the dishwasher, and
(*n*) a means for stopping the water supply to the dishwasher in response to a number of washing cycles set on the counter in accordance with the predetermined activity of the water softening ion exchanger.

10. A dishwasher comprising
(*a*) a casing; and mounted within said casing:
(*b*) a dish container defining a dish washing space and a wash water chamber below said space;
(*c*) a wash water drain outlet means in said wash water chamber;
(*d*) a wash water distributing means mounted in said dish washing space;
(*e*) a conduit means connecting the water drain outlet means with the water distributing means;
(*f*) a water circulation pump in said conduit means for supplying water from the wash water chamber to the dish washing space, the pump having an input connected to the drain outlet means and an output connected to the distributing means;
(*g*) a fresh water supply and conduit system connected to the input of the water circulation pump, said system including
(*h*) a first branch,
(*i*) a second branch,
(*j*) a water sump selectively receiving fresh water from either of said branches,
(*k*) a water softening ion exchanger in one of said branches,
(*o*) a valve in each of said branches for selectively opening and closing said branches;
(*p*) electromagnetic means for opening and closing the valves;
(*l*) a counter indicating the number of washing cycles of the dish washer; and
(*q*) actuating means for said counter, said actuating means being operated by the valve in said one branch.

11. An automatic dishwasher comprising
(*a*) a casing; and mounted within said casing:

(*b*) a dish container defining a dish washing space and a wash water chamber below said space;
(*c*) a wash water drain outlet means in said wash water chamber;
(*d*) a wash water distributing means mounted in said dish washing space;
(*e*) a conduit means connecting the water drain outlet means with the water distributing means;
(*f*) a water circulation pump in said conduit means for supplying water from the wash water chamber to the dish washing space, the pump having an input connected to the drain outlet means and an output connected to the distributing means;
(*g*) a fresh water supply and conduit system connected to the input of the water circulation pump, said system including
(*v*) a water supply conduit,
(*h*) a first branch conduit,
(*i*) a second branch conduit,
(*o*) valve means between said water supply conduit and said first and second branch conduits,
(*j*) a water sump selectively receiving fresh water from either of said branch conduits,
(*u*) an input conduit connecting the sump to the input of the water circulation pump, and
(*k*) a water softening ion exchanger in the second branch conduit;

(*r*) a programming means sequentially opening said valve means to connect the water supply conduit to the first branch conduit, closing said valve means in response to the water level in said wash water chamber, operating said water circulation pump, and finally opening said valve means to connect the water supply conduit to the second branch conduit;
(*l*) a counter indicating the number of washing cycles of the dishwasher, and
(*m*) a signaling means responsive to a number of washing cycles set in accordance with the predetermined activity of the water softening ion exchanger.

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